Chapter 4: Treatment Assessment – Existing Condition

The performance of the treatment system under existing conditions is documented and summarized in this chapter. Existing conditions are defined under Section 4.1. Items documented in this chapter related to the treatment system under existing conditions include influent flows and wasteloads, treatment processes, operations, policies and programs, and performance review

4.1 Introduction - Flows and Wasteload Development

A treatment plant must have the capacity to handle hydraulic impacts of influent flows while also treating the expected wasteloads in the sanitary flow to meet permitted effluent water quality standards. Jones Island Wastewater Treatment Plant (JIWWTP) and South Shore Wastewater Treatment Plant (SSWWTP) design flows and wasteloads must be compared to the existing influent conditions to determine if the current needs of the Milwaukee Metropolitan Sewerage District (MMSD) system are being met.

Design flows and wasteloads are used to size a wastewater treatment plant and set optimal operating parameters. The main parameters for design flows are average daily, maximum daily, and peak hourly flow. The main parameters for design wasteloads are average daily, maximum daily, and maximum weekly wasteload. The design peak hourly flows are used to determine the hydraulic capacity of the treatment plant and to size non-biological processes such as clarifiers, pipes, valves, and pumps, among other items. The maximum daily flow and wasteloads are used to size biological processes.

The existing condition for this report is defined as 1997 through June 30, 2004. The existing condition average daily flows and wasteloads, as well as peak flows and wasteloads, were developed using historical data from the MMSD Accounting Department records and the daily treatment plant flows and wasteloads reported in the monthly Discharge Monitoring Reports (DMRs) and yearly United Water Services (UWS) Daily/ Weekly Operating Reports (DWORs).(1,2,3) December 31, 2003 was originally set as the end date for the existing condition analysis to meet the *2020 Facilities Plan* (2020 FP) schedule. After the large storm events in May 2004, the time period was extended to June 2004 for peak flow analysis. Average daily and yearly analyses still end December 31, 2003.

The assessment of the MMSD treatment system during existing conditions is complicated by the fact that MMSD is continually undertaking projects to maintain and update the treatment system. In addition, MMSD is currently completing a $900 million capital improvement project program mandated by the terms of the Wisconsin Department of Natural Resources (WDNR) 2002 Stipulation between MMSD and the state of Wisconsin.(4) Where appropriate in this chapter, completed, committed and recommended MMSD treatment projects are noted. Committed projects discussed in this report are defined as projects that are required by the WDNR 2002 Stipulation and additional projects with construction contracts or identified as committed by MMSD as December 31, 2006.(5,6,7) Recommended MMSD treatment projects are projects that are included in the MMSD 2007 Annual Budget, but the MMSD has not yet committed to. The recommended MMSD treatment projects will be recommended by the 2020 FP as part of the common package of projects that are needed in the future. The committed and recommended MMSD treatment projects are not intended to increase the design capacity of either JIWWTP or SSWWTP, although a number of projects will improve plant performance. More in-depth discussions of individual committed and recommended MMSD treatment projects are included in Chapter 5, *Treatment Assessment – Future Condition*. The full lists of committed and recommend MMSD treatment projects are included in Chapter 8, *Common Treatment Facilities, Programs, Operational Improvements and Policies for the Recommended Plan*.

4.1.1 Design Capacity

Design Flows

The design flows listed in Table 4-1 include the total treatment plant average daily, maximum daily, and peak hourly flows along with the allowable in-plant diversion at JIWWTP.(8,9) All of these design flows were established in the *1980 MMSD Wastewater System Plan* based on the expected 2005 system flows, except for the allowable blending.(10) The allowable blending flow for JIWWTP in Table 4-1 is set by the 2003 Wisconsin Pollution Discharge Elimination System (WPDES) permit included in Appendix 6A, *MMSD WPDES Permit*. Blending is the process of diverting primary treatment effluent flow through an in-plant diversion around secondary treatment to avoid washing out the biological system during large wet weather events. The diverted flow is blended with biologically treated flow before disinfection and discharge. Two types of diversion are allowed at JIWWTP as wet weather strategies: primary effluent (PE) diversion to disinfection and diversion of flow from the Inline Storage System (ISS) pump out to disinfection. These two types of diversions are referred to as Blending. Blending, as well as other in-plant diversions, is discussed in more detail in Section 4.3.3, *In-Plant Diversion Structure Operation*.

TABLE 4-1
DESIGN FLOW CAPACITY

Design Flow	Average Day (MGD)	Maximum Day (MGD)	Peak Hour (MGD)	Allowable Blending (MGD)
JIWWTP	123	300	330	60
SSWWTP	113	250	300	0
TOTAL	**236**	**550**	**630**	**60**

Source: Jones Island O&M Manual, Section 400 and South Shore O&M Manual, Section 400

Design Wasteloads

The parameters typically used to size biological systems at a wastewater treatment plant are biochemical oxygen demand (BOD) and total suspended solids (TSS) loadings. Table 4-2 lists the BOD and TSS wasteloads used to design JIWWTP and SSWWTP.(11,12) These design wasteloads were established in the *1980 MMSD Wastewater System Plan* based on the expected 2005 system wasteloads.(13) The design wasteloads are based on pounds per day (lb/day) rather than concentration because concentrations can vary greatly with the influent flow.

TABLE 4-2
DESIGN WASTELOAD CAPACITY

Design Wasteloads	Average Day (lb/day)	Maximum Day (lb/day)	Maximum Week (lb/day)
BOD			
JIWWTP	299,000	687,000	478,000
SSWWTP	224,000	515,200	336,000
TOTAL	**523,000**	**1,202,200**	**814,000**
TSS			
JIWWTP	314,000	722,000	534,000
SSWWTP	266,000	611,800	452,200
TOTAL	**580,000**	**1,333,800**	**986,200**

BOD = Biochemical oxygen Demand
lb/day = Pounds per Day
TSS = Total Suspended Solids
JIWWTP = Jones Island Wastewater Treatment Plant
SSWWTP = South Shore Wastewater Treatment Plant

Source: Jones Island O&M Manual-Section 400 and South Shore O&M Manual-Section 400

4.1.2 Existing System Flows

Existing Condition Average Daily Flows

The wastewater flows processed at each treatment plant are generated by the MMSD customer municipalities. The wastewater comes from two sources – base sanitary flow and infiltration and inflow (I/I). Base sanitary flow is generated from residential, commercial, and industrial users. These flows, which are used to determine MMSD's municipal wholesale billing, are referred to as "billable" wastewater flows in this report. Billable flows are calculated by applying typical wastewater discharges, based on averaged winter water consumption, to the user information received from MMSD's municipal customers.(14) Infiltration and inflow comes from groundwater and stormwater entering the MMSD system through the separate and combined sewer systems. Infiltration and inflow is not part of the billable flow.(15) Infiltration and inflow is discussed in greater detail in Chapter 4 of the *Conveyance Facilities Plan*.

Table 4-3 shows the breakdown of billable flow for 2003, the last full year of the existing condition analysis, and Figure 4-1 shows the general trend in billable flow from 1997-2003.(16) Table 4-4 illustrates the breakdown of the total flow between the two treatment plants for 2003 and compares the 2003 flows to the design flows shown in Table 4-1.(17) The data are provided in more detail in Appendix 4A, *MMSD Annual Average Flow and Wasteload Review.*

System Flow	Year 2003 Average Daily Flow (MGD)	Percent of Total Flow (%)	Change in Flow Since 1997 (%)
Billable Flow			
Residential	58.9	52.1	(2.2)
Commercial	38.6	34.2	0.7
Industrial	15.6	13.8	(30.5)
Total	**113.0**	**100.0**	**(6.5)**

Source: 1997- 2003 MMSD Accounting Department Records

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TABLE 4-3

MMSD SYSTEM FLOW BREAKDOWN OF BILLABLE FLOW BY USER CATEGORY

2020 TREATMENT REPORT

6/11/07 TR_04.T003.07.06.11.cdr

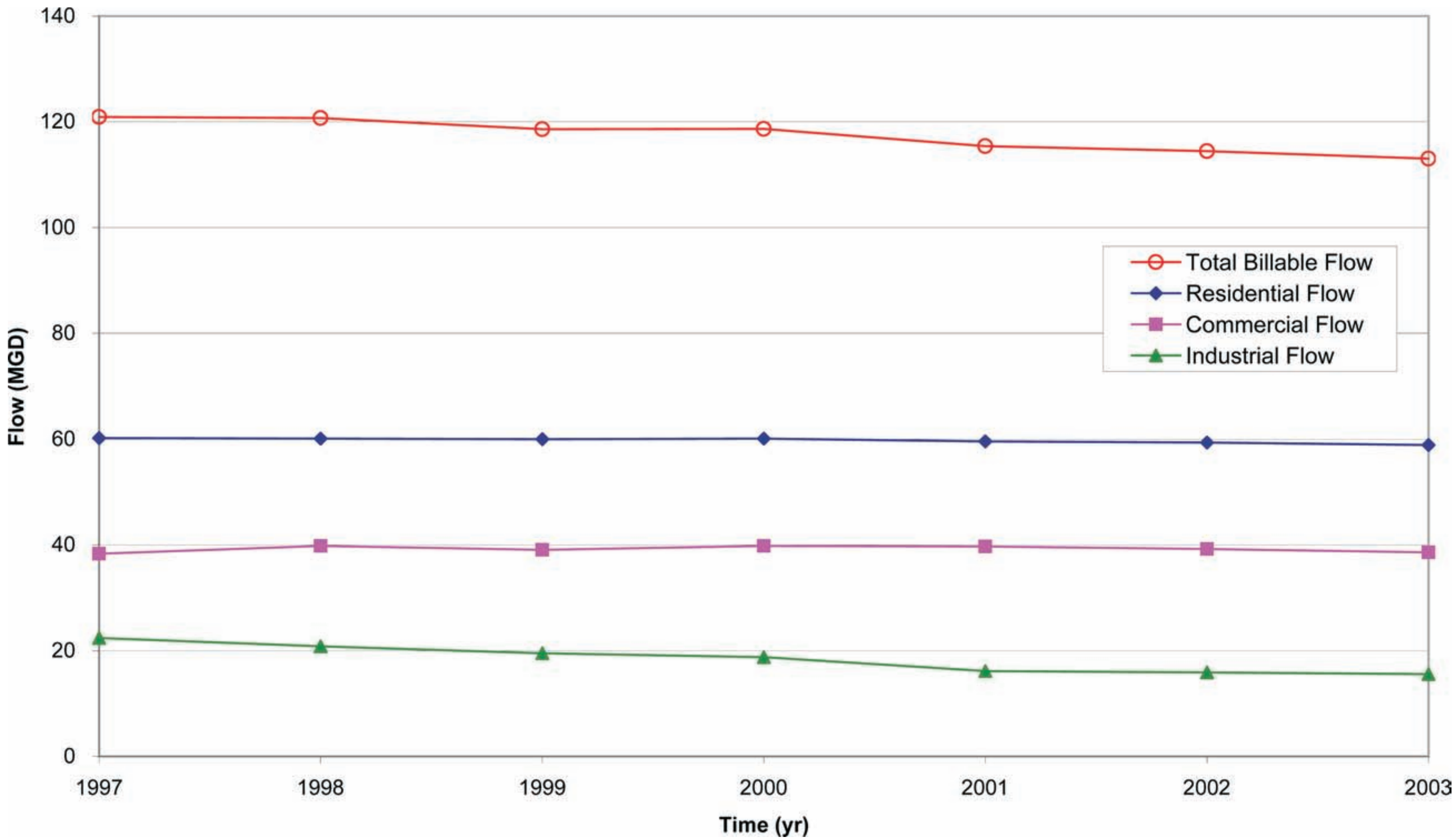

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FIGURE 4-1
FLOW TRENDS
2020 TREATMENT REPORT
5/17/07 TR_04.0001.07.05.17.cdr

TABLE 4-4
WASTEWATER TREATMENT PLANT EXISTING FLOWS COMPARISON: DESIGN AVERAGE DAILY FLOW TO ACTUAL AVERAGE DAILY FLOW

System Flow	Design Average Daily Flow (MGD)	Year 2003 Average Daily Flow (MGD)	Percent of Total Flow (%)	Change in Flow Since 1997 (%)
JIWWTP	123	82.9	48.7	(26.8)
SSWWTP	113	87.3	51.3	(12.3)
Total	**236**	**170.1**	**100**	**(20.0)**

MGD = Million Gallons per Day
JIWWTP = Jones Island Wastewater Treatment Plant
SSWWTP = South Shore Wastewater Treatment Plant

Source: 1997-2003 Discharge Monitoring Reports (DMRs)

The billable flows listed in Table 4-3 do not equal the total flow listed in Table 4-4 for two reasons:

1) The billable flows are yearly flows from which average daily flows have been calculated, while the treatment plant flows are actual daily flows.
2) The actual daily flows in Table 4-4 include I/I, whereas the billable flows listed in Table 4–3 do not.

As can be seen in Table 4-3 and Figure 4-1, the residential and industrial components of the total billable flow have declined while the commercial component has remained the same. The industrial flow component has declined the most noticeably. In addition, the actual average daily flows are significantly less than the design capacities. Overall, flow has decreased (especially to JIWWTP) over the last few years.

An additional review of 1997-2003 plant daily flows indicates that the average percent of the total MMSD system flow to JIWWTP is 50.2% and to SSWWTP is 49.8%. This review is also included in Appendix 4A, *MMSD Annual Average Flow and Wasteload Review*. These data indicate that the MMSD system flow has been almost evenly split between the treatment plants over this seven-year period.

Existing Condition Peak Flows

Peak Deliverable Conveyance System Flow

Table 4-5 lists the potential peak influent flows that the collection system could deliver to the treatment plants. The flows listed are not the actual peak flows recorded at the treatment plants. Notes below Table 4-5 detail under what conditions each of the peak conveyance system flows could be achieved.

Treatment Plant	Flow (MGD)
JIWWTP	
Low Level Siphon[1, 2]	100
High Level Siphon[1, 2]	160
Inline Pump Station[3]	120
Total Potential Influent Flow	380
SSWWTP	
Total Potential Influent Flow[4]	450-500

MGD = Million Gallons per Day
JIWWTP = Jones Island Wastewater Treatment Plant
SSWWTP = South Shore Wastewater Treatment Plant

1) Potential flows from the low and high level siphons were established by the hydraulic analysis discussed in the *Harbor Siphons and Downstream MIS Preliminary Engineering Report*, part of the committed Central Metropolitan Interceptor Sewer (CMIS) Harbor Siphons Project.(18) Note that the analysis found that these peak flows are achieved only when the ISS is filled and off-line; otherwise influent flows are less than listed. The ISS is considered off-line when all influent gates to the ISS are shut. When this occurs, flow is either forced through the siphons to JIWWTP or overflows out of the system. These influent flows are confirmed in the analysis of the system discussed in the *Conveyance Facilities Plan.* Potential peak influent flow to JIWWTP will increase significantly upon completion of the committed CMIS Harbor Siphons Project. This increase is discussed in Chapter 5, *Treatment Assessment - Future Condition*.

2) The influent pumping to JIWWTP has more capacity than the existing hydraulic conditions allow through the low and high level siphons. The firm capacity (capacity with the largest unit out of service) of the low level pumps is 140 MGD and the firm capacity of the high level pumps is 330 MGD (low level flow plus high level flow).(19) Influent pumping is discussed in more detail in Section 4.2.3, *Treatment Plant Unit Process Evaluation*, under the subsection, *JIWWTP Unit Process Evaluation*.

3) ISS Pump Station Peak Flow:

- The historic peak ISS Pump Station flow is assigned in Table 4-5 only to JIWWTP for simplicity because the ISS Pump Station can be – and has been – operated with all three pumps directed to JIWWTP as flow in addition to the flow from the Harbor Siphons.(20) This is a change from the original operational design. The design maximum pumping capacity is 150 MGD with two 50 MGD pumps to JIWWTP and one 50 MGD pump to SSWWTP.(21) However, the flow that is pumped to SSWWTP is actually directed to a point within the conveyance system. Due to conveyance system limitations, ISS pumpout to SSWWTP cannot always occur during peak flow conditions in the system – when this occurs and after the peak flows to JIWWTP recede, all three pumps are directed to JIWWTP.(22)
- The ISS Pump Station flow listed was established based on an analysis of the maximum pumpout during MMSD wet weather events from available storm event records for the 7-year period of review. The available storm event records are included in Appendix 4B, *Storm Event Summary Data*. The *Maximum ISS Pumpout* analysis is included in Appendix 4C, *ISS Pumpout Analysis*. The ISS Pump Station capacity can vary due to a number of factors, such as the storage level in the ISS, the debris accumulation on the stationary bar screen and the availability to pump to JIWWTP and SSWWTP.(23,24) Therefore, since the *Maximum ISS Pumpout* analysis indicates that the actual pumping capacity has been declining from the design capacity of 150 MGD, a capacity of 120 MGD will be used as a reasonable maximum pumping capacity for this planning report.
- The Inline Pump Station process is discussed in more detail in Section 4.2.3, *Treatment Plant Unit Process Evaluation*, under the subsection, *JIWWTP Unit Process Evaluation*.

4) The SSWWTP potential influent flow was determined through analysis discussed in the *State of the Art Report, Appendix 3A, Point Source Technologies*. According to the analysis, the flow listed is the maximum possible range of flows that could hydraulically reach SSWWTP. According to the model analysis performed as part of *Appendix 3A, Point Source Technologies*, the potential peak flows achieved are based on specific wet weather events; therefore a range has been given due to the variability of actual wet weather events. Currently the gates in the Metropolitan Intercepting Sewer (MIS) Flow Control Structure limit the influent flow into the plant to flows close to the SSWWTP peak hourly design flow of 300 MGD to protect the plant from flooding and damage to unit processes.(25) The MIS Control Structure is discussed in more detail in Section 4.2.3, *Treatment Plant Unit Process Evaluation*, under the subsection, *SSWWTP Unit Process Evaluation*.

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TABLE 4-5
POTENTIAL PEAK DELIVERABLE COLLECTION SYSTEM FLOWS TO TREATMENT PLANTS

Comparison between Peak Deliverable Collection System Flows and Treatment Plant Peak Design Capacity

Table 4-6 compares the potential conveyance system peak flows to the peak design capacities of the plants.

TABLE 4-6
COMPARISON OF POTENTIAL CONVEYANCE SYSTEM DELIVERABLE FLOW TO TREATMENT PLANT DESIGN CAPACITY

Treatment Plant	Potential Conveyance System Peak Deliverable Flow to Treatment Plant (MGD)	Treatment Plant Design Peak Hourly Flow w/o Diversion (MGD)	Difference (MGD)
JIWWTP	380	330	50
SSWWTP	450-500	300	150-200

JIWWTP = Jones Island Wastewater Treatment Plant
MGD = Million Gallons per Day
SSWWTP = South Shore Wastewater Treatment Plant

Source: Jones Island O&M Manual, South Shore O&M Manual, other references as noted in Footnotes to Table 4-5

In comparing the potential conveyance system peak deliverable flows to JIWWTP and SSWWTP to the design peak hourly flows listed in Table 4-1, it appears that the ability of the collection system to deliver flow is greater than the peak hourly design capacity of the treatment plants. Note that the difference at JIWWTP will increase after the completion of the Harbor Siphon Project, as discussed in Chapter 5, *Treatment Assessment – Future Condition*. The differences identified here and in Chapter 5 are reviewed in Chapter 9, *Alternatives Analysis* to determine if adding more treatment capacity to meet the differences would be a cost-effective method of achieving system overflow requirements during storm events.

The accuracy of the treatment plant peak hourly flow identified in Table 4-6 has been confirmed by review of existing data in Appendix 4B, *Storm Event Summary Data*, available in-plant diversion records, which have been compiled in Appendix 4D, *MMSD/UWS In-Plant Diversion Records*, and DMRs for the same period.(18) Section 4.3.3, *In-Plant Diversion Structure Operation* contains a discussion on in-plant diversions. Table 4-7 presents all of the JIWWTP peak hourly flows through secondary treatment that were greater than design peak hourly flow of 330 MGD for the 1997 – June 30, 2004 review period. The analysis indicates that the use of the peak hourly design flow in Table 4-6 is an accurate representation of the peak flow that JIWWTP can process since historical data show that JIWWTP rarely processes flows greater than a peak hourly flow of 330 MGD. Table 4-8 presents all SSWWTP actual peak daily flows that were greater than the design peak hourly flow of 300 MGD for the 1997 – June 30, 2004 review period. The peak hourly flows measured at SSWWTP were sustained over long enough periods of time to achieve **average daily** flows that were larger than the peak **hourly design** flow, even with the flow limitations placed on the influent flow by the metropolitan intercepting sewer (MIS) control structure. This analysis indicates that the both the maximum day and peak hourly flows that SSWWTP can actually treat and still meet effluent quality limits might be greater than current design flows. However, without a detailed study to re-evaluate the peak design capacity at SSWWTP, the current design peak hourly flow listed in Table 4-6 has been assumed. The full analysis of the available hourly peak flow data for both plants is included in Appendix 4E, *JIWWTP and SSWWTP Peak Hourly Flow Analysis*.

TABLE 4-7
JONES ISLAND WASTEWATER TREATMENT PLANT
RECORDED PEAK HOURLY FLOWS IN EXCESS OF DESIGN PEAK HOURLY FLOW

Date	Time	Secondary Treatment (MGD)
Design Peak Hour		**330**
5/18/00	13:00	340
5/18/00	14:00	331
5/18/00	18:00	341
5/18/00	19:00	334
5/18/00	20:00	331
2/9/01	10:00	365
2/9/01	11:00	376
2/9/01	12:00	365
2/9/01	13:00	341

MGD = Million Gallons per Day

Source: Storm Event Summary Data (Appendix 4B), MMSD/UWS In-plant Diversion Records (Appendix 4D)

TABLE 4-8
SOUTH SHORE WASTEWATER TREATMENT PLANT
PEAK DAILY FLOWS IN EXCESS OF DESIGN PEAK HOURLY FLOW

Date	Secondary Treatment (MGD)
DESIGN Peak Hour	**300**
2/12/98	302
4/23/99	307
6/2/00	301
7/2/00	304
5/22/04	301
5/23/04	307
5/24/04	301

MGD = Million Gallons per Day

Source: 1997-June 2004 Discharge Monitoring Reports (DMRs)

Treatment plant performance during wet weather events is discussed in more detail in Sections 4.5.1, *Review of Wet Weather Events* and 4.5.2, *Blending*.

4.1.3 Existing Wasteloads

The existing MMSD system wasteloads establish trends in average daily and maximum wasteload conditions. The following sections compare average daily and maximum wasteloads to design wasteloads to determine if the plants can handle all expected influent wasteloads.

Existing Condition Average Daily Wasteloads

Table 4-9 shows the breakdown of billable wasteloads along with the change in the wasteloads since 1997.(19) Figures 4-2 and 4-3 show the general trend in billable BOD and TSS from 1997 through 2003.(20) Table 4-10 shows the actual total average wasteloads between the two treatment plants from 2003 along with the change since 1999 (UWS DWORs only available since 1999).(21) Note that the wasteloads listed in Table 4-9 are daily averages calculated from yearly total wasteloads, and the treatment plant wasteloads indicated on Table 4-10 are actual daily wasteloads. Therefore, the total wasteloads from these tables should not be compared. The billable wasteloads are listed only to show general trends. The wasteload contributions associated with I/I, which are not included, make up only 10-15% of the total wasteloads. This review includes only BOD and TSS, as they are the only parameters that yielded consistent daily influent and effluent data during the review period. The data are provided in more detail in Appendix 4A, *MMSD Annual Average Flow and Wasteload Review*.

System Wasteloads	Year 2003 Average Day (lb/day)	Percent of Total (%)	Change Since 1997 (%)
BOD			
Residential	152,172	40.6	(2.2)
Commercial	97,030	25.9	0.7
Industrial	125,614	33.5	(23.6)
Total	**374,816**	**100.0**	**(10.0)**
TSS			
Residential	181,625	49.4	(2.2)
Commercial	115,478	31.4	0.9
Industrial	70,300	19.1	(33.1)
Total	**367,403**	**100.0**	**(9.4)**

BOD = biochemical oxygen demand
lb/day = pounds per day
TSS = total suspended solids

Source: 1997 – 2003 MMSD Accounting Records

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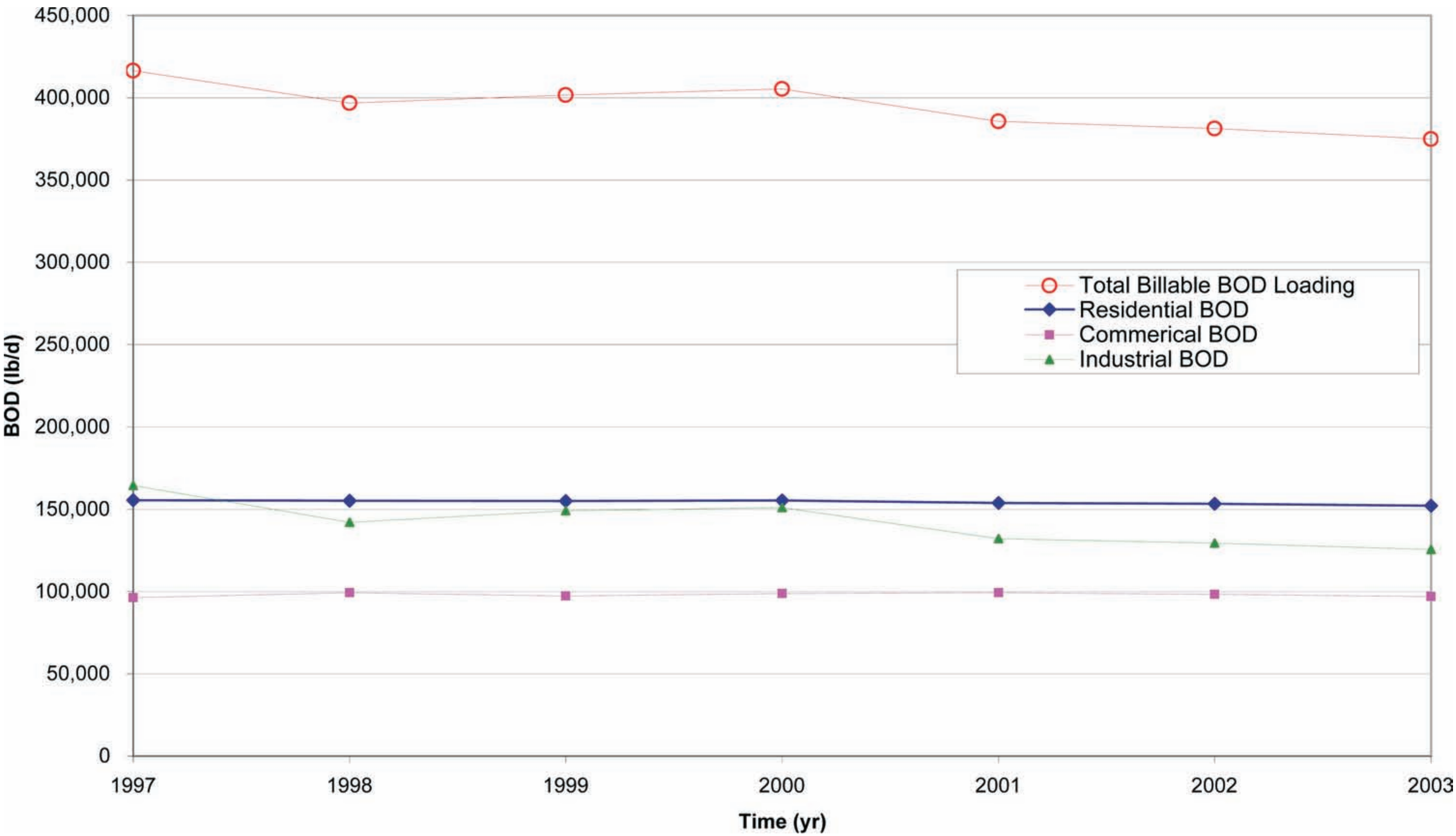
TABLE 4-9

MILWAUKEE METROPOLITAN SEWERAGE DISTRICT BREAKDOWN OF BILLABLE SYSTEM WASTELOAD BY USER CLASS



Source: MMSD Cost Recovery Procedural Manual

mmsd
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FIGURE 4-2
BOD TRENDS
2020 TREATMENT REPORT
5/18/07 TR_04.0002.07.05.18.cdr

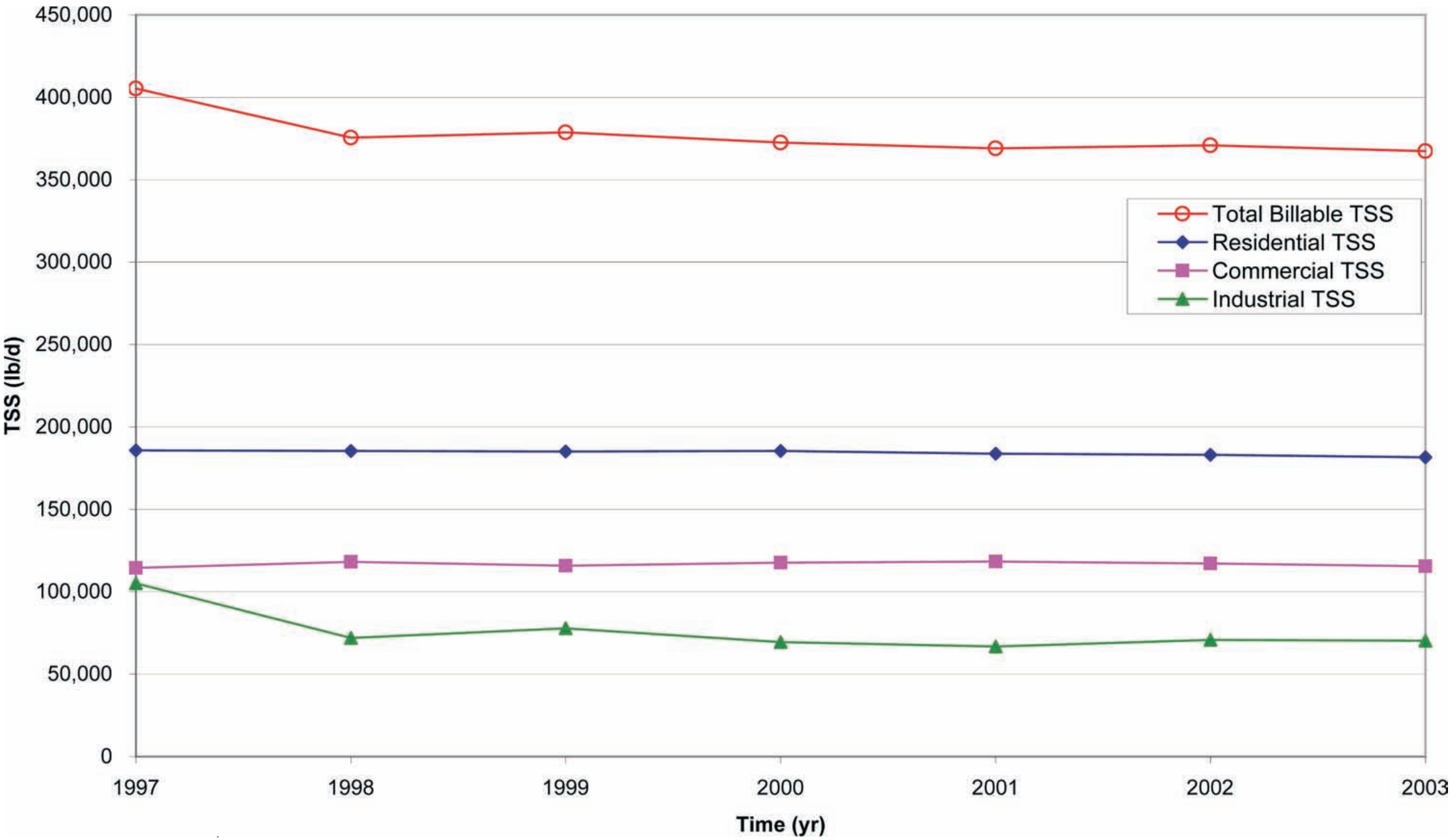

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FIGURE 4-3
TSS TRENDS
2020 TREATMENT REPORT
5/18/07 TR_04.0003.07.05.18.cdr

TABLE 4-10
WASTEWATER TREATMENT PLANT EXISTING WASTELOADS COMPARISON: DESIGN AVERAGE DAY WASTELOADS TO ACTUAL AVERAGE DAILY WASTELOADS

System Wasteload	Design, Average Day (lb/day)	Year 2003 Average Day (lb/day)	Percent of Total Wasteload (%)	Change Since 1999 (%)
BOD				
JIWWTP	299,000	246,000	59.7	(9.8)
SSWWTP	224,000	166,000	40.3	13.2
TOTAL	**523,000**	**412,000**	**100.0**	**(1.7)**
TSS				
JIWWTP	314,000	190,000	46.2	(26.8)
SSWWTP	266,000	221,000	53.8	19.1
TOTAL	**580,000**	**411,000**	**100.0**	**(7.7)**

BOD = Biochemical oxygen Demand
JIWWTP = Jones Island Wastewater Treatment Plant
lb/day = Pounds per Day
SSWWTP = South Shore Wastewater Treatment Plant
TSS = Total Suspended Solids

Source: 1999-2003 UWS Daily / Weekly Operating Reports (DWORs)

The data in Tables 4-9 and 4-10 and Figures 4-2 and 4-3 indicate that though overall wasteloads are declining, especially in the industrial sector, the wasteloads to SSWWTP have been increasing. The overall decline is due to the decline at JIWWTP, which has a larger industrial component. The trends also indicate that more BOD is treated at JIWWTP than SSWWTP and more TSS is treated at SSWWTP than JIWWTP.

When the 2003 influent wasteloads are compared to design wasteloads, actual wasteloads are less than design wasteloads.

Existing Condition Maximum Daily Wasteloads

The maximum daily and maximum rolling weekly wasteloads processed by the treatment plants were reviewed. The days that maximum wasteloads occurred were not necessarily the days that produced peak flows. Table 4-11 indicates the existing condition maximum wasteloads.(22) The data are provided in more detail in Appendix 4A, *MMSD Annual Average Flow and Wasteload Review*.

TABLE 4-11
WASTEWATER TREATMENT PLANT EXISTING CONDITION COMPARISON: DESIGN MAXIMUM WASTELOADS TO ACTUAL INFLUENT MAXIMUM WASTELOADS, 1999-2003

System Wasteload	Design Wasteload (lb/day)	Actual Wasteload, 1999-2003[1] (lb/day)
Maximum Daily Wasteload		
BOD		
JIWWTP	687,000	769,000
SSWWTP	515,200	470,000
TOTAL	**1,202,200**	**1,239,000**
TSS		
JIWWTP	722,000	1,448,000
SSWWTP	611,800	842,000
TOTAL	**1,333,800**	**2,290,000**
Maximum Weekly Wasteload		
BOD		
JIWWTP	478,000	417,000
SSWWTP	336,000	249,000
TOTAL	**814,000**	**666,000**
TSS		
JIWWTP	534,000	734,000
SSWWTP	452,200	505,000
TOTAL	**986,200**	**1,239,000**

BOD = Biochemical oxygen Demand
JIWWTP = Jones Island Wastewater Treatment Plant
lb/day = Pounds per Day
SSWWTP = South Shore Wastewater Treatment Plant
TSS = Total Suspended Solids

Note:
1) Influent maximum day and week TSS loadings may not be representative of actual maximum values.(23) However, because values were not excluded from monthly averages reported to WDNR, values are used in this report.

Source: 1999-2003 UWS Daily / Weekly Operating Reports (DWORs)

The actual maximum daily BOD and TSS wasteloads are greater than the design daily maximum wasteloads at both treatment plants – the maximum daily TSS at JIWWTP is two times greater than the design maximum daily value. However, MMSD has consistently achieved effluent limits at both treatment plants during the review period. Treatment plant effluent limits are discussed in more detail in Section 4.3.1, *Operator – UWS* and in Section 4.5.5, *UWS Review* under the subsection *Contract Effluent Discharge Limits*.

4.2 Treatment Process Evaluation

The JIWWTP and SSWWTP were evaluated in detail to identify all noteworthy items related to treatment plant capacity and operation. All noteworthy items are reviewed again in Chapter 5, *Treatment Assessment – Future Condition* and Chapter 8, *Common Treatment Facilities, Programs, Operational Improvements and Policies for the Recommended Plan* to determine if they should be included as issues to correct in the proposed recommendations common to all recommended alternatives . The review is divided into five parts:

1) A general overview of each plant identifying general issues
2) A review of the major processes such as the utility, electric and instrumentation and control (I&C) processes at each plant
3) The individual treatment unit processes at each plant
4) The biosolids processes at each plant
5) Air emissions

Note that the review period for the unit processes and the biosolids processes at the treatment plants is from 1999 through 2003. The review period is shorter for these analyses than for the full existing condition analysis because the most accessible process records available for review are kept by UWS, which took over mid-year 1998. In most cases, the data analyzed for the unit processes were from 2003, the last full year of the existing condition analysis. This data year was chosen because, due to the continued development of the data UWS collects in the DWORs, 2003 had the most complete set of data available.

Committed and recommended MMSD treatment projects, which were defined in Section 4.1, are briefly mentioned in this section where applicable. The complete lists of committed and recommended MMSD treatment projects can be found in Tables 8-1 and 8-2 of Chapter 8, *Common Treatment Facilities, Programs, Operational Improvements and Policies for the Recommended Plan*.

Evaluation Criteria

The treatment plants were evaluated based on a comparison between design criteria from Operation and Maintenance (O&M) Manuals and process data from MMSD and UWS, concerns identified in discussions with MMSD and UWS, WPDES permit requirements, current Wisconsin Administrative Code, Department of Natural Resources (NR) 110/204 regulations, and advisory 10-States Standards.(24,25,26,27,28,29,30)

4.2.1 Treatment Plants Overview

During the course of the evaluation, a number of existing issues at both plants were identified that did not fall under any specific treatment process. These issues include effluent metering, structural integrity, wastewater characterization, and operation and maintenance manuals:

Effluent Metering

The current WPDES permit requires that both influent and effluent flows be reported on monthly DMRs. Currently, both plants report effluent flow values on the basis of metered influent flow.

Jones Island Wastewater Treatment Plant

JIWWTP has two secondary treatment effluent meters, which are located downstream of the in-plant diversion channel and upstream of disinfection. Because flows recycled back to the plant (which are called W-3 and average around 10 MGD) are removed from the total flow after disinfection, these secondary treatment effluent meters overstate the actual flow discharged from the plant.(31) As a part of the committed JIWWTP I&C Upgrades - Final Project, the two secondary treatment effluent meters were upgraded with new electronics in 2005 and two new W-3 meters were installed in the spring of 2006. When these upgrades are fully operational, recycled effluent flow (W-3) will be metered and subtracted from the secondary effluent flow to yield a plant effluent flow value.

South Shore Wastewater Treatment Plant

At SSWWTP, two Parshall flumes are located upstream of the chlorination process. The existing metering equipment does not provide accurate data during submerged flow conditions.(32) Therefore, the equipment is scheduled for replacement in 2006 as a part of the committed SSWWTP I&C Upgrade – Final Project. The upgrades will better compensate for submerged flow conditions at the Parshall flumes when plant flows are high.

Structural Integrity

The condition of the structures and erosion/corrosion problems at both plants need to be considered. Some of the unit processes at JIWWTP are the original structures built in 1924.(33) The last major structural rehabilitation work was done at the plant between 1984 and 1995. The SSWWTP has unit processes that range in age from 1963 to 2003.(34) A detailed structural analysis of either of the treatment plants has not been done since 1982 when they were both reviewed as part of the MWPAP.

Since the 1982 structural analysis, ground settlement has been noted throughout JIWWTP, some of which has caused significant operational problems. Specifically, the regular plugging of some of the primary sludge drains, which required a project to replace the drains was attributed to ground settlement in the area. There is speculation that the other primary sludge drains that were not replaced and other non-pile supported pipelines may be at risk of failing due to ground settlement. This speculation is bolstered by the failure in 2001 of a compressed air line in the vicinity of the primary clarifiers serving the ISS Pump Station, which required an emergency repair.(35)

Wastewater Characterization

Though MMSD has done periodic treatment capacity evaluations, the most recent of which was the 2001 *Wet Weather Flow Optimization Study* issued as part of the Treatment Plant Wet Weather Project, the treatment plant models developed have never used project-specific, intensive wastewater sampling, as stated in the *Capacity Assurance, Management, Operation and Maintenance (CMOM) Program Strategic Plan* (discussed in more detail in Section 4.5.6, *Other MMSD Evaluations*).(36,37) The CMOM Program Strategic Plan states that the use of intensive wastewater sampling, rather than the available data from standard testing as is currently used, can provide more comprehensive wastewater characterization at critical process locations in the WWTP models.(38)

Operation and Maintenance Manuals

During the MWPAP, *O&M Manuals* were prepared for all capital projects. These manuals have been updated to reflect changes made during capital improvement projects since the MWPAP. The MMSD has established a program for ongoing updates of the *O&M Manuals* for the unit processes at the treatment plants. Depending on the extent of the changes to the *O&M Manual*, only the section that has changed may be rewritten. All updates are distributed to UWS, the Facilities Information section at MMSD, and MMSD's Record Center. It is each group's responsibility to update its copy of the *O&M Manual*.

Two long-term concerns regarding the current system are that there is more than one keeper of the *O&M Manuals* and most of the manuals are available only in hard-copy format.

4.2.2 Utility, Electric, and Instrumentation & Control Processes

Both JIWWTP and SSWWTP contain several utilities that service all unit processes: plant water systems (potable water, potable process water and plant service water), high-pressure air, and energy systems (electricity, digester gas and natural gas). A plant-wide process I&C system monitors all unit processes and utilities and allows operations personnel to make process control changes.

The information on existing buried utilities at the treatment plants is spread out between construction project record drawings and is not documented in one source for each of the plants. Therefore, a review of all historical record drawings is required each time a construction project is planned, which increases the chance that utilities may not be accurately located and could be struck during construction.

Plant Water Systems (W1, W2, and W3)

At both JIWWTP and SSWWTP, potable water is distributed through a looped piping system (at JIWWTP, the water is first pumped through centrifugal pumps to boost water pressure). The looped piping system has several isolation valves so that the entire plant is not impacted when a section of the loop or an entire building is disconnected.

Potable water (W1) is used in toilet facilities, locker rooms, kitchens, and in laboratories. When potable water is used for treatment processes (W2), the water passes through a pressure reducing backflow preventer to stop process water from inadvertently contaminating the potable water in accordance with the state and city plumbing codes.

Treatment plant effluent serves as the source for plant service water (W3). Service water pumps located at the plant's effluent facilities pump effluent into a looped header system that serves the entire plant. The looped piping system has several isolation valves that allow a section of the loop or a building to be isolated without impacting plant effluent water flow to the rest of the treatment plant. At each building, the service water is withdrawn from the looped header and used for chemical dilution, cooling, spray water, wash-down water, pump seal water, and for any other service that does not require clean water. The W3 system at SSWWTP has maintenance issues with the pumps, pump control values and the basket strainers at the lower pump station. In addition, the SSWWTP W3 system uses dechlorinated effluent water; the lack of chlorine residual leads to biological growth problems.(39) The recommended MMSD SSWWTP Valve Replacement & Utility Tunnel Improvement Project would fix these problems. This project will be recommended by the *2020 Facilities Plan* as part of the common package of future projects.

The plant water systems are adequately sized so that wastewater treatment processes can function as designed.

High Pressure Air

High-pressure air systems (AHP) generally exist on a building-by-building basis. The high-pressure air is generated on site and each system is sized to handle its process needs. In some cases, there is an interconnection between high-pressure air systems.

High-pressure air is used for equipment operation and for the instrumentation and control system. Sometimes, clean, dry air is required (instrument air or AI). In these cases, a portion of the high-pressure air passes through a moisture removal system and a set of filters.

The high-pressure air systems are adequately sized to allow the wastewater treatment processes to function as designed.

Energy Systems

Jones Island Wastewater Treatment Plant

Figure 4-4 shows a schematic of the energy systems at JIWWTP. Included on the schematic is a summary of the various energy demands for the year 2002.

JIWWTP receives energy to operate the wastewater treatment processes via a natural gas supply and two electrical power sources, the Dewey substation and the Harbor substation. Fuel oil, when priced appropriately, is occasionally used in lieu of natural gas. Propane is provided as an emergency back up for building heat should the natural gas be cut off from the plant.

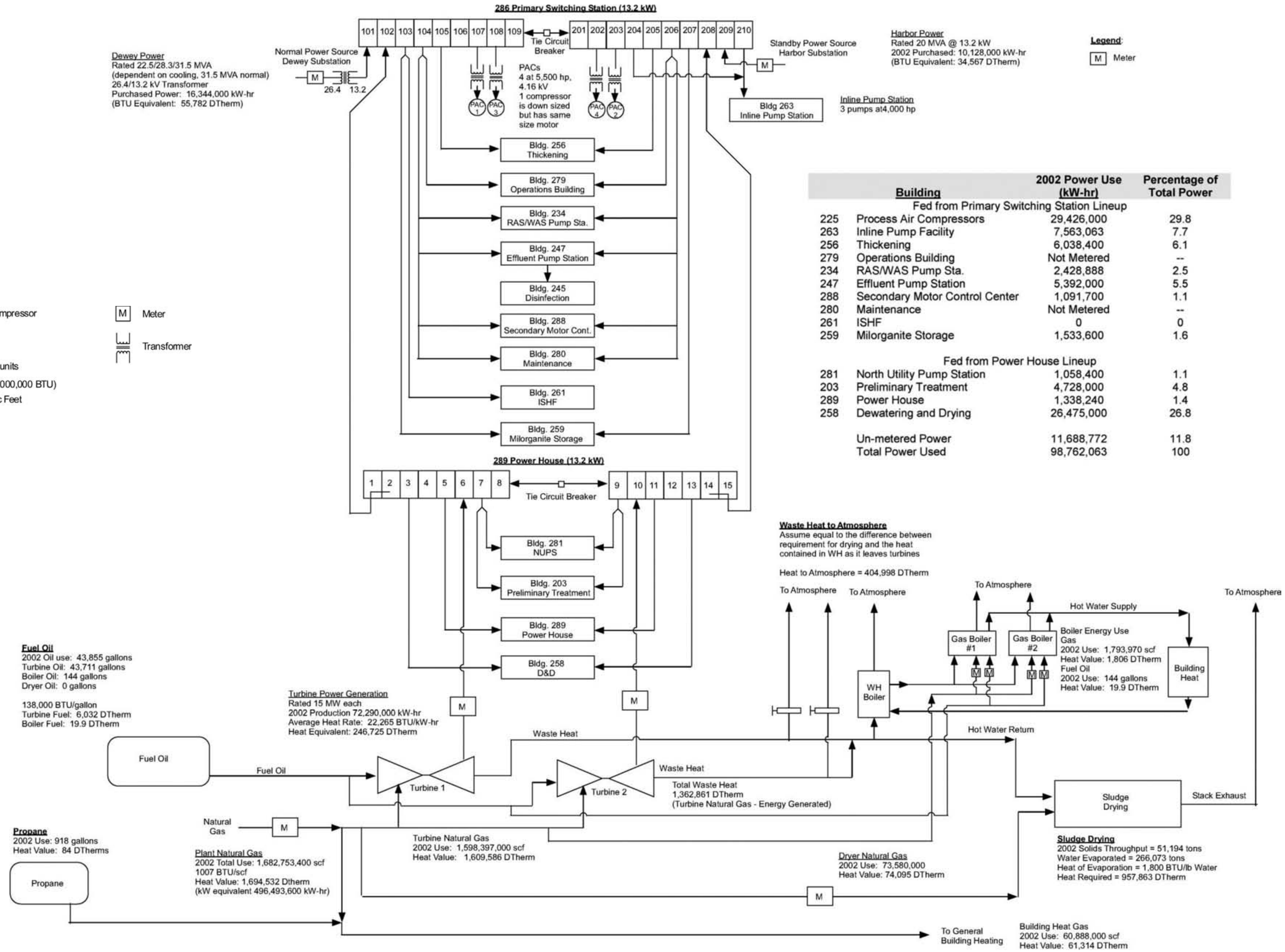
Natural gas is used primarily for the onsite generation of electrical power. Other uses for natural gas include building heating, hot water production, and, on occasion, sludge drying operations. The natural gas supply can be constrained by the marketer if other demands require the use of its supply of natural gas.(40,41)

<u>Turbine Electrical Power Generation</u>

Two GE Frame V turbines, using natural gas as the fuel source, generate electrical power on site. Each turbine has a nominal capacity to generate 15 megawatts (MW) of electrical power. Currently, the typical electrical demand on site varies between 10 and 13 MW. The exhaust gas from the turbines, referred to as waste heat, is used to dry the treatment plant sludge to produce Milorganite®, a process that typically does not use all waste heat. During those periods, excess heat is exhausted to the atmosphere, except for a small amount of waste heat that is used to generate hot water in the waste heat boiler during the heating season.

The turbines, which were installed in the mid-1970s and re-built in the mid-1990s, are reaching the end of their useful lives. The turbines are considered inefficient compared to modern technologies; however, the turbine inefficiency is at least partially offset by the use of the waste heat for sludge drying. At 15 MW total generating power, overall plant electrical power generation is sufficient but the use of waste heat (which is approximately 85% of the energy input) is dependent on sludge drying needs. The overall energy use is discussed further in Chapter 9.

PAC Process Air Compressor
kW Kilowatts
MW Megawatts
BTU British thermal units
DTherm DecaTherm (1,000,000 BTU)
scf Standard Cubic Feet
kW-hr Kilowatt Hours



	Building	2002 Power Use (kW-hr)	Percentage of Total Power
	Fed from Primary Switching Station Lineup		
225	Process Air Compressors	29,426,000	29.8
263	Inline Pump Facility	7,563,063	7.7
256	Thickening	6,038,400	6.1
279	Operations Building	Not Metered	--
234	RAS/WAS Pump Sta.	2,428,888	2.5
247	Effluent Pump Station	5,392,000	5.5
288	Secondary Motor Control Center	1,091,700	1.1
280	Maintenance	Not Metered	--
261	ISHF	0	0
259	Milorganite Storage	1,533,600	1.6
	Fed from Power House Lineup		
281	North Utility Pump Station	1,058,400	1.1
203	Preliminary Treatment	4,728,000	4.8
289	Power House	1,338,240	1.4
258	Dewatering and Drying	26,475,000	26.8
	Un-metered Power	11,688,772	11.8
	Total Power Used	98,762,063	100

Source: Turbine Power Generation O & M Manual, Jones Island O&M Manual, Correspondence with UWS Personnel

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FIGURE 4-4
JIWWTP ENERGY SCHEMATIC
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The turbines are operated to satisfy all electric power requirements during on-peak hours to avoid demand charges. During off-peak hours, the electric power generation is cut back so that only enough waste heat is generated to dry the dewatered sludge cake that is being processed into Milorganite® the rest of the power is provided through the Dewey substation.

Largest Electrical Power Demands

The inline pump station pumps and the process air compressors demand the most electrical power. While the turbine generators are adequately sized to operate these pieces of equipment, the power required to start the pumps and compressors (due to inrush of power) is more than either a single turbine generator or either of the power supplies can handle alone. As a result, when starting either an inline pump or a process air compressor (PAC), power must come from a turbine generator and either the Dewey or Harbor substation or two turbine generators. The power inrush problem with the PACs will be corrected in the recommended MMSD Upgrade of Electrical Switch Gear for PACs Project, listed in Chapter 8, *Common Treatment Facilities, Programs, Operational Improvements and Policies for the Recommended Plan.* This project will include modifications to the PACs so that the motors can start up slowly, also known as a soft start. The soft start will reduce the inrush of power that occurs when the current PAC motors start up to a level that can be handled by either a single turbine or the Dewey power supply alone.

Jones Island Wastewater Treatment Plant Energy Needs

The JIWWTP energy systems are adequately meeting current treatment plant needs. However, the turbines have exceeded their normal life expectancy of about 30 years. On peak demand, electrical demand charges can be significant if there is a turbine failure or if the inline pumps or process air compressors need to be started during on-peak periods. Future energy issues and requirements are discussed in the Appendix 9A, *Biosolids/Energy Analysis*.

South Shore Wastewater Treatment Plant

Figure 4-5 shows a schematic of the SSWWTP energy systems. Included on the schematic is a summary of the energy use for the year 2002.

The SSWWTP treatment plant receives energy from natural gas, one of two electrical power supplies, and from digester gas produced during the anaerobic sludge digestion process. The digester gas, which contains about 65% methane, is used to power the blower engines, which operate the blowers that provide the air to the secondary treatment process and the engine generator. Natural gas is used in small quantities to supplement digester gas. An onsite engine/generator uses digester gas and some natural gas to generate electrical power during on-peak periods and reduce electrical demand charges.

Emergency Power Supply

Electrical power comes from two independent power cables fed from two separate transformers in a common substation in the WE Energies distribution system, each of which is sized to carry the plant electrical load.(42) An automatic transfer switch monitors the normal power supply and automatically switches over to the other power supply if needed. NR 110.15 (2)(d) requires that a sewerage treatment plant's electrical system provide sufficient emergency power to maintain primary settling and disinfection under all design flow conditions.(43) Several alternative means of ensuring continued operation during emergencies are contemplated under the regulations, including the option that "the sewage treatment facility electrical system may be connected to two independent electrical transmission routes which receive power from the same electrical grid network which supplies power to the treatment facility service area…"(44) The current system meets the terms of this regulation.

In addition to the current power supply, MMSD has committed to the establishment of additional back up emergency power generation sufficient to power critical plant processes in the event of total loss of power supply to the plant. A plant project to upgrade the power house has been proposed under the recommended MMSD SSWWTP Blower Engine System Upgrade Project. Upon completion of this project, SSWWTP will have five generators capable of start up in the event that both the primary and secondary power supply cables are disabled. If necessary in a wet weather event where power supply is limited, the MIS flow control structure can be controlled via an emergency power generator to limit influent flow.(45)

UWS installed the existing engine generator in 2000. The generator can run on either digester gas or natural gas (but not both simultaneously) and is sized to produce a maximum of 1.5 MW. Normal plant load is slightly above 2 MW, so the current generator is not sized to carry the normal plant load. In the unlikely event that all power is lost, the generator will not have the energy to continue to spin against the higher plant load and will shut down on a "low frequency" alarm. The generator is currently not capable of starting without connection to the normal electrical power supply because the gas compressors and control systems require power to operate. Under the recommended MMSD SSWWTP Blower Engine System Upgrade Project, previously mentioned, all generators will have the capability of starting in the event of total power supply loss, thus enabling continued operation of critical processes.

Power Distribution

Power is distributed to the treatment plant through a series of four local control unit substations (LCUS). These substations step the power down from 4160 volts to 480 volts. LCUS 2 is severely corroded and in need of significant repairs. LCUS 2 serves the liquid treatment processes located at the base of the plant. These processes include preliminary treatment, primary clarification, aeration basins (except the blowers located at the top of the plant, which run on gas), and secondary clarifiers. The operation of the return activated sludge (RAS) pumps is the largest single load, and that load is not significant compared to other plant loads. Issues related to LCUS 2, as well as LCUS 1, 3, and 4, will be addressed in the MMSD recommended JIWWTP and SSWWTP Facilities Improvement Project.

The blower engines, installed in 1968, are at the end of their useful life. Parts have become difficult to find and the treatment plant frequently operates without a backup blower. The recommended MMSD Blower Engine System Upgrade Project mentioned above will also include the replacement of blower engines with electric motors, four new engine generators, and the upgrade of the main switchgear.

Waste Heat

Waste heat from the generator and the blower engines provides hot water for heating the anaerobic digesters and several buildings. During the summer months, the demand for hot water is relatively small and much of the waste heat is wasted to the aeration basins or is exhausted out the stack. This represents an untapped energy source. (The aeration basin flow is high enough that the additional heat does not raise the wastewater temperature by an appreciable amount.)

South Shore Wastewater Treatment Plant Energy Needs

Compared to JJWWTP, SSWWTP has a relatively low power demand because the blowers are engine driven and there are no high horsepower inline pumps. Centrifuges that thicken anaerobically digested sludge represent the biggest power use. The completed SSWWTP Gravity Belt Thickeners Project replaced one of the centrifuges with a gravity belt thickener in 2005. The installation of a second gravity belt thickener is under consideration; this will further reduce power demand at the plant.

Instrumentation and Control

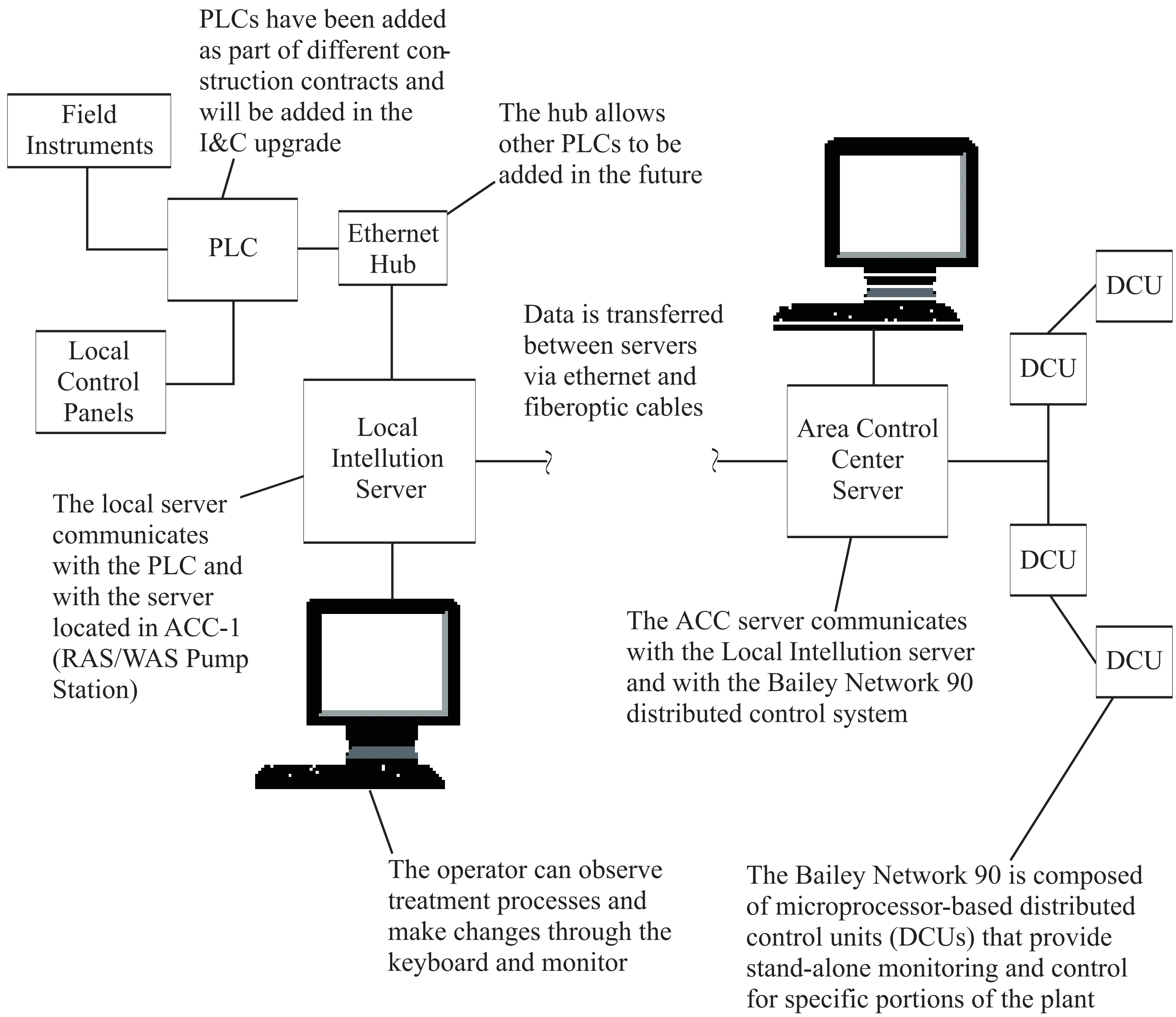
Both treatment plants use a distributed I&C system for the monitoring and control of treatment plant processes. Figure 4-6 shows a schematic of how the current I&C system functions.

The I&C system is currently undergoing an upgrade to replace the Bailey Network 90 equipment with Rockwell (Allen-Bradley) hardware and software as part of the committed JIWWTP and SSWWTP I&C Upgrade - Final Projects. The projects are not intended to modify the functionality of the system; rather, they are intended to replace outdated equipment with new equipment that is easier to maintain and modify.

4.2.3 Treatment Plant Unit Process Evaluation

The treatment unit processes at each of the plants were evaluated to determine their ability to meet current flows, loads, and design intent. The evaluations compared the total and firm capacities as well as specific design criteria (as listed in the *O&M Manuals*) to the actual performance based on UWS DWORs and DMRs, as applicable.(46,47,48,49) Total and firm capacities are defined as follows:

- **Total capacity** is defined as the capacity of the unit process with all units in service.
- **Firm capacity** is the capacity with the largest unit out of service.



ACC = Area Control Center
PLC = Programmable Logic Controller
DCN = Distributed Control Unit
RAS = Return Activated Sludge
WAS = Waste Activated Sludge

Source: Preliminary Treatment O&M Manual

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FIGURE 4-6
INSTRUMENTATION AND CONTROL SYSTEM SCHEMATIC
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The unit processes were also compared to the current NR 110 regulations that *new* treatment plants must meet (regulations have been changed since the treatment plants were originally built and expanded) and advisory 10-States Standards.(50,51,52) All items that do not match current design criteria or regulations/advisory standards are noted. These items are reviewed again in Chapter 5, *Treatment Assessment – Future Condition* assuming committed projects have been implemented. If these items continue to exist, they are reviewed in Chapter 8, *Common Treatment Facilities, Programs, Operational Improvements and Policies for the Recommended Plan* to determine if they are issues that should be included in proposed recommendations common to all recommended alternatives. Committed projects identified are taken from Table 8-1. Recommended MMSD treatment projects, which are listed in Table 8-2 in Chapter 8, *Common Treatment Facilities, Programs, Operational Improvements and Policies for the Recommended Plan*, are also noted where appropriate.

Jones Island Wastewater Treatment Plant Unit Process Evaluation

The wastewater treatment train at JIWWTP consists of nine major wastewater treatment unit processes. Table 4-12 compares the performance of these major unit processes to the design intent.(53,54) Also included in Table 4-12 are additional secondary wastewater treatment unit processes not discussed in the text. The regulations and standards evaluation compare the design of the unit processes at JIWWTP to the current NR 110 requirements and advisory 10-States Standards. The unit processes for which a gap may exist between current NR 110 design requirements or advisory 10-States Standards, or both, are shown in Table 4-13.(55,56) More detailed analyses of all of the unit processes at JIWWTP can be found in Appendix 4F, *MMSD Wastewater Treatment Plant Unit Process Analysis and Regulation Review*, including references for all specific information and calculations.

The following discussion highlights the equipment under the nine major unit processes as well as the major issues and committed and recommended MMSD projects.

Unit Process No. PS0801: ISS Pump Station

The ISS Pump Station, which has a design pumping capacity of 150 MGD, can pump wastewater to either JIWWTP or SSWWTP.(57) At the ISS Pump Station, the wastewater collected in the ISS passes through a stationary bar screen before being pumped by three 50 MGD pumps to two head tanks. One head tank distributes flow to JIWWTP; flow can be directed either to the influent screening process or through an in-plant diversion channel to disinfection. The other tank has three options for distributing flow: to the South Shore Force Main and on to an MIS that conveys wastewater to SSWWTP, to the JIWWTP head tank, or to the Inline Solids Handling Facility (ISHF). The original design designated one pump to the JIWWTP head tank, one pump to the SSWWTP head tank and one pump to either head tank.(58) Because the hydraulic capacity of the South Shore Force Main is 35 MGD, the SSWWTP head tank is designed to receive flow from only one pump at a time. The JIWWTP head tank can receive flow from two pumps at once. The original design criteria were two pumps at 100 MGD to JJWWTP and one pump at 50 MGD to SSWWTP simultaneously, with a total capacity of 150 MGD.(59) However, the ISS Pump Station design does allow for flow from the SSWWTP head tank to be directed to the JIWWTP head tank while the other two pumps are pumping directly into the JIWWTP head tank, with all flow going to JIWWTP.(60)

Unit Process No.[1]	Unit Process Title	Design Treatment Capacity Total	Design Treatment Capacity Firm	Specific Design Criteria	Actual Performance
PS0801[2]	ISS Pump Station	150 MGD	100 MGD	• 3 Pumps: 50 MGD at 380' TDH each • ISHF: – 5 MG solids storage – 2 Rotary Drum Screens, 1000 GPM each – 1 grit separator, 4 cy/hr – 1 transfer pump, 2000 GPM	Pump Options Utilized: – 1 pump to JIWWTP, 1 pump to SSWWTP – 2 pumps to JIWWTP, 1 pump to SSWWTP – 3 pumps to JIWWTP, by directing Pump #1 flow from South Shore Head Tank to Jones Island Head Tank <u>Maximum Pumpout, averaged from available Storm Event Data, 1998-2004</u>: P 1: 38.2 MGD, P 2: 47.5 MGD, P 3: 47.0 MGD ISHF has never been used except for testing
1	Influent Pumping	LL – 187 MGD HL – 413 MGD	LL – 140 MGD HL – 330 MGD	LL Pumps • 4 Screw Pumps: 46.7 MGD at 24' TDH each HL Pumps • 5 Screw Pumps: 82.6 MGD at 13.1' TDH each	1998-2003 Ave Peak Hr Pumped: • LL – 97 MGD • HL – 256 MGD
2	Influent Screening	412.5 MGD	330 MGD	• 5 Mechanically Cleaned Bar Screens at 82.5 MGD each • ¾" Clear Opening	330 MGD (No specific performance data available – assumed unit process could meet design capacity, even with issues discussed in text)
3	Grit Removal	330 MGD	275 MGD	• 6 Pista Grit Vortex Concentrators • 55 MGD treatment capacity, 70 MGD hydraulic capacity each • 95 percent removal of particles 70 mesh (0.20 mm) and larger with a specific gravity of 2.65 (silica sand)	330 MGD (No specific performance data available – assumed unit process could meet design capacity, even with issues discussed in text)
4	Primary Clarification	330 MGD	289 MGD	• 8 Primary Clarifiers • SOR: average day – 760 gpd/sf, estimated peak hour – 2050 gpd/sf • WLR: average day – 30,600 gpd/lf, estimated peak hour – 82,100 gpd/lf • Maximum day removal: 60 % TSS, 25% BOD • Average day removal: 70 % TSS, 35% BOD	• 2003 average day – SOR – 520 gpd/sf – WLR – 20,600 gpd/lf • 2/9/01 Peak Hour (more realistic – 2003 flows below ave) – SOR – 2590 gpd/sf – WLR – 103,600 gpd/lf • 2003 Removal on maximum day: TSS – 39%, BOD– 9% • Average 2003 removal: TSS – 46%, BOD– 22%
5	Secondary Flow Control/ Aeration System	Max Day 508,500 lb/d BOD	Max Day 492,600 lb/d BOD	• West Plant – 12 single pass channels, 1 MG • East Plant – 20 single pass channels,1-1.4 MG, 19-1.65 MG • Average Day Influent Load: 191,500 lb BOD • MLSS – 2400 mg/L • BOD load: average day – 32 lb/1000 cf, maximum day – 85 lb/1000 cf • F/M: average day – 0.3, maximum day – 0.8	• 2003 Max Day Influent Aeration System BOD: 313,700 lb/d • UWS Calculated Daily Secondary Capacity < 300 MGD 45% of 2003 • Calculated Secondary Treatment Capacity Never < influent flow in 2003
6	Secondary Clarification	330 MGD	306 MGD	• West Plant – 11 at 8,550 sf surface area each; 94, 050 sf total (31.2% of total secondary clarification capacity) • East Plant – 10 at 13,230 sf surface area each; 132,300 sf total (43.9% of total secondary clarification capacity) • New East Plant – 12 at 6,250 sf surface area each; 75,000 sf total (24.9% of total secondary clarification capacity) • SOR: average day – 410 gpd/sf, estimated peak hour – 1100 gpd/sf • SLR: average day – 12 lb/d/sf, estimated peak hour – 34.4 lb/d/sf	East Plant should represent almost 45% of the total secondary clarification capacity based on surface area but was limited to about 30% of the capacity due to poor settlebility.

Unit Process No.[1]	Unit Process Title	Design Treatment Capacity: Total	Design Treatment Capacity: Firm	Specific Design Criteria	Actual Performance
7	Activated Sludge Pumping	Return – 165 MGD Waste – 5390 GPM	Return – 120 MGD Waste – 3350 GPM	• Return sludge – Average day 49 MGD (40% of ave flow) – Maximum day 160 MGD (130% of ave flow) – West Plant – 3 centrifugal pumps at 14.8 MGD, 28' TDH, 125 hp each – East Plant – 4 centifugal pumps at 30.2 MGD, 24' TDH, 200 hp each • Waste sludge – Waste sludge production: average day – 218,000 lb/d (109 tpd), maximum day – 400,000 lb/d (200 tpd) – Flow: average day – 2150 GPM, maximum day – 5390 GPM – West Plant – 2 centrifugal pumps at 730 GPM, 80' TDH, 25 hp each – East Plant – 3 centifugal pumps at 1310 GPM, 80' TDH, 50 hp each	• Est. Return Sludge 2003 – Average day 30 MGD – Maximum day 60 MGD • Waste sludge 2003 – Average day 2075 GPM – Maximum day 4420 GPM
8	Disinfection	409 MGD	307 MGD	• 4 Contact Basins, 8.5 MG total volume • Sodium hypochlorite use: average day – 4,900 gpd, maximum day – 12,000 gpd, emergency – 44,000 gpd • Sodium bisulfite use: average day – 790 gpd, maximum day – 1925 gpd • Contact Time: average day – 100 min, peak hour w/o blending – 37.2 min, peak hour with 60 MGD blending – 31.5 min	2003 Usage • NaOCl used: average day – 1480 gal, maximum day - 6710 gal • Cl_2 Dose: average day – 3 mg/L, maximum day - 13 mg/L • $NaHSO_3$ used: average day – 240 gal, maximum day - 1200 gal • SO_2 Dose: average day – 0.4 mg/L, maximum day - 2 mg/L
9	Effluent Pumping	520 MGD	390 MGD	• 4 propeller pumps, 130 MGD at 10.2' TDH, 300 hp each	Used intermittently for the following reasons: • Pump out high flows • To keep effluent flap gates closed (wind out of east causes flap gates to bang) • Testing
15	Process Air	472,000 cfm	236,000 cfm	• 4 blower, 118,000 cfm, 5500 hp each • 2 blowers are redundant	• Air Usage 2004-2005 (UWS only keeps air records for 12 month period, representative of past average usage) – Average day: 115,000 cfm – Maximum day: 142,000 cfm
18	Scum Concentration	600 GPM	300 GPM	• 2 Rotating drum screen, 300 GPM each • Scum press, 141 cf/hr capacity	• Screens operate below design capacity, both screens needed during peak conditions • 2003 total scum waste hauled away appeared low – 1.7cy/d • Average per day for 2001 – June, 2004 – 4 cy/d
20	Pickle Liquor	N/A	N/A	Pumped feed: • Pickle liquor feed – 25 GPM • Iron addition – 25,200 lb/d Gravity feed: • Pickle liquor feed – 15 GPM • Iron addition – 15,000 lb/d	• Process suspended in September 2002 • Usage information for 2001 no longer available • Iron added in the form of ferric chloride in September 2004 – only time iron was added to plant since pickle liquor addition was suspended

ISS = Inline Storage System
cy/hr = cubic yards per hour
LL = Low Level
mm = Millimeters
SLR = Solids Loading Rate
F/M = Food to Microorganism
Cl_2 = Chlorine
$NaHSO_3$ = Sodium Bisulfite
Hp = Horsepower
MGD = Million Gallons per Day
MG = Million Gallons
gpd/sf = Gallons per Day per Square Foot
WLR = Weir Loading Rate
lb/d/sf = Pounds per Day per Square Foot
TDH = Total Dynamic Head
JIWWTP = Jones Island Wastewater Treatment Plant
TSS = Total Suspended Solids
mg/L = Milligrams per Liter
SO_2 = Sulfur Dioxide
ISHF = Inline Solids Handling Facility
SSWWTP = South Shore Wastewater Treatment Plant
gpd/lf = Gallons per Day per Lineal Foot
BOD = Biochemical Oxygen Demand
cfm = Cubic Feet per Minute
NaOCl = Sodium Hypochlorite
cf/hr = Cubic Feet per Hour
GPM = Gallons per Minute
HL = High Level
SOR = Surface Overflow Rate
MLSS = Mixed Liquor Suspended Solids
O&M = Operation and Maintenance

Notes:
1) All unit processes at JIWWTP have a unit process number designation. Only the major and secondary unit processes which handle wastewater treatment are listed in this table. Unit processes which handle biosolids treatment at JIWWTP are listed in Table 4-16, Milorganite® Processes, and Table 4-18, Interplant Solids Pumping. All other unit processes are included in Appendix 4F, MMSD WWTP Unit Process Analysis and Regulation Review (note that not all number designations are used).
2) The ISS Pump Station is technically not a JIWWTP unit process so its pump station designation, PS0801, was used instead.

Source: Jones Island O&M Manual, Individual Unit Process O&M Manuals, 1999-2003 UWS DWORs (see Appendix 4F, MMSD WWTP Unit Process Analysis and Regulation Review, for more specific sources)

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Unit Process No.	Unit Process Title	Comparison of Process Unit Capacities to Current Regulations and Advisory Standards	
		Current NR 110 Regulations	**Advisory 10 – States Standards**
PS0801	ISS Pump Station	• NR 110.14.3 (e) – Pump station is not capable of pumping the design pumping rate with one unit out of service • PER LETTER FROM WDNR DATED NOVEMBER 2, 1982, THIS REGULATION (NR 110.14(2)(d) at the time) DOES NOT APPLY TO THE ISS PUMP STATION	Sec. 42.31 – Pump station cannot handle the design peak hourly flow with one unit out of service
2	Influent Screening	Meets regulations as listed in NR 110.16, Screening Devices	Sec. 61.1242 – Where two or more mechanically cleaned screens are used, the design shall provide for taking any unit out of service without sacrificing the capability to handle the design peak instantaneous flows • During high flow loadings, all five screen are utilized
4	Primary Clarification	NR 110.18.2 (d).1: • Maximum hourly surface settling rate for primary clarification is 1500 gpd/sf • Average day weir loading rate for primary clarification is 15,000 gpd/lf • Actual peak hour surface overflow rate is 2,050 gpd/sf and actual average day weir loading rate is 30,600 gpd/lf	• Sec. 72.21 – Maximum hourly surface settling rate for primary clarification is 1500-2000 gpd/sf • Sec. 72.43 – Maximum hourly weir loading rate for primary clarification is 30,000 gpd/sf • Actual peak hourly surface overflow rate is 2,050 gpd/sf and peak hourly weir loading rate is 82,100 gpd/lf
6	Secondary Clarification	Meets regulations as listed in NR 110.18, Settling Tanks	Sec. 72.232 – with chemical addition, maximum surface overflow rate is 900 gpd/sf • Actual peak hour surface overflow rate is 1,100 gpd/sf

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TABLE 4-13 SHEET 1 OF 2

JIWWTP COMPARISON OF PROCESSES TO CURRENT DESIGN REGULATIONS

Unit Process No.	Unit Process Title	Comparison of Process Unit Capacities to Current Regulations and Advisory Standards	Unit Process No.
		Current NR 110 Regulations	**Advisory 10-States Standards**
7	Activated Sludge Pumping	• Meets regulations as listed in NR 110.21, Activated Sludge	• Sec. 92.44 – Waste sludge control facilities shall have a capacity of at least 25 percent of the design average rate of wastewater flow (123 mgd), which would be 21,400 gpm • Actual total waste pumping capacity is 5390 gpm

ISS = Inline Storage System
gpd/sf = Gallons Per Day Per Square Foot
gpd/lf = Gallons Per Day Per Lineal Foot
gpm = Gallons Per Minute
WWTP = Wastewater Treatment Plant
O&M = Operation and Maintenance

NOTE:
1) Current NR 110 regulations and advisory 10-States Standards were updated after the WWTP unit processes were constructed. Applicable NR 110 regulations were most recently updated May 2001. 10-States Standards were most recently updated in 2004. NR 110 applies to new or modified sewerage systems. NR110.04 authorizes the WDNR to approve alternate requirements.
2) All unit processes not listed in this table have been determined to meet current NR 110 requirements and advisory 10-States Standards.

Source: Jones Island O&M Manual, Individual Unit Process O&M Manuals, NR 110, 10-States Standards (see Appendix 4F, MMSD WWTP Unit Process Analysis and Regulation Review for more specific sources)

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TABLE 4-13 SHEET 2 OF 2
JIWWTP COMPARISON OF PROCESSES TO CURRENT DESIGN REGULATIONS
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During periods when the MIS to SSWWTP is full, the ISS Pump Station cannot pump flow to the MIS to SSWWTP. This situation allows operators to use all three pumps to pump flow from the ISS to JIWWTP when capacity is available during a wet weather event.(61) Currently, the pumps are configured to operate individually or in combination as follows: all three pumps to JIWWTP or two pumps to JIWWTP and one to SSWWTP. When all three pumps are used to direct flow to JIWWTP, the current maximum pump out rate is approximately 120 MGD, although the pump out rate is higher if the tunnel is full or close to full due to pump motor limitations (according to the Maximum ISS Pumpout analysis included in Appendix 4C, *ISS Pumpout Analysis*).(62) The actual pump out rate is expected to increase to near the design rate of 150 MGD upon completion of the motor brush cooling system replacement being done as part of the Capital Repair and Replacement program planned for 2006.(63)

Issues identified for the ISS Pump Station include:

- To meet the design capacity of 150 MGD, all three pumps must be in service.(64,65) In 1982, MMSD requested that the WDNR waive the NR 110 pump station requirement (also an advisory 10-States Standard) that design capacity be achieved with one pump out of service for the ISS Pump Station.(66) In an approval letter dated November 2, 1982, WDNR agreed to this waiver request, stating that the regulation did not apply to the ISS Pump Station.(67)
- The ISS pumps and the head tanks have had excessive vibrations during various operating conditions. The vibrations in the pumps sometimes cause the pumps to shut down due to the vibration sensors during wet weather events. The pumps and motors backspin upon shutdown, and the backspin increases vibration and wear on the equipment. The tank vibrations resulted in the replacement of the head tanks as part of the completed JIWWTP Inline Pump System Improvements Project.
- The liquid rheostat Flomatcher controls and wound rotor motors for the pumps are prone to unpredictable malfunction. Parts for the motor speed controls and electrical equipment are difficult to obtain as they are no longer manufactured. A recommended MMSD project, the Conceptual Design to Upgrade JIWWTP ISS Pump Station Project, will include the replacement of these components. As mentioned above in the discussion on actual capacity, the motor brush cooling systems on all three pumps will be replaced as part of the Capital Repair and Replacement program by 2006. These planned improvements are expected to increase the pumping capacity.
- Maximum usage of the tunnel wet weather storage requires that the tunnel remain empty, which requires daily dewatering.(68) The existing pumps are not suitable for low volume dewatering duty, since the pumps are designed to pump higher volumes. The pumping of low volumes of groundwater infiltration creates increased wear on the pumps.
- As identified in the *2010 Facilities Plan*, there is no permanent equipment in place to isolate the cone valves located on the suction side of the pumps from the ISS.(69) Should it become necessary to replace or repair a valve, isolation of the valves will be difficult. The committed JIWWTP Inline Pump Station Project includes installation of cone valve isolation equipment.

The ISS Pump Station unit process also includes ISHF. If required, wastewater pumped from the tunnels could be sent to ISHF for storage and pre-treatment prior to being introduced into the wastewater stream at the head end of JIWWTP. ISHF contains 5 MG of solids storage, two 1,000 gallons per minute (gpm) capacity rotary drum screens, a grit separator, and a 2,000 gpm transfer pump. ISHF has never been used since tunnel operation began, except for testing. The maximum solids loading of the wastewater in the tunnel has never been high enough in concentration to warrant the use of ISHF and it has been more practical to treat the wastewater with the normal plant process system.

Unit Process No. 1: Influent Pumping

The firm design capacity of influent pumping is 330 MGD. Influent pumping consists of four low level and five high level screw pumps. The low level pumps each have a capacity of 46.7 MGD, with a firm capacity of 140 MGD. The high level pumps each have a capacity of 82.5 MGD with a firm capacity of 330 MGD. However, the existing siphons are currently hydraulically constricted, so flow to the influent pumps is limited to approximately 260 MGD at peak flows. The ISS Pump Station supplies additional flow up to the available capacity at JIWWTP during wet weather events. A committed project, the CMIS Harbor Siphons Project, is under construction to increase the capacity of the low level and high level siphons. Though the influent pumps have not experienced major problems and currently perform to capacity, there is a project, under the committed Preliminary Treatment Facility Upgrade Project, to overhaul the screw pump equipment which is reaching the end of its useful life.

Influent flow measurement, also included in the influent pumping unit process, consists of three magnetic flow meters: one on the low level siphon, rated at 150 MGD; one on the high level siphon, rated at 200 MGD; and one on the ISS pumpout, rated at 120 MGD. The data collected from the three influent meters are added together and reported as the daily influent flow and effluent flow on the DMRs.

Unit Process No. 2: Influent Screening

Influent screening has a firm design capacity of 330 MGD. Each of the five screens within the screening unit contains ¾” openings and has a capacity of 82.5 MGD, so the design capacity should be able to be met with one screen out of service. However, plant operators have indicated that on multiple occasions during high flow loadings (typically flows that contain a large quantity of leaves, known as “leaf load” situations), the capacity of the screens has decreased, making it necessary to run all five influent screens.(70) This operation is inconsistent with the design intent of the unit process; during these high flow loadings, the unit process does not have the redundancy it was designed to have. The ability to meet peak flow with one unit out of service is also recommended in the advisory 10-States Standards. In addition, floatables that are not caught during the screening process apparently are not removed in subsequent processes and, therefore, may be discharged to the harbor. Currently, MMSD has installed nets in the chlorine contact basins under the completed Floatable Removal Project and UWS personnel skim the basin in an effort to prevent floatables from being discharged. The MMSD has a committed project, the Preliminary Treatment Facility Upgrade Project, which will replace the current screens with screens that have ¼” openings. In addition, the project will increase the number of screens from five to eight screens (designed to meet 330 MGD with six screens in service, two redundant). The committed JIWWTP Preliminary Treatment Facility Upgrade Project also includes upgrading the lugger loading, HVAC, scum concentration, and primary sludge systems.

Unit Process No. 3: Grit Removal

The grit removal system has a total design capacity of 330 MGD and is operated with all units in service.(71) As recommended by the *2010 Facilities Plan*, the system was upgraded under the JIWWTP Grit Handling Project, completed in 2003.(72) The system consists of six grit basins, fluidizing pumps and grit removal pumps, and grit concentrators. Even after the JIWWTP Grit Handling Project was completed, the grit swirl concentrators sometimes failed during high flow conditions due to grit accumulation and clogging.(73,74) The JIWWTP serves the combined sewer area and receives heavy grit loads during rainstorms and snow melt. When the grit removal system fails during heavy grit loads, grit can escape to downstream unit processes. However, as part of the ongoing system review, it was found that due to UWS maintenance on the influent screens, installation of pressure monitoring devices in all six grit pump discharge lines to shut down pumps before major pipe clogging occurred, and replacement of the grit dewatering cyclones, the operation of the grit removal unit process has greatly improved to acceptable levels.(75) There continue to be efficiency issues with high grit loadings to primary clarifiers during wet weather events, which will be evaluated as part of the recommended MMSD Upgrade Primary Clarifier Mechanisms Project.

Unit Process No. 4: Primary Clarification

The primary clarification process includes the primary clarifiers, primary sludge removal, sludge screening, and scum removal and dewatering. The process, which includes eight primary clarifiers, was designed for a total maximum day of 300 MGD.(76) However, the *Wet Weather Flow Optimization Study* indicated that at a flow of 272 MGD, the effluent weirs are submerged, allowing solids to flow to secondary treatment that should have been settled out of the wastewater.(77)

There are a number of significant hydraulic issues in the primary clarification unit process:

- Primary Clarification Influent Channel Flooding. Grit and scum has collected in the primary clarifier influent channels.(78) During wet weather events, surging water can lift access hatches and covers allowing small amounts of scum material to escape onto concrete channel covers. Figure 4-7 is a photograph of the access cover over the end of the main influent channel during a storm that occurred May 11, 2005.(79) The storm lasted approximately 8-10 hours, and the peak hourly flow measured through JIWWTP was 338 MGD.(80) There were no in-plant diversions or overflows during this event.(81) Although this event took place after the end of the existing condition review period, it illustrates an ongoing problem.
- Primary Clarifier Flooding. The flooding of the effluent weirs and scum baffles is a recurring wet weather problem that significantly reduces the capability of these units to remove scum, grease and floatables. When scum baffles are flooded, no floatables are retained and removed in the clarifiers. In addition, this condition may be impacting the ability of the primary clarifiers to settle solids. Figures 4-8 through 4-11 are photographs of several primary clarifiers during the May 11, 2005 wet weather event. The photographs were all taken within minutes of each other when flows were increasing. The photographs appear to indicate hydraulic overload: some units have flooded scum baffles, some units have flooded weirs and some units appear to be operating within acceptable limits.

Primary Clarifier Influent Channel Discharge

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FIGURE 4-7
PRIMARY CLARIFIER INFLUENT CHANNEL DISCHARGE
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Wet Weather Event: Primary Clarifier #1 Looking South

Wet Weather Event: Primary Clarifier #2 Looking Southwest

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FIGURE 4-8
PRIMARY CLARIFIER #1 AND #2 DURING A WET WEATHER EVENT
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Wet Weather Event: Primary Clarifier #2 Looking East

Wet Weather Event: Primary Clarifier #3 Looking Northwest

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FIGURE 4-9

PRIMARY CLARIFIER #2 AND #3 DURING A WET WEATHER EVENT

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Wet Weather Event: Primary Clarifier #3 Looking South

Wet Weather Event: Primary Clarifier #4 Looking Northwest

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FIGURE 4-10

PRIMARY CLARIFIER #3 AND #4 DURING A WET WEATHER EVENT

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Wet Weather Event: Primary Clarifier # 4 Looking Southeast

Wet Weather Event: Primary Clarifier #6 Looking Northwest

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FIGURE 4-11
PRIMARY CLARIFIER #4 AND #6 DURING A WET WEATHER EVENT
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- Analysis of Influent Channel and Primary Clarifier Flooding. The flooding issues were reviewed in the technical memorandum titled, *JI2-Jones Island Primary Treatment Hydraulic and Treatment Capacity*.(82) As part of this technical memorandum, UWS isolated the two west primary influent channels feeding primary clarifiers 5, 6, 7, and 8. The north channel, which feeds primary clarifiers 5 and 7, was found to have scum and grit along the length of the channel at depths up to seven feet. The south channel, which feeds primary clarifiers 6 and 8, was found to have minimal scum and grit accumulation, possibly one-foot high. Recommendations in the technical memorandum included cleaning the channels, improving the grit removal system, redesigning the scum removal system, and performing routine maintenance to keep the channels clean. The uneven buildup of scum and grit may indicate that there is also an uneven hydraulic split during wet weather; however, whether the uneven buildup of scum and grit and the potential uneven hydraulic split are due to the grit accumulation or a hydraulic design/structure problem is unknown.

  The recommended MMSD Upgrade Primary Clarifier Mechanism Project will include sampling and quantification of grit, cost analyses comparison of primary sludge degritting alternatives, inspection of primary influent and primary effluent channels, along with the mechanism rehabilitation (sandblast and paint) work. In addition, MMSD is planning on cleaning the east and west primary clarifier feed channels to remove grease, scum and grit deposits noted above.(83)

Another issue affecting the operation of the primary clarifiers during the existing condition review period was frequent plugging of the primary sludge drains. The plugging was attributed to accelerated ground settlement that caused vertical distortion or dips in the drain line's horizontal alignment, which impeded flow. This issue required the implementation of a project, completed in 2001, to replace the primary sludge drains on primary clarifier nos. 2, 4, 6, and 8. The other four clarifiers' primary sludge drains appear to be operating adequately, so there are no plans to replace the remaining drains. However, there is speculation that the other drains that were not replaced and other non-pile supported pipelines may be at risk of failing due to the ground settlement.

Review of current NR 110 regulations and advisory 10-States Standards indicates that the primary clarification unit process is now designed in part based on peak hourly flow rates, rather than maximum day flow rates. In comparing the primary clarification surface overflow rates and weir loading rates at JIWWTP to the current NR 110 regulations and advisory 10-States Standards, the existing condition rates were higher than the maximum recommended rates in some cases. Table 4-13 contains more details. These findings are reviewed again in Chapter 5, *Treatment Assessment – Future Condition* and Chapter 8, *Common Treatment Facilities, Programs, Operational Improvements and Policies for the Recommended Plan* to determine if an issue exists.

Unit Process No. 5: Secondary Flow Control/Aeration System

The activated sludge system consists of 32 aeration basins - 12 at 1 MG each, 19 at 1.65 MG each and 1 at 1.4 MG for a total volume of 44.8 MG. Unit Process No. 6, Secondary Clarification, and solids loading control the capacity of the activated sludge process.

The original maximum day design capacity of secondary treatment was 300 MGD.(84) According to the *Wet Weather Flow Optimization Study,* the treatment capacity of the secondary treatment system was less than 300 MGD based on biological modeling using BioWin™ and field testing.(85)

United Water Services bases the capacity on the sludge volume index (SVI). A lower SVI indicates improved sludge settling characteristics and therefore greater secondary treatment capacity. Review of UWS DWOR data for this unit process in Appendix 4F, *MMSD Wastewater Treatment Plant Unit Process Analysis and Regulation Review* indicates that the calculated secondary treatment capacity (which applies to the secondary clarifiers as well) was less than 300 MGD 45% of the time during 2003; however, the capacity was never less than the influent flow on the day measured. Pickle liquor addition upstream of the aeration basins to meet effluent phosphorus limits was determined to be one potential reason for poor sludge settling and was discontinued in 2002.(86) Ferric chloride is currently added instead of pickle liquor (pickle liquor availability has become limited) as necessary to aerated effluent to meet effluent phosphorus limits; no addition was required through the end of June 30, 2004.

The MMSD has committed to improving wet weather capacity at JIWWTP. The JIWWTP Wet Weather Secondary Capacity Improvements Project was split into two phases. The Aeration System modifications in Phase 1, completed in 2003, included automatic flow control between the east and west plants (flow is typically split 2/3 and 1/3, respectively), biosolids storage within selected aeration basins (airflow is turned off and solids are allowed to settle and build up within the basin to avoid overloading secondary clarifiers), and idling aeration basins. These Phase 1 improvements aim to restore the capacity of JIWWTP secondary treatment to a firm capacity of 300 MGD. The Aeration System modifications in the committed Phase 2 Project include reconfiguration of feed piping of phosphorus control chemicals (ferric chloride or pickle liquor as available) so chemicals are added to aeration basin effluent instead of aeration basin influent to help sludge settleability. Improvements already completed appear to have increased the capacity of the secondary treatment system based on performance during wet weather events. However, a re-rating study would be required to determine the actual increase in the capacity of JIWWTP secondary treatment.

As part of the biosolids storage modifications under the JIWWTP Phase 1 Wet Weather Secondary Capacity Improvements Project, four east plant basins and two west plant basins had all of the ceramic plate diffusers replaced with fine-pore membrane diffusers. The old diffusers, which remain in 26 non-storage basins, require that the air still be supplied to a basin even if it is not in service to prevent the diffusers from plugging with solids.(87)

Unit Process No. 6: Secondary Clarification

The secondary clarification process consists of 33 clarifiers with a total design treatment capacity of 300 MGD. However, solids settling problems affect secondary treatment capacity. The secondary treatment capacity was less than 300 MGD during peak flow conditions due to solids overloading.(88) A specific concern was that the old east clarifiers, which should represent almost 45% of the secondary clarification capacity, were limited to only 30% of the secondary clarification capacity due to poor solids settling performance.(89)

Due to this issue, specific modifications to secondary clarification were included in the completed Phase I of the JIWWTP Wet Weather Secondary Capacity Improvements Project: installation of influent flow control gates, modulating gate actuators, Stamford and density current baffles and corner blocking weirs to reduce hydraulic short circuiting. The modification of the aeration basins to store biosolids during high flows reduces the solids loading to the secondary clarifiers, which results in an increased flow capacity of the secondary clarifiers back up to at least design capacity of 300 MGD.(90)

In addition, the MMSD recommended Secondary Clarifier Drive Replacement Project would overhaul the existing secondary clarifier drives and mechanisms.

Current NR 110 regulations and advisory 10-States Standards were reviewed for the secondary clarification process. The current NR 110 regulations for final settling after activated sludge treatment are met. However, the estimated peak hourly surface overflow rate is higher than the maximum recommended peak hourly surface overflow rate for secondary settling with the use of chemical addition indicated in the advisory 10-States Standards. Table 4-13 contains more details. This finding will be reviewed again in Chapter 5, *Treatment Assessment – Future Condition* and Chapter 8, *Common Treatment Facilities, Programs, Operational Improvements and Policies for the Recommended Plan* to determine if an issue exists.

Unit Process No. 7: Activated Sludge Pumping

Activated sludge pumping includes RAS and waste activated sludge (WAS) pumping. RAS pumping consists of seven centrifugal pumps with a firm capacity of 120 MGD. The WAS pumping consists of five centrifugal pumps with a total capacity of 5,390 gpm (7.8 MGD).

As shown in Table 4-12, the RAS and WAS capacities are sufficient for the operational requirements of JIWWTP. As listed in Table 4-13, the WAS pumping capacity meets current NR 110 regulations but not advisory 10-States Standards. This finding will be reviewed again in Chapter 5, *Treatment Assessment – Future Condition* and Chapter 8, *Common Treatment Facilities, Programs, Operational Improvements and Policies for the Recommended Plan* to determine if an issue exists.

The recommended MMSD JIWWTP RAS Discharge Pipeline Improvements Project will correct certain problems in the activated sludge pumping process: RAS pumping header leaks and inoperable RAS and WAS sluice gate operators.

Unit Process No. 8: Disinfection

The disinfection system at JIWWTP that used gaseous chlorine/sulfur dioxide was replaced in 2000 with a system using sodium hypochlorite/sodium bisulfite based on the recommendations of the *2010 Facilities Plan*.(91) This was due to the age of the system as well as the potential risk of the release of gaseous chemicals to the air. Both the sodium hypochlorite and the sodium bisulfite solutions are introduced directly into the wastewater in the contact basins by US Filter Stranco Water Champ® injectors. The sodium hypochlorite system has the capability to supply up to 44,000 gallons/day (gpd) in an emergency situation. The chlorine contact system has four contact basins with a total calculated capacity of 409 MGD at the 30-minute detention time required by current NR 110 regulations.(92) The maximum hydraulic capacity of 390 MGD is based on the 330 MGD peak hourly design flow and the 60 MGD in-plant diversion allowed by the WPDES permit.(93)

Effluent nets were installed in early 2004 as part of the completed Floatable Removal Project at the downstream end of the chlorine contact basins in an effort to prevent floatables that pass through the influent screening unit process from being discharged into the harbor.(94) The net installation has had limited success so far – though collecting a lot of debris, some floatables are still escaping into open water. In addition, the nets become clogged with algae and therefore must be changed more often than planned. The influent screens to be installed as part of the committed JIWWTP Preliminary Treatment Facility Upgrade Project should reduce the amount of floatables currently reaching the effluent nets.

Effluent metering is upstream of disinfection and includes two electromagnetic meters, each with a capacity of 200 MGD. The effluent metering is used to pace the chlorine dose for disinfection. The effluent meters are located upstream of the point where flows are recycled back to the front of the plant. As discussed in Section 4.2.1, *Treatment Plants Overview*, when upgrades that are being done as part of committed JIWWTP I&C Upgrade – Final Project are completed, recycled flows will also be metered.

Unit Process No. 9: Effluent Pumping

Effluent pumping, required to discharge effluent from the plant when hydraulic conditions limit gravity flow (i.e., when Lake Michigan water levels are high), consists of four pumps, each at 130 MGD, with a firm capacity of 390 MGD. Due to the low levels of Lake Michigan in recent years, effluent pumping has not been required on a regular basis. According to UWS personnel, the pumps are intermittently run for one of three reasons: high flows, to keep effluent flap gates closed (wind out of east causes high waves, which in turn cause the flap gates to open and slam shut), or pump testing.(95)

South Shore Wastewater Treatment Plant Unit Process Evaluation

The wastewater treatment train at SSWWTP consists of eight major wastewater treatment unit processes (the Unit Process No. 7 designation is not used). The evaluation of the performance of these major unit processes compared to the design intent is shown in Table 4-14.(96,97) Also included in Table 4-14 are other secondary wastewater treatment unit processes not discussed in the text. The regulations and standards evaluation compared the design of the unit processes at SSWWTP to the current NR 110 requirements and advisory 10-States Standards. The unit processes for which a gap may exist between either current NR 110 requirements or advisory 10-States Standards, or both, are shown in Table 4-15.(98,99) More detailed analyses of all of the unit processes at SSWWTP can be found in Appendix 4F, *MMSD Wastewater Treatment Plant Unit Process Analysis and Regulation Review*, including references for all specific information and calculations.

Unit Process No.[1]	Unit Process Title	Design Treatment Capacity (MGD)		Specific Design Criteria	Actual Performance
		Total	Firm		
1	MIS Flow Control Structure	530 MGD	300 MGD	• 2 sluice gates, 6'x10' • Water level monitors, 4 upstream, 2 downstream	WWTP Capacity limited during Preliminary Treatment Construction 2001-2003 • Average Flow 1997-2001: 108 MGD • Maximum Flow 1997-2001, 2004 (through June): 323 MGD
2	Influent Screening	350 MGD	300 MGD	• 7 fine screens, 50 MGD operating capacity, 0.25" opening each • Screenings – 2.2 cy/hr • Diversion Bar Screen – 300 MGD capacity	• May 2004 – Peak flow event since new influent screening system installed Peak flow recorded at SSWWTP during event – 321 MGD
3	Grit Removal	300 MGD	257 MGD	• 7 grit channels, 42.9 MGD treatment capacity • 7 grit pumps, 600 GPM each • 7 Slurry Cup grit separation units, 590 GPM each	• May 2004 – Peak flow event since new influent screening system installed Peak flow recorded at SSWWTP during event – 321 MGD
4	Primary Clarification	300 MGD	281 MGD	• Plant flow metering (upstream of priamry clarification): 4 Magnetic meters, 120 MGD each • 16 rectangular basins • SOR: average day – 1100 gpd/sf, estimated peak hour SOR – 2930 gpd/sf • WLR: average day – 24,500 gpd/lf, estimated peak hour – 65,100 gpd/lf • Maximum day removal: 44 % TSS, 17% BOD Rem • Average day Removal: 60 % TSS, 32% BOD Rem	• Peak capacity with weir configuration using plud feed mode and step feed valves open – 357 MGD • 2003 TSS/BOD Removal - Average day: TSS - 40%, BOD – 46% - 2003 removal on maximum day: TSS – 24%, BOD– 26%
5	Aeration and RAS Pumping	Maximum day 442,400 lb/d BOD RAS – 125 MGD WAS – 4790 GPM	Maximum day 426,600 lb/d BOD RAS – 109 MGD WAS – 3600 GPM	• 28 basins, 1.25 MG each • Average Day Influent Load: 158,500 lb BOD • MLSS: average day – 3030 mg/L, Maximum Day – 2450 mg/L • BOD Load: average day – 34 lb/1000 cf, maximum day – 95 lb/1000 cf • F/M: average day – 0.24, maximum day – 0.84 • Return sludge pumping: average day – 57 MGD, maximum day – 125 MGD – 6 RAS-WAS transfer pumps, 7.7 MGD each, 3 per battery – 8 RAS pumps, 15.6 MGD each, 2 per battery • Waste sludge: - Waste sludge production: average day – 172,900 lb/d, maximum day – 320,900 lb/d – Flow: average day – 1600 GPM, maximum day – 3810 GPM – 4 WAS pumps, 1200 GPM each	• 2003 Maximum Day Inf Act Sludge BOD: 147,300 lb/d • Average Calculated Secondary Treatment Capacity: >400 MGD • UWS does not keep daily RAS records for South Shore • Est. RAS 2003 (Based on UWS DWOR Plant Schematic & 2003 Data): average day – 19 MGD, maximum day – 49 MGD • Waste sludge 2003: average day – 720 GPM, maximum day – 1430 GPM
6	Secondary Clarification	300 MGD	288 MGD	• 24 octagonal clarifiers, 10,333 sf surface area each • SOR: average day – 480 gpd/sf, estimate peak hour – 1210 gpd/sf • SLR: average day – 18 lb/d/sf, estimated peak hour – 33.2 lb/d/sf	• No hydraulic limitations
8	Disinfection	300 MGD	150 MGD	• 2 contact basins, 5 MG total volume • Sodium hypochlorite use: average day – 3,020 gpd, maximum day – 6,670 gpd, emergency – 44,000 gpd • Sodium bisulfite use: average day – 720 gpd, maximum day – 1600 gpd • Contact Time: average day – 64.1 min, peak hour – 24.2 min	2003 Usage • NaOCl used: average day – 930 gal, maximum day – 2920 gal • Cl_2 Dose: average day – 2 mg/L, maximum day – 6 mg/L • $NaHSO_3$ used: average day – 210 gal, maximum day – 910 gal • SO_2 Dose: average day – 1 mg/L, maximum day – 2 mg/L
9	Effluent Pumping	375 MGD	300 MGD	• 5 Wet pit axial flow pumps, 75 MGD each • Effluent measurement – 15 ft Parshall flume, not used	• Effluent pumping has not been used for 5+ yrs. Lake Michigan water levels have been low enough to allow gravity discharge from South Shore even during wet weather events.

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TABLE 4-14 SHEET 1 OF 2
SSWWTP UNIT PROCESS EVALUATION
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Unit Process No.[1]	Unit Process Title	Design Treatment Capacity (MGD) Total	Firm	Specific Design Criteria	Actual Performance
15	Process Air	120,000 CFM	90,000 CFM	• 4 blower, 30,000 cfm each	• Air Usage 2004-2005 (UWS only keeps air records for 12 month period representative of past average usage) – Average day – 50,000 cfm – Maximum day – 64,000 cfm
18	Pickle Liquor Storage and Feed	Maximum day: 13,500 lb/d 21 gpm		• Dose: average day – 5,200 GPM, maximum day – 13,500 lb/d • Usage: average day – 8 GPM, maximum day – 21 GPM • Storage: 20,000 gal	• Pickle Liquor Feed 2003 – Average day – 3 GPM – Maximum day – 16 GPM

MIS = Metropolitan Interceptor Sewer
GPM = Gallon per Minute
MG = Million Gallons
WAS = Waste Activated Sludge
min = Minute
cf/hr = Cubic Feet per Hour
O&M = Operation and Maintenance
MGD = Million Gallons per Day
SOR = Surface Overflow Rate
mg/L = Milligrams per Liter
F/M = Food to Microorganism
NaOCl = Sodium Hypochlorite
ft = foot
cy/hr = Cubic Yards per Hour
WLR = Weir Loading Rate
cf = Cubic Foot
SLR = Solids Loading Rate
Cl_2 = Chlorine
cfm = Cubic Foot per Minute
SSWWTP = South Shore Wastewater Treatment Plant
BOD = Biochemical Oxygen Demand
lb/d = Pounds per Day
gpd/sf = Gallons per Day per Square Foot
$NaHSO_3$ = Sodium Bisulfite
UWS = United Water Service
WWTP = Wastewater Treatment Plant
TSS = Total Suspended Solids
RAS = Return Activated Sludge
lb/d/sf = Pounds per Day per Square Foot
SO_2 = Sulfur Dioxide
DWOR = Daily/Weekly Operating Report

Notes:
1) All unit processes at SSWWTP have a unit process number designation. Only the major and secondary unit processes which handle wastewater treatment are listed in this table. Unit processes which handle biosolids treatment at SSWWTP are listed in Table 4-17, Agri-Life® Processes, and Table 4-18, Interplant Solids Pumping. All other unit processes are included in Appendix 4F, MMSD WWTP Unit Process Analysis and Regulation Review (note that not all number designations are used).

Source: South Shore O&M Manual, Individual Unit Process O&M Manuals, 1999-2003 UWS DWORs (see Appendix 4F, MMSD WWTP Unit Process Analysis and Regulation Review for more specific sources)

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TABLE 4-14 SHEET 2 OF 2
SSWWTP UNIT PROCESS EVALUATION
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Unit Process No.	Unit Process Title	Comparison of Process Unit Capacities to Current Regulations and Advisory Standards	
		Current NR 110 Regulations	**Advisory 10-States Standards**
4	Primary Clarification	• NR 110.18.2(d).1 – Maximum hourly surface settling rate for primary clarification is 1500 gpd/sf. • Actual peak hourly surface overflow rate is 2,930 gpd/sf.	• Section 72.21 – Maximum hourly surface settling rate for primary clarification is 2000 gpd/sf. • Actual peak hourly surface overflow rate is 2,930 gpd/sf.
5	Aeration and RAS Pumping	• Meets regulation as listed in NR 110.21, Activated Sludge.	• Section 92.44 – Waste sluge control facilities shall have a capacity of at least 25 percent of the design average rate of wastewater flow (113 MGD), which would be 28.3 MGD or 19,600 GPM. • Actual total waste pumping capacity is 4,790 GPM.
6	Secondary Clarification	• NR 110.18.2 (d).1 – Maximum hourly surface settling rate for clarification after activate sludge treatment is 1200 gpd/sf. • Actual peak hourly surface overflow rate is 1,250 gpd/sf	• Section 72.232 – Design peak hourly rate is 900 gpd/sf SOR for activated sludge with chemical addition to mixed liquor for phosphorus removal. • Actual peak hourly surface overflow rate is 1,250 gpd/sf

gpd = Gallons Per Day Per Square Foot
MGD = Million Gallons Per Day
GPM = Gallons Per Minute
WWTP = Wastewater Treatment Plant
SOR = Surface Overflow Rate
O&M = Operation and Maintenance

NOTES:
1) Current NR 110 regulations and advisory 10-States Standards were updated after the WWTP unit processes were constructed. Applicable NR 110 regulations were most recently updated May 2001. 10-States Standards were most recently updated in 2004. NR 110 applies to new or modified sewerage systems. NR110.04 authorizes the WDNR to approve alternate requirements.
2) All unit processes not listed in this table have been determined to meet current NR 110 requirements and advisory 10-States Standards.

Source: South Shore O&M Manual, Individual Unit Process O&M Manuals, NR 110, 10-States Standards (see Appendix 4F, MMSD WWTP Un it Process Analysis and Regulation Review for more specific sources)

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TABLE 4-15
SSWWTP COMPARISON OF PROCESSES TO CURRENT DESIGN REGULATIONS
2020 TREATMENT REPORT
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The following discussion highlights the equipment under each unit process as well as major issues and committed and recommended MMSD projects as applicable.

Unit Process No. 1: Metropolitan Interceptor Sewer Flow Control Structure

The MIS flow control structure was installed in 1993 to regulate flow to SSWWTP. The structure limits the flow into SSWWTP to an amount close to the peak design flow of 300 MGD. Flows that exceed the current capacity of SSWWTP could be delivered to the plant if the control structure were not in place, thereby flooding and incapacitating unit process equipment beyond repair. The structure has two 6’x10’ sluice gates, one redundant, which control the flow entering the plant. The existing SSWWTP control system controls the opening and closing of the gates based on information transmitted by the six water level monitors located in the structure, as well as information transmitted from the four flow meters downstream of preliminary treatment and information collected by level transmitters in the conveyance system. The structure is designed to allow manual operation of the gates in the event of an emergency.

Unit Process No. 2: Influent Screening

The upgrade of the influent screening process, completed in 2003 as part of the Preliminary Treatment Project, included the replacement of the original four screens and installation of three more screens. Each screen is located in a five-foot wide channel passing 70 MGD in clean conditions with a downstream water level of 10 feet with a head loss of not more than 16 inches of water.(100) However, operating experience shows actual capacity is less than 70 MGD, and is assumed to be approximately 50 MGD.(101) Therefore, the firm operating capacity of the unit process is 300 MGD.

The influent screening process also includes a 300 MGD diversion channel and trash rack around the preliminary treatment process to the primary treatment process.

Unit Process No. 3: Grit Removal

The upgrade of the grit removal process was completed in 2003 as part of the Preliminary Treatment Project. The upgrade included the installation of three more grit removal channels and seven swirl vortex units, four replacing the old grit separator systems and three installed on the new channels. The treatment capacity with all seven channels in service, each removing 95% of 65 mesh particles at a velocity of 1.00 ft/s, is 300 MGD.(102) The total design hydraulic capacity is 350 MGD at a velocity of 0.80 ft/s, but grit removal efficiency declines at this flow.(103)

Pickle liquor is added on an as needed basis to the grit basin effluent, with ferric chloride supplement as necessary, to meet effluent phosphorus limits.

Influent metering is located on the four pipes from the preliminary treatment facility to the primary clarifiers. There is one meter on each pipe, each with a capacity of 120 MGD. The data collected from the four meters are used to report both daily influent flow and daily effluent flow on the DMRs.

Unit Process No. 4: Primary Clarification

The primary clarification process consists of 16 rectangular clarifiers installed in 1968 with chain and flight solids collector mechanisms, each with a design capacity of 18.75 MGD. The primary clarification process has a total design capacity of 300 MGD. The Primary Clarifier

Modification Projects were completed in 2003 to improve the removal capabilities of both sludge and scum as part of recommendations made in the *2010 Facilities Plan*. As part of the completed SSWWTP Preliminary Treatment Improvement Project, the sludge screens and scum concentrators were also upgraded. Under the South Shore Aeration Project, effluent weir arrangements in all the primary clarifiers were replaced to reduce head loss and prevent the weirs from submerging during high flows.

A review of the unit process, included in Appendix 4F, *MMSD Wastewater Treatment Plant Unit Process Analysis and Regulation Review,* indicates that BOD removal was greater than design removal requirements but removal rates for TSS were low in 2003 compared to design removal requirements, as shown in Table 4-14.

Review of current NR 110 regulations and advisory 10-States Standards indicates that new primary clarification unit processes are now designed in part based on peak hourly flow rates, rather than maximum day flow rates. As indicated in Table 4-15, the existing condition rates of the primary clarifiers were higher than the maximum rates currently required or recommended in some cases. These findings are reviewed again in Chapter 5, *Treatment Assessment – Future Condition* and Chapter 8, *Common Treatment Facilities, Programs, Operational Improvements and Policies for the Recommended Plan* to determine if an issue exists.

Unit Process No. 5: Aeration and Return Activated Sludge Pumping

The activated sludge system consists of 28 aeration basins, with a total volume of 34.9 MG. Twenty-four of the basins were installed in 1974, and the remaining four installed in the 1980s. The capacity of the activated sludge process is controlled by Unit Process No. 6, Secondary Clarification, and solids loading. The *Wet Weather Flow Optimization* study indicated that the secondary treatment process was able to achieve its full hydraulic throughput design capacity of 300 MGD.(104) However, the treatment capacity of the primary treatment system was being limited in part by the plug flow operation of the aeration basin feed.

MMSD, based on the recommendations of the Treatment Plant Aeration Project, determined that membrane diffusers should be installed in 14 aeration basins, the diffusers in the rest of the basins should be replaced, and the step feed capabilities should be used in the aeration basins during wet weather events. These improvements were made in 2002 as part of the SSWWTP Aeration and Digester Facility Improvements Project.

UWS currently determines the secondary treatment capacity based on the SVI. A lower SVI indicates improved settling, which results in greater secondary treatment capacity. Review of the unit process capacity, included in Appendix Table 4F-55, *SSWWTP Unit Process No. 5: Aeration and RAS Pumping* indicates that the average calculated secondary capacity at SSWWTP was over 400 MGD. This review applies to the capacity of Unit Process No. 6, Secondary Clarification, as well. These results suggest that SSWWTP secondary treatment capacity may be even higher than the design capacity.

Activated sludge pumping includes return and waste sludge pumping. Return sludge pumping consists of six RAS-WAS centrifugal transfer pumps and eight RAS centrifugal pumps with a firm design capacity of 125 MGD. Waste sludge pumping consists of four centrifugal pumps with a firm capacity of 3600 gpm (5.2 MGD). As shown in Table 4-14, the RAS and WAS capacities are sufficient for the operational requirements of JIWWTP. As shown in Table 4-15, the WAS pumping capacity is less than is required by current NR 110 regulations and advisory

10-States Standards. This finding is reviewed again in Chapter 5, *Treatment Assessment – Future Condition* and Chapter 8, *Common Treatment Facilities, Programs, Operational Improvements and Policies for the Recommended Plan* to determine if an issue exists.

The air required for the activated sludge process is provided by four process air blowers. The current NR 110 regulations and advisory 10-States Standards for Unit Process No. 15, Process Air, were also reviewed. Both the current NR 110 requirements and advisory 10-States Standards recommendations state that the maximum design air requirements be supplied with one unit out of service, which the Process Air unit process at SSWWTP appear to meet.(105) Review of the actual maximum day air flow usage indicates that existing condition air flow requirements also agree with the review; only three blowers would are needed to supply existing condition maximum day air flow needs. This issue is presented in more detail in the review of SSWWTP Unit No. 15, Process Air in Appendix 4F, *MMSD Wastewater Treatment Plant Unit Process Analysis and Regulation Review*. Another issue with the process air concerns the line that runs from the blowers to the aeration basins: with only one line supplying all the air, there is no redundancy with the system.(106)

Unit Process No. 6: Secondary Clarification

The secondary clarification process consists of 24 octagonal clarifiers, each with a design capacity of 12.5 MGD, for a total design capacity of 300 MGD. The first 16 were installed in 1974 and the remaining eight were installed in 1989. The *Wet Weather Flow Optimization* study indicated that the clarifiers had no hydraulic limitations, which appears to be confirmed by the capacity review as discussed above in subsection *Unit Process No. 5, Aeration and RAS Pumping*.(107) The *Wet Weather Flow Optimization* study did indicate that there was an imbalance of flows to all of the secondary clarifiers – some clarifiers received more flow, others less, when each clarifier should receive an even portion of the total flow; however, a recent evaluation indicated that the imbalance is not as significant as the study suggested.(108) Those improvements that were determined to be necessary are being completed under the completed SSWWTP Wet Weather Secondary Capacity Improvements Project and the committed SSWWTP I&C Upgrade - Final Project.

As indicated in Table 4-15, the design peak hourly surface overflow rate is greater than the maximum recommended rate as listed in the current NR 110 regulations and advisory 10-States Standards. This finding is reviewed again in Chapter 5, *Treatment Assessment – Future Condition* and Chapter 8, *Common Treatment Facilities, Programs, Operational Improvements and Policies for the Recommended Plan* to determine if an issue exists.

Unit Process No. 7: Disinfection

The disinfection system at SSWWTP was upgraded to sodium hypochlorite/sodium bisulfite from gaseous chlorine/sulfur dioxide in 2000 due to the age and reliability of the systems as well as concerns with the release of hazardous gaseous chemicals.(109) The sodium hypochlorite system has the capability to supply up to 40,000 gpd in an emergency situation. The system also includes two chlorine contact basins, with a total volume of 5 MG. NR 110 regulations require that the disinfection system be sized to provide a detention time of 60 minutes at average daily flow or 30 minutes at maximum design flow and that effluent bacterial concentrations conform to WPDES permit requirements. Though the contact basins only have a total design capacity of 242 MGD at a 30-minute detention time, they provide more than 64 minutes of detention time at the design average daily flow of 113 MGD. Therefore, NR 110 regulations are met since effluent fecal coliform limits are met. As at JIWWTP, both the sodium hypochlorite and the sodium bisulfite solutions are introduced directly into the wastewater in the contact basins by US Filter Stranco Water Champ® injectors.

The entrance to each of the contact basins contains a Parshall flume with a flow measurement capacity of 150 MGD. The existing measurement equipment is being replaced with newer technology that will more accurately measure effluent flow in the flumes as part of committed SSWWTP I&C Upgrade - Final Project. UWS does not currently use these flumes to measure the flow through SSWWTP.

Unit Process No. 8: Effluent Pumping

Effluent pumping consists of five effluent pumps, each with a capacity of 75 MGD, for a firm capacity of 300 MGD. The effluent pump station was installed in 1985. Pumping is used intermittently at SSWWTP to pump effluent flow from the treatment plant to the outfall in Lake Michigan. Effluent pumping has not been used at SSWWTP for more than five years.(110) Lake Michigan water levels have been low enough to allow gravity discharge from SSWWTP even during wet weather events.

4.2.4 Biosolids Evaluation

The MMSD has developed several options for the disposal of residual biosolids. These options consist of the following:

- Milorganite® – A Class A (as defined by the U.S. Environmental Protection Agency's (USEPA) Part 503 Biosolids Rule) dried biosolid that is sold as a fertilizer product. Milorganite® has several different classifications based on the size gradation of the final product and its nutrient qualities.
- Agri-Life® – A Class B (as defined by USEPA Part 503 Biosolids Rule) anaerobically digested liquid sludge that is applied to farmlands in the spring and fall.
- Land Application/Landfill System – The filter press system located at SSWWTP can produce a filter cake suitable for landfill or land application.
- Other Solids Disposal - Other waste solids from the treatment processing include influent screenings, grit, scum, and sludge screenings. These solids are landfilled, along with the dust and chaff produced in the Milorganite® process.

As part of the biosolids disposal management, MMSD operates the interplant solids pumping process. Residuals are pumped between the treatment plants by four interplant solids pipelines to maximize the quality and quantity of Milorganite®. In addition, pumping primary sludge to SSWWTP maximizes methane gas production in the anaerobic digestion process.

The MMSD biosolids management is evaluated in this section based on design criteria (as given in the O&M Manuals), actual performance, NR 110/204 regulations, and 10-States Standards. Biosolids management is also discussed in more detail in the following sections. Note that "raw" sludge refers to sludge that has not been treated, which at the MMSD treatment plants means sludge that has not been digested or dried. Though Milorganite® and Agri-Life® are produced from solids from either of the two plants, only the unit processes at JIWWTP are discussed under subsection titled *Milorganite® Evaluation* because Milorganite® is only produced at JIWWTP and only the processes at SSWWTP are discussed under subsection titled *Agri-Life® Evaluation* because it is only produced at SSWWTP.

The evaluation of the MMSD biosolids system presented below only discusses the system based on existing facilities and committed and recommended MMSD projects. Appendix 9A, *Biosolids/Energy Analysis* reviews MMSD biosolids management in detail and presents recommended alternatives for the future management of biosolids.

Jones Island Wastewater Treatment Plant Milorganite® Evaluation

Milorganite® is a registered fertilizer product produced at JIWWTP. It is heat dried and therefore classified as a Class A biosolid. Due to MMSD's industrial pretreatment program, only low levels of regulated metals are present in Milorganite®. Due to the low level of regulated metals, Milorganite® is listed as being of exceptional quality, meeting the Class A pathogen, high quality pollutant concentrations, and vector attraction requirements defined in NR 204 and outlined in the WPDES permit. Chapter 6, *Regulations and Permits* contains more information on biosolids disposal requirements. These classifications allow Milorganite® to be land applied with minimal regulatory restrictions. The largest market for this product is golf courses.

The unit processes at JIWWTP that produce Milorganite® are discussed in more detail below and reviewed in Table 4-16.(111,112,113,114,115,116) A more in-depth review of unit processes at JIWWTP that produce Milorganite® is included in Appendix 4F, *MMSD Wastewater Treatment Plant Unit Process Analysis and Regulation Review*.

Sludge Thickening

The JIWWTP sludge thickening facility was placed into service in 1987; it originally used seven solid bowl centrifuges for the thickening process. The centrifuges were high-energy users and required a significant amount of maintenance. These centrifuges were replaced in 2000 with four 3-meter wide gravity belt thickeners (GBTs).

The thickening facility receives raw secondary WAS from JIWWTP and SSWWTP via the interplant solids pipeline. The WAS is blended with polymer and fed to the GBTs, which allow much of the water to be removed, concentrating the sludge from 0.8% solids to about 6% solids.

Experience by MMSD and UWS using the GBTs at JIWWTP has shown that feeding the belt filter presses (see *Dewatering and Drying* below) sludge thickened to 2-2.5% optimizes energy and chemical usage. As a result, only a portion of the secondary sludge is actually thickened to 6% with the remaining portion blended with un-thickened waste activated sludge (at 0.8% solids) and digested sludge (at approximately 2% solids) in the equalization and blend tanks.

Sludge Screening and Pumping

The primary sludge screening system consists of three Parkson sludge screens and one Contra Shear rotary screener. The three Parkson sludge screens were installed in 2003 as part of the JIWWTP Grit Handling Project. The rotary screener is from the original preliminary treatment facility construction in 1985.

Unit Process No.	Unit Process Title	Design Treatment Capacity		Specific Design Criteria	Actual Performance
		Total	Firm		
10	Sludge Thickening	5035 GPM	3780 GPM	• Four 3-meter GBTS • 1260 gpm, 45.25 ton/d each • Four thickened sludge transfer pumps, 1,800 GPM total capacity	GBT Feed 2003 - Average Day – 2260 GPM - Maximum Day – 4600 GPM WAS % 2003 - Average Day – 4.5 - Maximum Day – 6.0
11	Sludge Screening and Pumping	1450 GPM	750 GPM	• 3 Parkson screens, 250 GPM each • 1 Contra-Shear screen, 700 GPM • Screening conveyor, 250 cf/hr • Screened sludge pumping, 3 units, 1080 GPM each	Primary Sludge Pumped 2003 - Average Day – 200 GPM - Maximum Day – 360 GPM
12	Equalization and Blend	3430 GPM	1715 GPM	• 2 mix tanks, 360,000 gal each • Tank 1 – Primary sludge equalization before pumping to digesters at SS • Tank 2 – Blend portion of JI Primary, portion of JI WAS, and JI GBT sludge before Belt Filter Presses	Blended Sludge Pumped 2003 - Average Day – 1160 GPM - Maximum Day – 2850 GPM
23	Waste Activated Sludge Receiving/ Gallery Solids Piping Intertie	5610 GPM	3740 GPM	• 3 pumps, 1870 GPM at 138' TDH, 100 hp each • 2 wet wells, 21,200 gal each	• WAS Processed 2003 - Average Day – 2670 GPM - Maximum Day – 4200

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TABLE 4-16 SHEET 1 OF 2

MILORGANITE® PROCESSESS

Unit Process No.	Unit Process Title	Design Treatment Capacity		Specific Design Criteria	Actual Performance
		Total	Firm		
					GPM
24 25 27	Dewatering and Drying Facility[1]	240 dry tons per day	200 dry tons per day	• 24 2-meter dewatering belt filter presses • 12 rotary drum dryers, each capable of producing 20 tons per day • Two redundant material classification trains • 12 exhaust gas treatment systems consisting of a cyclone and wet electrostatic precipitator	• Milorganite® Produced 2003 - Total – 47700 tons - Est Average Day – 136 tons

gal = Gallon
TAS = Thickened Activated Sludge
MGD = Million Gallons Per Day
WWTP = Wastewater Treatment Plant
O&M = Operation and Maintenance
JIWWTP = Jones Island Wastewater Treatment Plant
THD = Total Dynamic Head
GBT = Gravity Belt Thickener
cf/hr = Cubic Feet Per Hour
GPM = Gallons Per Minute
SOR = Surface Overflow Rate
SSWWTP = South Shore Wastewater Treatment Plant
WAS = Waste Activated Sludge
hp = Horsepower

NOTE:
1) The Dewatering and Drying facility houses the unit processes necessary to produce Milorganite® from the blended sludge. It is discussed as one unit process.

Source: Jones Island O&M Manual, Individual O&M Manuals, 1999-2003 UWS DWORs and MMSD Contract Compliance Office (CCO) Annual Reports (see Appendix 4F, MMSD WWTP Unit Process Analysis and Regulation Review for more specific sources)

The sludge screens are used for normal plant flows, but have insufficient capacity to handle peak primary sludge production during wet weather events.(117) The rotary screener is placed into operation during these wet weather events. A committed project, JIWWTP Preliminary Treatment Facility Upgrade Project, is evaluating the addition of more sludge screen so that the rotary screen can be removed.

The screened primary sludge was originally intended to be pumped directly into the Milorganite® production process. Currently, the screened primary sludge is pumped to SSWWTP to be treated in the anaerobic digestion process. The digested sludge is used in either the Agri-Life® or the Milorganite® program.

Equalization and Blend

The equalization and blend system consists of two 360,000-gallon tanks constructed in 1990. The tanks were originally intended to blend thickened WAS with primary sludge to produce a homogenous sludge for feed to the dewatering belt filter presses. Current operations use one blend tank as a screened primary sludge equalization tank while the other blend tank is used to blend thickened waste activated sludge, digested sludge, and WAS prior to feed to the belt filter presses. Available information indicates that the system has operated well.

Waste Activated Sludge Receiving/Gallery Solids Piping Intertie

WAS Receiving receives WAS that is to be thickened on the gravity belt thickeners. The process consists of two tanks and some pumps and valves that distribute SSWWTP and JIWWTP WAS to the JIWWTP biosolids processes. Almost all SSWWTP WAS passes through WAS Receiving. A portion of JIWWTP WAS is processed and the remainder is used for blending. WAS receiving was recently modified to receive SSWWTP digested sludge. The digested sludge is not thickened but it is blended with thickened sludge.

Dewatering and Drying

The dewatering and drying facility, placed into operation in 1994, consists of 24 belt filter presses, 12 rotary drum dryers, two redundant classification systems, and ancillary equipment. The facility is designed to receive up to 240 dry tons of blended sludge solids per day and produce 200 dry tons of Milorganite® per day. The remaining 40 tons was projected to be recycled to the treatment plant influent or leave the plant as fines and chaff (fine dry particulate matter that is too small and can not be made into Milorganite) for processing at an offsite facility.

Milorganite® Grades

Over the years, MMSD has found markets for several versions of Milorganite®. Currently, MMSD sells four different grades of Milorganite®:

- Milorganite® Classic 6-2-0 fertilizer
- Milorganite® 6-2-0 Greens Grade, which is a fine granule, dust-free fertilizer formulated for golf courses
- Milwaukee Biosolids, a grade produced for the Sunniland Corp., which formulates specialty fertilizer products, and Spring Valley Turf Products, which is also a fertilizer manufacturer. It is a screened Milorganite® Classic product that has separated the fine granules that are in the Greens Grade
- Nu-Gro (low iron material)

All four of these grades of Milorganite® are produced in the dewatering and drying facility. The MMSD used to produce a product called Blenders Grade consisting, in part, of reconstituted chaff and dust. Blenders Grade was discontinued in 2001 due to quality control and other concerns. Milwaukee Biosolids, established in 2002, is a product that does not necessarily meet the 6% minimum nitrogen and 4% iron guarantee of Milorganite® Classic, although the iron content is at least 3% iron. This product still meets the needs of various clients in the Wisconsin area.

As part of the Milorganite® production process, MMSD also generates off-specification product (product that does not meet the 6% nitrogen or 2% iron guarantees). At the time it is produced, off-spec product is not designated as Milorganite® or any other specifically marketed product. Off-spec product is either land applied or landfilled, depending on the market, time of year, and availability of agricultural land.

During initial operations of the dewatering and drying facility in 1994, Milorganite® production averaged about 150 tons per day. Recent production is substantially less as shown on Figure 4-12.(118,119) Background data used to develop this figure is provided in Appendix 4F, *MMSD Wastewater Treatment Plant Unit Process Analysis and Regulation Review*. Reasons for the drop in Milorganite production are varied but are generally associated with a reduction in wasteloads in the treatment plant influent.

Milorganite® Design Guidelines and Recommendation Review Summary

Evaluation of Milorganite® production and unit processes under current NR 110/204 regulations and advisory 10-States Standards indicates that all current design guidelines and recommendations are met.

South Shore Wastewater Treatment Plant Agri-Life® Evaluation

Agri-Life® is a Class B liquid biosolid applied as a soil conditioner to farmlands in southeastern Wisconsin. Because Agri-Life® is a Class B biosolid, there are certain limitations to its application. The SSWWTP unit processes that produce Agri-Life® are discussed below and reviewed in Table 4-17.(120,121,122,123,124,125) The Agri-Life® program also uses the plate and frame filter presses for the Agri-Life® cake, discussed further under the subsection *Land Application/ Landfill Program* (below). A more in-depth review of unit processes at SSWWTP that produce Milorganite® is included in Appendix 4F, *MMSD Wastewater Treatment Plant Unit Process Analysis and Regulation Review*.

Sludge Dissolved Air Floatation Thickening

Dissolved air floatation thickening is provided to thicken WAS prior to it being fed to the anaerobic digesters. Typically, most of the raw WAS from SSWWTP is pumped to JIWWTP for introduction into the Milorganite® production process. The remaining WAS is thickened in the air flotation units and pumped to the anaerobic digesters along with JIWWTP and SSWWTP primary sludge.

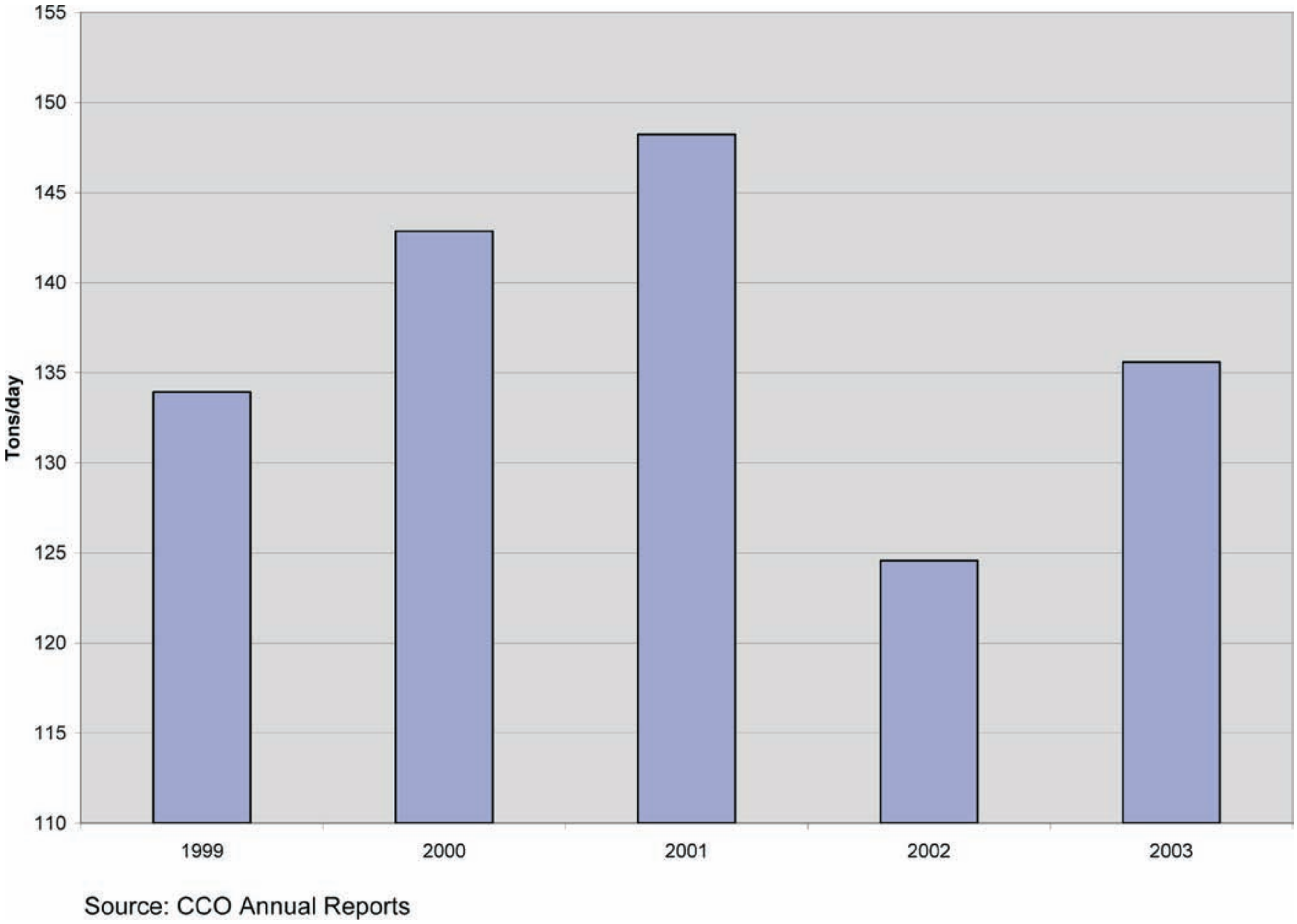

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FIGURE 4-12
MILORGANITE® PRODUCTION
2020 TREATMENT REPORT
5/21/07 TR_04.0012.07.05.21.cdr

Unit Process No.	Unit Process Title	Design Treatment Capacity		Specific Design Criteria	Actual Performance
		Total	Firm		
10	Sludge Thickening	7440 lb/hr TWAS – 675 GPM	6200 lb/hr TWAS – 450 GPM	• 6 dissolved air floatation thickeners at 1240 lb/hr each • 1240 sf surface area each • 6% thickened sludge (TWAS) solids concentration	• WAS Feed 2003 - Average Day – 150 GPM (1340 lb/d) - Maximum Day – 1160 GPM (11,800 lb/d) • TWAS Solids Concentration - Average Day – 3.8% - Maximum Day –6.3%
11	Anaerobic Digestion	265,000 lb (VS)/d	209,000 lb VS/d	• Six anaerobic digesters • Four North digesters – 3.2 MG each • Two South digesters – 1.2 MG each • Bubble cannon mixing on North digesters • Mechanical propeller mixing on South digesters	• Digester Feed 2003 - Average Day – 155,000 lb VS/d - Maximum Day –254,300 lb VS/d • Average Hydraulic Detention Time 2003 – 25.3 days
12	Centrifuge Thickening	1560 GPM	1170 GPM	• Four thickening centrifuges, 390 gpm each • 6 – 10% thickened sludge solids	• Centrifuge Feed 2003 - Average Day – 180 GPM (25 ton/d) - Max Day – 710 GPM (110 ton/d)
14	Filter Press Dewatering	• Feed – 3200 GPM • Cake Production – 66.3 ton/d	• Feed – 2000 GPM • Cake Production – 53 ton/d	• 5 Plate & Frame Presses – • 8 pumps, 400 GPM each – 3 pumps per pair of presses for four presses, 2 pumps for fifth press	• Filter Cake Total Production 2003 - 1570 Dry Tons

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TABLE 4-17 SHEET 1 OF 2
AGRI-LIFE® PROCESSES
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Unit Process No.	Unit Process Title	Design Treatment Capacity		Specific Design Criteria	Actual Performance
		Total	Firm		
20	Agri-Life® Storage	Storage: 9 MG	Storage: 7.5 MG	• Using old digesters converted to sludge storage – originally planned on converting all eight South digesters but only converted six • 1.5 MG storage for each digester	• Agri-Life® Storage 2003 - Average – 4.4 MG - Maximum – 7.3 MG • Agri-Life® Production 2003 - Average Day – 55,400 gpd - 5300 Total Dry Tons

MG = Million Gallons
WWTP = Wastewater Treatment Plant
TWAS = Thickened Waste Activated Sludge
lb/d = Pound Per Day
lb (VS)/d = Pound Volatile Solids Per Day
UWS = United Water Service
CCO = Contract Compliance Office

GPM = Gallons Per Minute
O&M = Operation and Maintenance
sf = Square Feet
lb/hr = Pound Per Hour
ton/d = Ton Per Day
DWOR = Daily/Weekly Operating Report

Source: South Shore O&M Manual, Individual O&M Manuals, 1999-2003 UWS DWORs and CCO Annual Reports (see Appendix 4F, MMSD WWTP Unit Process Analysis and Regulation Review for more specific sources)

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TABLE 4-17 SHEET 2 OF 2
AGRI-LIFE® PROCESSES
2020 TREATMENT REPORT

Anaerobic Digestion

Raw primary sludge from both SSWWTP and JIWWTP are treated in SSWWTP anaerobic digesters. Two of the original eight south digesters installed in the 1970s, along with the four north digesters installed in 1985, are used to treat all MMSD primary sludge along with some SSWWTP thickened WAS. The remaining six original digesters were converted to provide sludge storage.

Each of the four north anaerobic digesters has an effective volume (excluding allowance for grit and scum accumulation and freeboard) of approximately 3.2 million gallons. The two active south anaerobic digesters each have an effective volume of approximately 1.2 million gallons. A review of the anaerobic digesters, included in Appendix 4F, *MMSD WWTP Unit Process Analysis and Regulation Review* indicates that at current sludge production rates, the hydraulic detention time is longer than 20 days.

The digesters operate in parallel at mesophilic temperatures (approximately 95 degrees F). As a result, the digestion process is not listed as a *Process to Further Reduce Pathogens* under the USEPA Part 503 Biosolids Rule; therefore, it is not classified as a Class A biosolid. To qualify as a Class B biosolid, MMSD must monitor various indicator organisms. Through this monitoring, MMSD has maintained a Class B rating for their Agri-Life® biosolids.

Mixers combine the contents of each digester. Bubble cannon mixers are used in the four north digesters while mechanical propeller mixers are used in the two south digesters. For primary sludge only, volatile solids reduction is expected to be between 60 and 65% at 95 degrees F and an solids residence time (SRT) of 10-60 days.(126) At SSWWTP, the volatile solids reduction averaged between 50 and 55%, based on the limited analysis on volatile solids reduction in the digesters in 2003 included in Appendix 4G, *SSWWTP Volatile Solids Reduction Analysis*. The design average day SRT of SSWWTP digesters is 31 days.(127) Proper mixing is an important consideration in achieving optimum process performance; poor mixing could be the reason for the lower than expected conversion of volatile solids to digester gas.(128)

The digester gas is stored in a high-pressure sphere and then used for running aeration blower engines, generating electricity via an engine generator, and fueling the hot water boilers. A gas flare system is provided for excess gas and emergency operation. The gas flare system update was completed in early 2004.

In 2000, MMSD began accepting concentrated deicing fluid from the General Mitchell International Airport (GMIA) for treatment in the digesters.(129) This practice benefits both parties – GMIA is required to reduce the amount of deicing fluid being discharged to nearby streams, and deicing fluid increases the production of digester gas at SSWWTP. GMIA collects deicing fluid as it is used (typically December through April) and periodically trucks it to SSWWTP for storage on site. The deicing fluid is metered into the general digester feed lines and distributed to all active digesters. On average, the digesters treat over 200,000 gallons of deicing fluid per season.

Review of current NR 110 regulations and advisory 10-States Standards indicates that the design maximum volatile solids loading rate is greater than the current NR 110 requirement and advisory 10-States Standards recommendation. However, the operation of the digesters has changed tremendously since the design requirements were set forth in the South Shore O&M Manual, with almost half of the original digesters now being used for Agri-Life® storage. This issue is presented in more detail in Appendix 4F, *MMSD Wastewater Treatment Plant Unit Process Analysis and Regulation Review*. These findings are reviewed again in Chapter 5, *Treatment Assessment – Future Condition* and Chapter 8, *Common Treatment Facilities, Programs, Operational Improvements and Policies for the Recommended Plan* to determine if an issue exists.

Centrifuge Thickening

During the MWPAP facilities planning, sludge production at SSWWTP was projected to increase substantially. The increase never materialized and, as a result, the total centrifuge capacity has not been required. There were 10 centrifuges installed in 1988. There are only four centrifuges still in operation, each with a capacity of 390 gpm. These are used to thicken the digested sludge prior to being placed in sludge storage. The MMSD completed the SSWWTP Gravity Belt Thickeners Project in 2005, which installed a single gravity belt thickener with a capacity of 300 gpm. Due to concern regarding the reliability and maintenance of the centrifuges, this gravity belt thickener replaced one of the centrifuges and is used for most of the thickening activities.

Agri-Life® Storage

The thickened sludge is stored in six converted anaerobic digesters with a design total sludge storage volume of approximately 9 million gallons (MG). Review of 2003 data from the *UWS Storage Digester Inventory* provided by UWS, included in Appendix 4H, *UWS Storage Digester Inventory Review* indicate that the maximum storage was 7.3 MG. The 2003 average daily digester sludge production sent to the Agri-Life® program was approximately 55,400 gpd. If the sludge is properly managed, there is adequate capacity to provide more than six months of storage. If the sludge is not adequately thickened or there is a problem applying the sludge to farmland, the sludge storage volume can be limiting. A limit on sludge storage would require more filter cake production. A more detailed analysis of Agri-Life® Storage is included Appendix 4F, *MMSD Wastewater Treatment Plant Unit Process Analysis and Regulation Review.*

The sludge in the storage tanks is not mixed, so sludge tends to stratify within the tank. The thicker bottom sludge can ultimately become too thick to pump.

Agri-Life® Design Guidelines and Recommendation Review Summary

Evaluation of Agri-Life® production and all of the other unit processes besides Anaerobic Digestion under current NR 110/204 regulations and advisory 10-States Standards indicates that all other current design guidelines and recommendations are met.

Land Application/ Landfill Program

The SSWWTP has five plate and frame filter presses capable of processing 66 tons per day of biosolids in its filter press dewatering unit process. The plate and frame filter presses were installed in the late 1980s to landfill biosolids, but were rarely used until the last few years due to the high cost of landfilling. At the beginning of the UWS contract, a portion of the filter cake was provided to WE Energies for their Lightweight Aggregate Program (which was classified as Minergy in MMSD documents). The Minergy practice was discontinued by WE Energies in early 2001. Now, the plate and frame filter presses are being used to produce a cake that is applied to farmland as part of the Agri-Life® program. In 2003, approximately 1,600 dry tons of solids were processed through the plate and frame presses; all solids were land applied.

The filter presses receive digested sludge from the sludge storage tanks. The feed sludge averages around 6% solids. The filter cake averages around 32% solids. Chemical addition includes polymer used in the dewatering process, though capabilities exist to add either lime or ferric to the plate and frame feed. A cake storage building, with a capacity to store approximately 4,400 cubic yards of filter cake, is located adjacent to the filter press building to allow temporary storage of the filter cake prior to its delivery to farmland or landfill.(130,131) A more in-depth review of the filter presses at SSWWTP is included in Appendix 4F, *MMSD Wastewater Treatment Plant Unit Process Analysis and Regulation Review*.

Landfill of filter cake is an option; however, it is used only as a last resort due to the high cost of landfill.

Other Solids Disposal

The remaining solids at JIWWTP and SSWWTP that require disposal include scum, grit, screening, and chaff. At both treatment plants, the solids that are removed are dumped in luggers and disposed of by Waste Management. Currently, UWS uses chaff as needed to assist in dewatering the wet debris that is collected during catch basin and sewer cleaning and brought to JIWWTP by local municipalities and contractors. The wet debris must be dewatered to meet landfill dewatering requirements before disposal in the luggers.

The landfill operator, Waste Management, has indicated that the disposal of dry chaff is a potential issue for them. They noted that the dust created from handling the chaff is causing an air quality issue as it is disposed at the landfill. Due to these air emissions issues, landfill operators may limit the amount of chaff allowed in the waste disposed by the MMSD in the future.(132) It should be noted that chaff is considered an insignificant air emissions source at JIWWTP.

Interplant Solids Pumping

As discussed previously, interplant solids pumping interconnects the biosolids handling at JIWWTP and SSWWTP to maximize Milorganite® production. The process includes four pipelines that run between the two plants (two that are 12-inch in diameter and two that are 14-inch in diameter), interplant solids pumps, and receiving tanks. Milorganite® production was to be 70% WAS and 30% primary sludge by dry solids weight to meet proper nutrient values.(133) Since JIWWTP was expected to generate equal amounts of primary sludge and WAS, excess JIWWTP primary sludge was to be pumped to SSWWTP for digestion and additional SSWWTP WAS was to be pumped to JIWWTP for Milorganite® production. In addition, excess JIWWTP WAS during high wastewater loadings and inline solids removed at ISHF during wet weather events were to be pumped intermittently to SSWWTP. However, the current operation involves pumping most of JIWWTP primary sludge to SSWWTP to be digested, and pumping most of SSWWTP WAS and over half of the digester sludge to JIWWTP for Milorganite® production. Since ISHF has rarely been used, no inline solids have been pumped to SSWWTP. Table 4-18 shows the interplant solids processing system at each plant.(134,135) A more in-depth review of the interplant solids pumping processes is included in Appendix 4F, *MMSD Wastewater Treatment Plant Unit Process Analysis and Regulation Review*.

TABLE 4-18
INTERPLANT SOLIDS PUMPING

No.	Unit Process	Design Pumping	Treatment Capacity	Specific Design Criteria	Actual Performance
		Total	Firm		
13 at both JIWWTP & SSWWTP	Interplant Solids Pumping	JIWWTP: 6000 GPM SSWWTP: 3,480 GPM	JIWWTP: 4000 GPM SSWWTP: 2,320 GPM	• Three 2-stage pairs of pumps, 2000 GPM each at JI, 1,160 GPM at SS • 4 Interplant Solids Pipes between plants: #1 & #4, 14-inch, #2&3, 12-inch • JIWWTP Primary Sludge to SSWWTP • SSWWTP WAS & Digested Sludge to JIWWTP	**TO SSWWTP**: • Primary Sludge Pumped, 2003: Average Day: 190 GPM, Maximum Day: 360 GPM **FROM SSWWTP**: • WAS Pumped, 2003: Average Day: 590 GPM, Maximum Day: 1,320 GPM • Digested Sludge Pumped, 2003: Average Day: 250 GPM, Maximum Day: 500 GPM

GPM = Gallons per Minute
JIWWTP = Jones Island Wastewater Treatment Plant
WAS = Waste Activated Sludge
SSWWTP = South Shore Wastewater Treatment Plant

Source: Jones Island O&M Manual, South Shore O&M Manual

4.2.5 Air Emissions Evaluation

The air emissions at SSWWTP and JIWWTP are regulated under WDNR air pollution control operation permits. Both treatment plants are classified as Part-70 Sources (or Title V), which defines them as major sources of air pollution emissions. Before the Title V permits were issued at the end of 2004, individual emission sources at the plants were regulated by separate construction/operating air pollution control permits. The operation permits established requirements and conditions of operation for each of the emission sources at the treatment plants. In addition, the permits identified regulated pollutants, emission limitations and compliance demonstration requirements. The MMSD reports its emissions from the emission sources at each treatment plant in annual *Air Emission Inventory Summary Reports* for each treatment plant. The MMSD submits semi-annual monitoring reports according to the compliance demonstration and monitoring requirements specified by the permits and annual certification of compliance with the requirements of the permit for each treatment plant.

The permits that were in effect during the existing condition review period are listed below:(136)

- Jones Island Wastewater Treatment Plant:
  - 96-VAR-221 Dewatering & Drying Facility
  - 96-DJH-211 Boilers
  - 96-RV-088 Dewatering & Drying construction permit revision
  - 96-RV-088R1 Dewatering & Drying construction permit revision
  - 96-RV-088-OP Dewatering & Drying operation permit

- South Shore Wastewater Treatment Plant:
  - 96-DJH-272 Engine Generator
  - 02-JSB-286 Flares

In addition, there was a construction permit for SSWWTP boilers.

As mentioned above, these permits were superseded by the respective Title V permits issued at the end of 2004 for both treatment plants. The Title V permits will be discussed in Chapter 5.

4.3 Treatment Systems Operations Documentation

4.3.1 Operator - United Water Services

United Water Services has been the contracted operator of MMSD treatment plants and conveyance system since 1998. According to the contract with the MMSD, which expires on February 29, 2008, UWS is responsible for the maintenance and operation of the treatment plants, the conveyance system - including the ISS, and some watercourse maintenance. The MMSD still maintains the water quality testing laboratory, industrial pretreatment program, the capital improvements program, and Milorganite® marketing. This report only reviews treatment operations, including the operation of the ISS Pump Station. The contract also establishes weekly, monthly, and annual average effluent standards that UWS must meet. Some of these standards are more stringent than the WPDES permit limits, as shown in Table 4-19.(137,138) Under the contract, UWS receives separate year-end bonuses or penalties if effluent BOD and TSS parameters are less or more than specified values for the entire year. These values are also shown in Table 4-19.

United Water Services is also contracted to produce Milorganite® and Agri-Life®, which is discussed in more detail in Section 4.3.4, *Biosolids Operations*.

TABLE 4-19
UNITED WATER SERVICES CONTRACT EFFLUENT LIMITS COMPARED TO WISCONSIN DEPARTMENT OF NATURAL RESOURCES PERMIT EFFLUENT LIMITS

Constituent	Bonus Limit (Less than)	Penalty Threshold (Greater than)	Contract Limit (Greater than)	Permit Limit (Greater than)
Biochemical oxygen Demand (BOD)	9 mg/L[3]	13 mg/L[3]	15 mg/L[2], 45 mg/L[1]	30 mg/L[2], 45 mg/L[1]
Total Suspended Solids (TSS)	8 mg/L[3]	13 mg/L[3]	15 mg/L[2], 45 mg/L[1]	30 mg/L[2], 45 mg/L[1]
Total Phosphorus	None	None	1 mg/L at SSWWTP 0.5 mg/L at JIWWTP[2]	1.0 mg/L[2]
Fecal Coliform	None	None	100 units/100 mL[3]	400 units/ 100 mL[4]
Nitrogen, Ammonia (NH_3-N) Total	None	None	SSWWTP – Variable[5] JIWWTP - None	SSWWTP – Variable[5] JIWWTP - None

1) Weekly average
2) Monthly average
3) Annual average
4) Geometric mean
5) Variable weekly average during the months of June through September based on the month and the pH

Source: CCO Monthly Reports, Mayor's Independent MMSD Audit Committee Final Report, MMSD 2003 WPDES permit

4.3.2 Inline Storage System Pump Station Operation

The ISS Pump Station, in operation since 1994, removes flow from the ISS. The ISS is critical in maximizing storage during wet weather events. The pump station was designed to allow operators to decide to which plant the flow is pumped. As discussed in Section 4.2.3, *Treatment Plant Unit Process Evaluation* under the subsection, *Unit Process No. PS0801: ISS Pump Station,* the number of pumps that deliver flow to each treatment plant depends on the capacity of JIWWTP and the capacity of the conveyance system at the point where the SSWWTP force main discharges the ISS flow.(139) During non-storm time periods, the tunnel remains empty in preparation for a wet weather event, so the ISS Pump Station is used to pump out all dry weather tunnel infiltration on a frequent basis.

4.3.3 In-Plant Diversion Structure Operation

In the review of diversions at the treatment plants, an in-plant diversion is defined as the actual physical structure that allows wastewater to be diverted around some of the treatment processes. Blending is defined in this review as the act of diverting some wastewater through an in-plant diversion during a wet weather event as part of a wet weather peak flow management plan.

Jones Island Wastewater Treatment Plant In-Plant Diversions

The use of the in-plant diversions at JIWWTP was regulated for the first time in the most current WPDES permit issued by the WDNR in April 2003. The permit requires that all flow, including the flow diverted around secondary treatment, receive treatment equivalent to primary treatment and disinfection before discharge. (See Appendix 6A in Chapter 6, *Wastewater Treatment Plant (WWTP) Permits* for the 2003 WPDES permit.)

There are five potential in-plant diversion locations at JIWWTP.(140) These diversion structures are listed in Table 4-20. At JIWWTP, only the ISS pumpout (ISS) and primary effluent (partial) (PE) diversions are used for blending.(141) The ISS diversion delivers wastewater pumped from the ISS Pump Station directly to the disinfection process and does not receive conventional primary treatment. The wastewater pumped from the ISS Pump Station can be characterized as equivalent to wastewater receiving conventional primary treatment. The maximum allowable wet weather diversion capacity set in the permit is 60 MGD. The permit also requires that the WDNR be notified of all blending events. The other three diversions listed in Table 4-20 are only used in emergency situations.

The decision to allow an in-plant diversion at JIWWTP is based on the conditions at JIWWTP and SSWWTP and is made in collaboration between MMSD and UWS.(142) Different conditions at JIWWTP may result in a PE or an ISS in-plant diversion:

- Primary Effluent Diversion: A PE diversion could occur when flow to secondary treatment is greater than allowable capacity and there is an urgent need to process flow through the plant. When secondary capacity is exceeded, the sludge blanket in the secondary treatment system begins to rise. When the sludge blanket rises, biosolids may wash out of the system and discharge into the effluent. UWS uses a plant capacity calculation, also called the solids flux model, combined with visual observations of secondary clarifier blankets, turbidity meter readings, and channel heights to determine when to blend.(143)
- Inline Storage System Diversion: An ISS diversion could occur when flow exceeds primary clarifier capacity and other system conditions indicate a need for diversion.(144)

South Shore Wastewater Treatment Plant In-Plant Diversions

The 2003 WPDES permit does not allow in-plant diversion at SSWWTP for wet weather peak flow management because the peak capacities of the primary and secondary unit processes are both 300 MGD; therefore, no additional wastewater could be processed through primary treatment and diverted around secondary treatment to the disinfection unit process.

There are three potential emergency diversion locations, which are listed in Table 4-21.(145,146) In-plant diversions that occurred at SSWWTP prior to 2003 during very high flow conditions used the primary effluent to disinfection diversion, which diverted flow from primary treatment through a channel that runs along the east side of the aeration basins and in between the secondary clarifiers to the chlorine contact basins (shown on Figure 2-4 in Chapter 2, *Description of Treatment Facilities*). However, MMSD/UWS in-plant diversion records indicate that blending rarely occurred at SSWWTP before the permit restricted such diversions.

TABLE 4-20
JONES ISLAND WASTEWATER TREATMENT PLANT DIVERSION POINTS

No.	In-plant Diversion	Capacity (MGD)	Location
1	ISS Pumpout (ISS)	100	From ISS Pumpout Line to Disinfection Basin/ Effluent Pumping Facilities
2	Primary Effluent (partial) (PE)	145	From Diversion Box in Primary Effluent Channel to Disinfection Basin/ Effluent Pumping Facilities
3	High-Level	110	From High-Level Wet Well to Disinfection Basin/ Effluent Pumping Facilities
4	Primary Effluent (complete)	330	From East Plant Mixed Liquor Channel to Disinfection Basin/ Effluent Pumping Facilities
5	Secondary Effluent/ In-Plant Diversion Channel	330	Secondary Effluent Junction Box/ Inline Flow System (In-plant Diversion Channel) to Effluent Pumping Facilities, Bypassing Disinfection System

Source: Jones Island O&M Manual

TABLE 4-21
SOUTH SHORE WASTEWATER TREATMENT PLANT DIVERSION POINTS

No.	In-plant Diversion	Capacity (MGD)	Location
1	Preliminary Treatment	300	From Influent Channel to Preliminary Treatment to Battery No. 1 Primary Clarifiers
2	Primary Effluent to Disinfection	300	From Primary Clarifiers to Chlorine Contact Basin
3	Primary Effluent to Plant Effluent	300	From Primary Clarifiers to Plant Effluent Conduit

Source: South Shore O&M Manual, SSWWTP Advanced Facility Plan

4.3.4 Biosolids Operation

Under its contract, UWS is responsible for the production of Milorganite®, Agri-Life®, and variations of these products. The *Operations & Maintenance* contract requires UWS to meet the yearly MMSD requested tonnage of Milorganite® products. UWS is also responsible for the disposal of any product produced over and above the volume requested, provided the range of production is between 45,000-60,000 tons. According to the contract, UWS is only responsible for maintaining a viable Agri-Life® program; no yearly volume requests are made. The Agri-Life® program is active in numerous townships within Racine, Kenosha, Walworth, and Waukesha Counties, and has also made some applications in Washington, Jefferson and Dodge Counties since the commencement of the contract in 1998. The program includes the land application of filter cake as well as Agri-Life®.

4.3.5 Energy Operation

The principal sources of energy at the two plants are as follows:

Jones Island Wastewater Treatment Plant

- Natural Gas
- Electricity
- Fuel Oil
- Propane

South Shore Wastewater Treatment Plant

- Electricity
- Digester Gas
- Natural Gas

Jones Island Wastewater Treatment Plant

Natural Gas

Natural gas is used primarily for onsite turbine power generation. Natural gas can also be used for hot water heating, sludge drying, and building heat. The natural gas supply is classified as interruptible, which means that the gas supply can be cut off if there is a shortage in the area. Interruption of the natural gas supply is a rare occurrence.

Prior to the start of each month, the supervisor predicts the quantity of natural gas that will be used during the next month (called gas nominations). UWS will pay for gas according to these gas nominations, regardless of whether the predicted amount is used or not. There are penalties if the actual gas use surpasses the monthly gas nomination by more that 3.5%.

Turbine power generation is relatively stable, which makes the gas nomination practice relatively reliable. A turbine failure or the need to operate biosolids dryers on natural gas can significantly impact the gas nomination practice.

Electricity

As previously discussed, the electrical power required to operate JIWWTP is typically generated on site; though, the plant is also connected to WE Energies at the Harbor and the Dewey substations. The power supply to each of the substations operates at a different phase, so the two substations cannot be interconnected.

A single turbine cannot provide sufficient power to start a process air compressor or an inline storage system pump. When starting either of these pieces of equipment, a turbine must be in operation and the plant must be connected to either the Dewey or the Harbor substation.

The JIWWTP electrical bill has five components (all charges are as of the end of the review period, June 2004, and are subject to change)(147):

1) Facilities charge: This charge is $525.00/month and is fixed regardless of power generation strategy. There are no operational strategies to alter this cost.
2) Customer charge: This charge is $110.00/month and is fixed regardless of power generation strategy. There are no operational strategies to alter this cost.
3) Energy charges*: This is the rate for electrical use in kilowatt-hours (kWh). The rate for on-peak power is $0.0453/kWh and for off-peak it is $0.02226/kWh.
4) On-peak demand charge*: This charge is applied to the peak power use during the on-peak power period. The charge is applied on a monthly basis for the peak power used during that billing month. The on-peak power demand charge is $9.50/kW.
5) Customer demand charge*: This charge is applied to the peak power use during any 15-minute period (whether on-peak or off-peak). The charge is on a monthly basis but looks back over the previous 11 months and applies the charge to the peak power used during the last 12 months. The customer demand charge is $0.76/kW.

* These values include current fuel cost and transmission surcharges.

Peak hours are from 10:00 AM to 10:00 PM, Monday through Friday, except for the electric utility designated holidays. During these peak hour periods, plant operations minimize the amount of energy purchased from WE Energies. (148,149)

The selection of how much power to generate and how much to purchase depends on a number of variables including:

- What time of the month it is – UWS is more likely to take a demand charge earlier in the month when they have an opportunity to recover the expense through lower operating costs (it costs less to purchase electricity than it does to generate it). Later in the month, they are more likely to generate power to avoid the demand charge.
- Whether the plant is in on-peak or off-peak hours.
- Whether a demand charge has occurred already in the current month.
- How much waste heat is required by the dryers.
- The required waste heat temperature. (150,151)

Fuel Oil

Fuel oil is used as an alternative to natural gas for powering the turbine generators. The selection between fuel oil and natural gas is based primarily on economics (i.e., whichever is a lower cost per unit of energy). Typically natural gas has a lower cost and is the fuel of choice. In addition, fuel oil must be trucked to the treatment plants and on-site storage is limited to less than 24 hours of operation.

Propane

Propane is used as a backup to natural gas for building heat. The propane system is seldom used and does not represent a significant portion of the plant energy.

South Shore Wastewater Treatment Plant

Digester Gas

Digester gas is a byproduct of the anaerobic sludge digestion process. Primary sludge from both treatment plants and a portion of the thickened WAS from SSWWTP are processed in the digesters at SSWWTP. The quantity of the digester gas produced is dependent on the quantity of primary sludge processed: the more sludge that is processed, the greater the quantity of digester gas produced. Digester gas is typically about 65-70% methane and 25-30% carbon dioxide and small amounts of other gases.(152) Digester gas has a heat value of about 600 BTU per cubic foot compared to natural gas, which has a heat value of about 1,000 BTU per cubic foot.

Digester gas is used to drive the aeration blower engines. In the summer months, three blower engines are required to meet treatment plant aeration needs while two blowers are sufficient during the rest of the year. Typically, enough digester gas is produced to drive all three blowers with a small amount of additional digester gas available for electrical generation, even during the summer months. However, all of the primary sludge from both treatment plants must be digested to accomplish this level of digester gas production.(153,154)

In addition to the blower engines, digester gas can be used to generate hot water for building heat and to heat the anaerobic digesters. The digester gas can also be used for the generation of some electrical power through the engine generator. Usually, there is excess digester gas that is not required for the blower engines or for generating hot water. This excess gas is used to generate some electricity. The goal of the engine generator is to reduce the on-peak electrical demand charge (peak shaving). To accomplish this goal, the engine generator is operated five days a week during the on-peak hours of each month. Excess digester gas is stored in a sphere until it is needed in the engine generator to produce power.(155,156,157)

Electricity

The SSWWTP receives its electricity from two separate power supplies. Both power supplies are identical and come from a common substation within the electric utility grid. The SSWWTP electric bill has the same five components as the JIWWTP electric bill described above.

4.4 <u>Treatment Systems Policies / Programs Documentation</u>

4.4.1 Industrial Pretreatment

The Industrial Waste Pretreatment Program is monitored and regulated in accord with Chapter 11 of the *MMSD Rules*.(158) The pretreatment program establishes pretreatment requirements that aim to reduce the pollutant load in the wastewater before it is introduced to the sewer system and delivered to the treatment plants. The pretreatment program aims to, among other objectives, prevent the discharge of pollutants that could damage sewers or treatment plants and avoid violations of the MMSD's discharge limits from the treatment plants.(159) The MMSD pretreatment program reached its twentieth anniversary in 2004.

4.4.2 Household Hazardous Waste

The Household Hazardous Waste collection program was established in 1996 in conjunction with the Intergovernmental Cooperation Council, a special committee made up of Milwaukee County municipal leaders, to fulfill the public need for proper household hazardous waste collection and disposal. The primary goal of the program is to alleviate public health concerns, as well as environmental and safety concerns associated with the improper disposal of household hazardous materials.(160) Homeowners routinely drop off items including oil-based and latex paints, flammables such as varnish remover and gasoline, poisons such as antifreeze and mothballs, and various materials containing asbestos, polychlorinated biphenyls (PCBs), dioxins, and mercury.

Household hazardous wastes are collected in one of two ways: 1) Through the Household Hazardous Waste Mobile Site Collection program, which travels throughout Milwaukee County between April and October, and 2) At three permanent collection facilities: W124 N9451 Boundary Road, Menomonee Falls; 10518 S. 124th St., Franklin; and a self-help station at 3879 W. Lincoln Ave., Milwaukee (last facility added in 2006). The MMSD contracts with Veolia Environmental Services (formerly Onyx Environmental Services) to operate the mobile collection program and the first two permanent facilities.

A significant number of residents (10,914) brought 945,081 pounds of household hazardous wastes to 11 mobile collections and the two permanent collection facilities in 2002.(161) While about three-fourths of the total pounds collected were discarded paints, large volumes of hazardous materials were also collected. Those hazardous materials included:

- 90,216 pounds of products containing poisons (i.e., antifreeze, mothballs)
- 19,039 pounds of asbestos (some types of insulation, floor tiles, fireproofing materials)
- 10,020 pounds of corrosives (pool chemicals, oven cleaners, drain cleaners)
- 5,543 pounds of PCB containing materials (light ballasts, some marine paints, capacitors)
- 1,387 pounds of dioxins (wood preservatives, weed killers)
- 158 pounds of mercury (thermometers, thermostats)

About 4.3 million pounds of household hazardous materials have been collected at the mobile and permanent collection sites between 1997, the program's first full year of operation, and 2003. Of the total pounds collected each year, about half gets recycled or reclaimed, one-third is incinerated, and the remainder is landfilled.(162)

4.5 Treatment System Performance Review and Analysis

4.5.1 Review of Wet Weather Events

Wet weather events were analyzed from 1997-2004. Documentation of daily flow data and tunnel pumping records was difficult to obtain before 1997. In addition, only three storms occurred in 1994-1996 that resulted in both combined sewer overflow (CSO) or separate sewer overflow (SSO) events. The documentation reviewed included the available storm event reports (included in Appendix 4B, *Storm Event Summary Data*), available rain event data (included in Appendix 4I, *Rain Event Summary Master Spreadsheet Information*), review of largest CSO and SSO event information as reported to the WDNR (included in *Top CSO/SSO Events* under Appendix 4J, *Wet Weather Events Analysis*), UWS monthly reports, MMSD Contract Compliance Office (CCO) monthly reports, and DMRs.(163,164,165) The detailed analyses of the documentation listed above are included in Appendix 4J, *Wet Weather Events Analysis*.

The performance of the treatment plants for 14 wet weather events was evaluated. Three events were chosen for more detailed analysis (The letter identification for each of events corresponds with the letters assigned in Appendix 4J, *Wet Weather Events Analysis*, under the subsection, *Wet Weather Events Identified for In-depth Analysis*.)

1) Event B: August 1998
2) Event H: May 2000
3) Event I: September 2000

In each of these events, CSOs and SSOs occurred on days when the total flow through each of the treatment plants did not appear to reach the maximum day design capacity based on the daily flows reported in the DMRs.(166) Event N, May 2004, was also a major event but is not reviewed here since it was analyzed in great detail in the *Mayor's Independent MMSD Audit Committee Final Report*.(167)

The evaluations that follow are presented in graphical form and include hourly rainfall, treatment plant flow, ISS Pump Station pumping rate, and daily CSO and SSO volumes. The data used to develop these evaluations and the conclusions discussed are included in Appendix 4J, *Wet Weather Events Analysis*. The separate sewer and combined sewer gates indicated on the graphs represent the separate sewer and combined sewer gates to the tunnel. The CS gates close when the tunnel reaches a predetermined volume, with a reserve for the separate sewer flow. The SS gates close when the tunnel is full. The three events are shown on Figures 4-13 through 4-15.

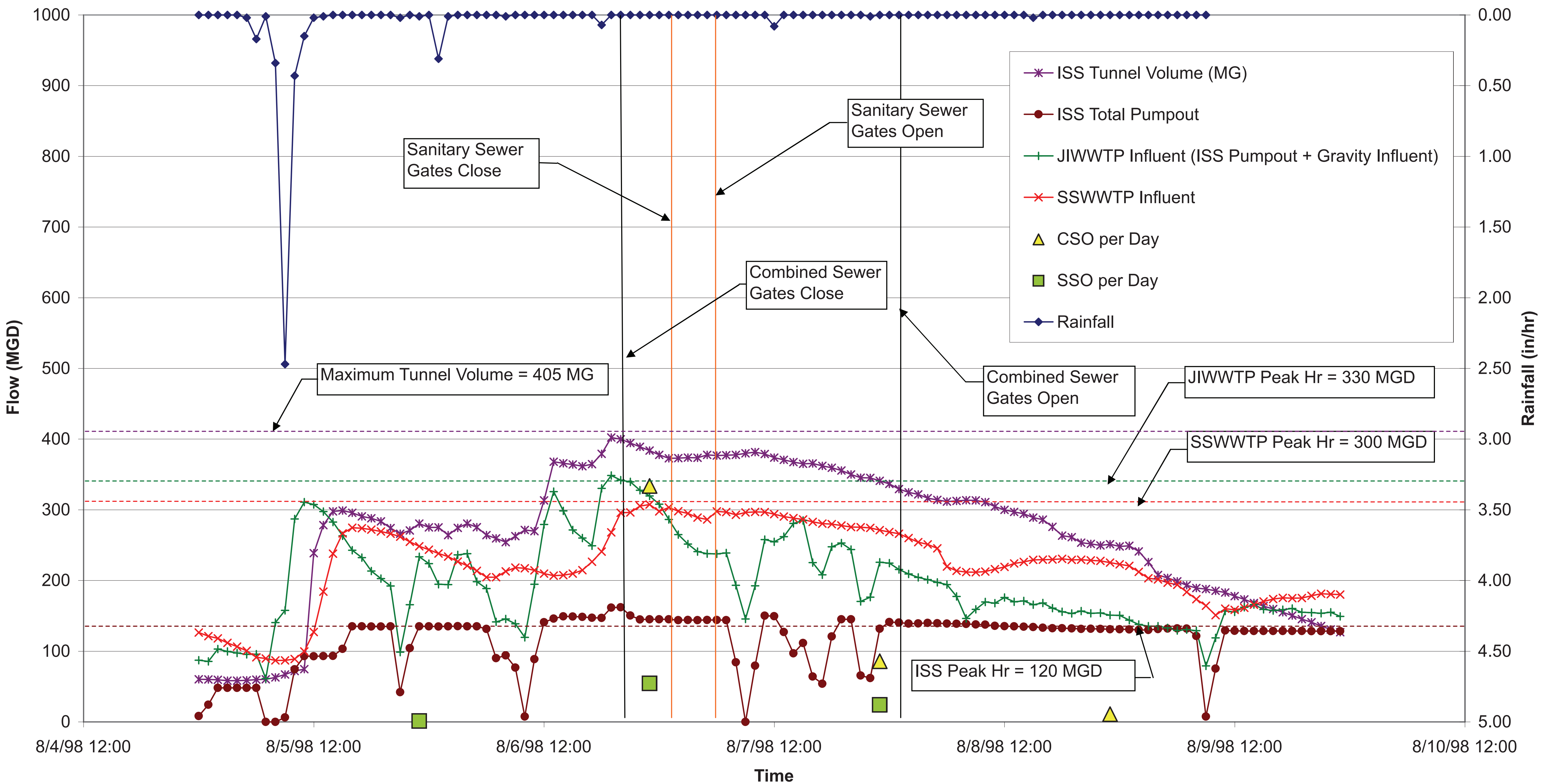
Event B Analysis

The August 4-10, 1998 wet weather event shown in Figure 4-13 was an intense rainfall event occurring in a short period of time.(168,169) In addition, a power outage occurred at JIWWTP. The in-plant diversion at JIWWTP was a 21 MG ISS diversion. The storm event included reported CSOs and SSOs to the WDNR.

Review of the storm indicates that ISS pumpout reached its full capacity of 120 MGD 12 hours into the event. The ISS Pump Station maintained its full pumpout capacity, except for a few brief interruptions, until the tunnel volume was reduced to 100 MG. Incoming flows to both treatment plants did not each reach peak hourly design capacity until hours later and only sustained that flow for a few subsequent hours.

Event H Analysis

The May 17-24, 2000 wet weather event shown in Figure 4-14 occurred during the second wettest May on record at the time. The rainfall was not as intense as that of Event B, but it was sustained over a period of 24 hours. The ISS diversion, which extended from late on May 17th through May 19th, was 100 MG - the largest diversion on record at JIWWTP. The SSWWTP was under construction, but reached peak hourly design capacity during the event. The wet weather event included some of the largest total CSO and SSO volumes reported to the WDNR during the time period reviewed.



Source: MMSD Storm Event Reports, Reported CSO and SSO Data (see Appendices 4B, Storm Event Summary Data, and 4J, Wet Weather Events Analysis, for more specific sources)

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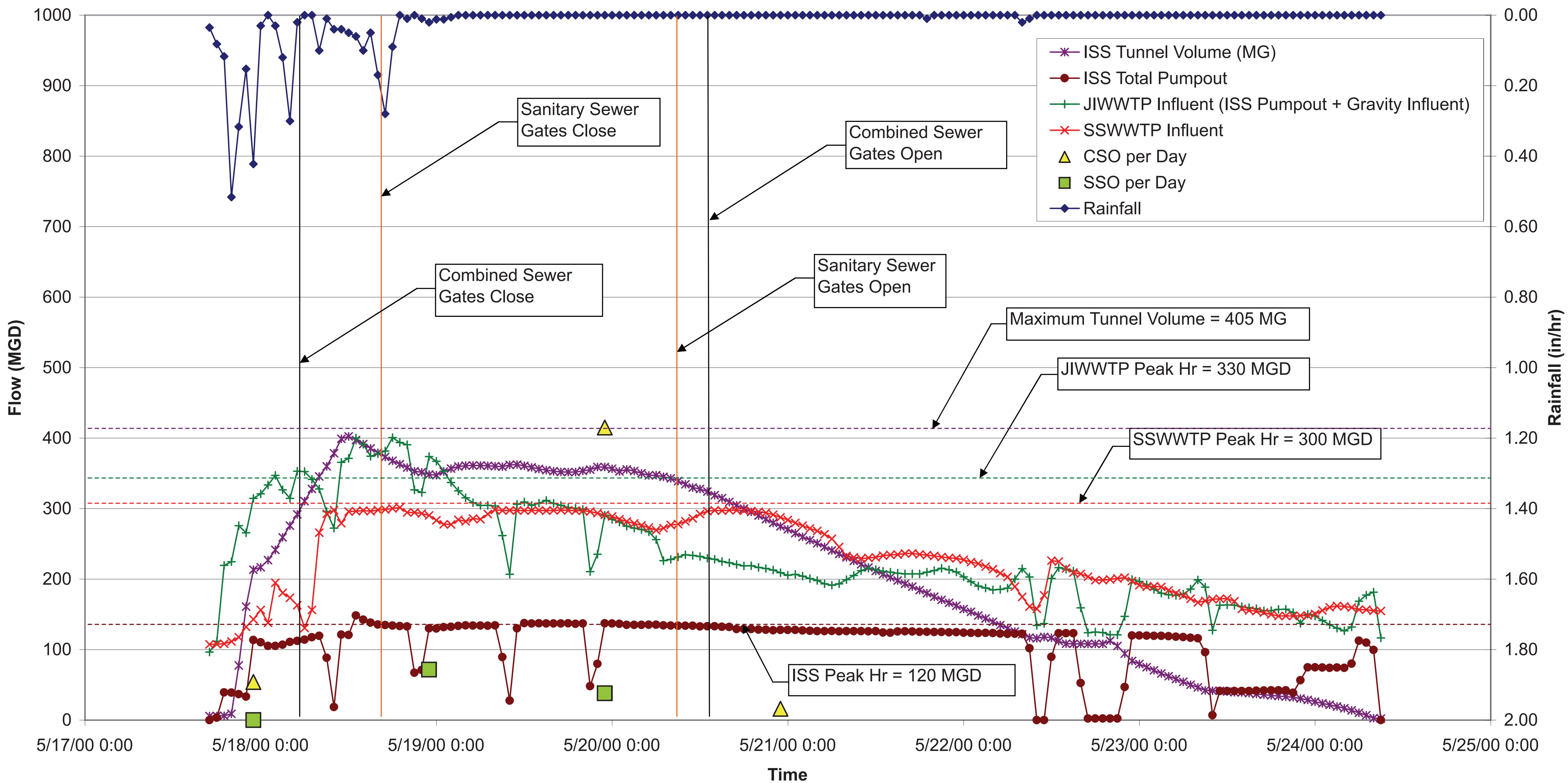
FIGURE 4-13
IN-DEPTH ANALYSIS: EVENT B, AUGUST 1998
2020 TREATMENT REPORT
5/21/07 TR_04.0013.07.05.21.cdr



Source: MMSD Storm Event Reports, Reported CSO and SSO Data (see Appendices 4B, Storm Event Summary Data, and 4J, Wet Weather Events Analysis, for more specific sources)

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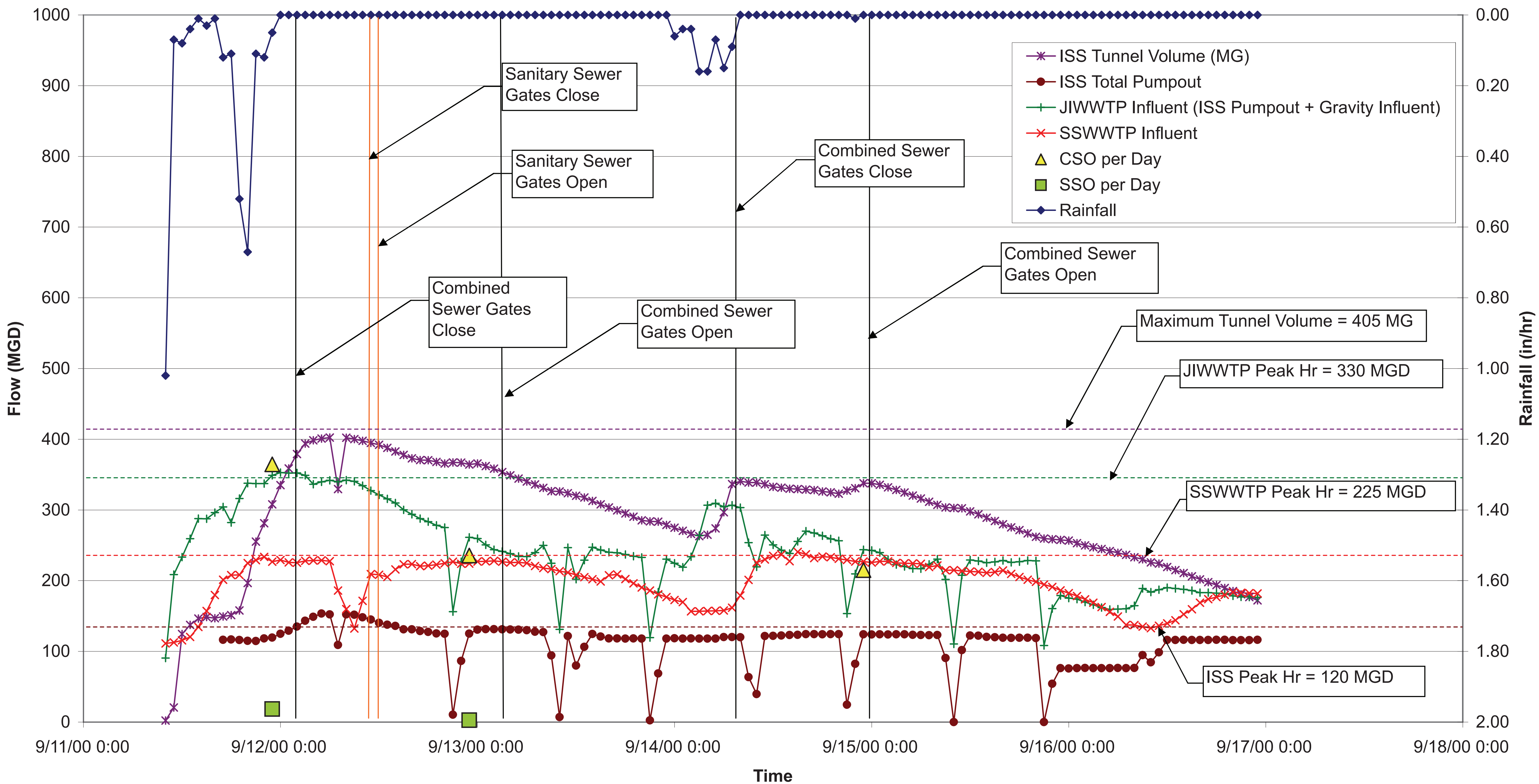
FIGURE 4-14
IN-DEPTH ANALYSIS: EVENT H, MAY 2000
2020 TREATMENT REPORT
5/21/07 TR_04.0014.07.05.21.cdr



Source: MMSD Storm Event Reports, Reported CSO and SSO Data (see Appendices 4B, Storm Event Summary Data, and 4J, Wet Weather Events Analysis, for more specific sources)

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FIGURE 4-15
IN-DEPTH ANALYSIS: EVENT I, SEPT. 2000
2020 TREATMENT REPORT
5/21/07 TR_04.0015.07.05.21.cdr

The hourly data indicates that during the peak hours of the event both treatment plants were at or exceeding peak hourly design capacity. Therefore, a conclusion was reached that the treatment plants were operating to capacity during the event.

Event I Analysis

The September 11-18, 2000 wet weather event shown in Figure 4-15 included two intense peaks of rain within 10 hours as well as another rainfall event two days later. The reported in-plant diversion at JIWWTP was an ISS diversion of 35 MG. The SSWWTP was under construction and never treated more than 240 MGD of flow. The combined sewer gates closed twice during the event. The event resulted in reported CSOs and SSOs to the WDNR.

The JIWWTP reached peak hourly design capacity at the beginning of the storm but tapered off as the flows from the initial rain event receded. The SSWWTP capacity was limited by construction at the plant, and ISS pumpout was at maximum capacity. From reviewing Figure 4-15, a conclusion was reached that JIWWTP could have processed more flow from the tunnel as the gravity flow receded if the ISS Pump Station had more capacity.

The review of these wet weather events seem to indicate that the capacity of the ISS Pump Station limited the use of available JIWWTP treatment capacity. The peak gravity flow to JIWWTP of 260 MGD was only achieved when the tunnel was full and all gates to the ISS were closed. It also appears that the ISS Pump Station pumps have failed at times for various reasons during wet weather events. The ISS Pump Station can pump out approximately 120 MG per day. The peak pumping capacity results in a full tunnel pump out of about 3.5 days (405 MG divided by 120 MGD). If a second wet weather event were to occur before the tunnel was emptied as happened in Event I, the tunnel would be limited to less than its full storage volume, thus creating a higher potential for CSOs and SSOs. Note that after the committed CMIS Harbor Siphons Project is complete, the flow that can reach JIWWTP by gravity will increase significantly, allowing more storage capacity to be available in the ISS during wet weather events. The effects of this project are discussed in more detail in Chapter 5, *Treatment Assessment – Future Condition*.

The *Wet Weather Flow Optimization* study also analyzed both treatment plants to identify hydraulic and treatment capacity restrictions.(170) The study determined that the unit processes with the most restrictions at JIWWTP are the primary treatment process, which has a number of performance issues during wet weather conditions, and the secondary clarifiers, which had less than 300 MGD total capacity during peak flow conditions. The study stated that the rest of the unit processes are capable of treating 330 MGD or greater. The secondary clarifier capacity has increased with the completion of the JIWWTP Phase 1 Wet Weather Secondary Capacity Improvements Project, but the actual capacity is unknown without a re-rating study. The limited capacity in the primary and secondary clarifiers may signify that the effluent quality declined during peak wastewater flow conditions at JIWWTP; this possibility is examined in more detail in Section 4.5.2, *Blending*, under the subsection, *Effluent Quality Limits.* At the time of the *Wet Weather Flow Optimization* study, the preliminary and primary treatment processes limited SSWWTP treatment capacity.(171) Completed projects on both primary and secondary unit processes have increased SSWWTP back to design peak flow. The SSWWTP continues to be able to fully process the wastewater at peak flow conditions.

4.5.2 Blending

Historical Blending Usage

In the past, blending was unregulated, so long as final effluent limitations were met. Current discharge permit terms now restrict the use of blending (referred to as in-plant diversions in the WPDES permit) for wet weather flow management. Table 4-22 estimates the total blending volume at each plant, broken down by ISS and PE diversions (described in Table 4-20, *JIWWTP Diversions*). Note that diverted flow was historically not metered, so all values listed in this table are estimates. Also, 2004 data only includes blending through June 2004.

TABLE 4-22
SUMMARY OF ESTIMATED BLENDING 1997-2004

	JIWWTP		SSWWTP
Year	**ISS (MG)**	**PE (MG)**	**PE (MG)**
1997	17	0	50
1998	54	0	0
1999	267	0	0
2000	186	0	0
2001	54	50	0
2002	75	88	34
2003	0	36	0
2004 (partial)	0	27	0
TOTAL	**653**	**201**	**84**

ISS = Inline Storage System
JIWWTP = Jones Island Wastewater Treatment Plant
MG = Million Gallons
PE = Primary Effluent
SSWWTP = South Shore Wastewater Treatment Plant

Source: MMSD/UWS In-plant Diversion Records; see Appendix 4D, *MMSD/UWS In-Plant Diversion Records* for more details

When comparing these flows to the total flows treated by both treatment plants over the same time period, blended flow accounted for only 0.18% of the total flow treated. The total yearly JIWWTP blending averaged about 150 MG per year for the years 2000-2002, but decreased dramatically in 2003. The current operation of JIWWTP during wet weather events allows blending only when all permit conditions for blending have been met. Blending at SSWWTP is not allowed under the current permit.

Note that only the ISS and PE diversions are listed for JIWWTP in Table 4-21. As stated above, Table 4-20 defines five potential diversions that could be used at the treatment plant. The three other in-plant diversions at JIWWTP listed in Table 4-20 (High-Level, Primary Effluent (complete) and Secondary Effluent/In-Plant Diversion Channel) have not been intentionally used during the period of review. However, in 2004, there were three separate accidental high-level diversion incidents due to equipment malfunction that received WDNR Notices of Noncompliance. The MMSD and UWS have taken steps to prevent future occurrences of accidental high-level diversions.

The largest single blending event in recent history had a volume of 100 MG and occurred at JIWWTP on May 17-19, 2000. The system data for this wet weather event indicate that just over a 100 MG of SSO was recorded. If the blending event had not occurred, the SSO volume recorded might have increased by 100%.

Blending Criteria

There are two different types of blending that may occur at JIWWTP - ISS and PE - as part of the wet weather flow management. The use of blending for wet weather flow management is governed by the WPDES permit requirements and the Wet Weather Standard Operating Procedure.(172)

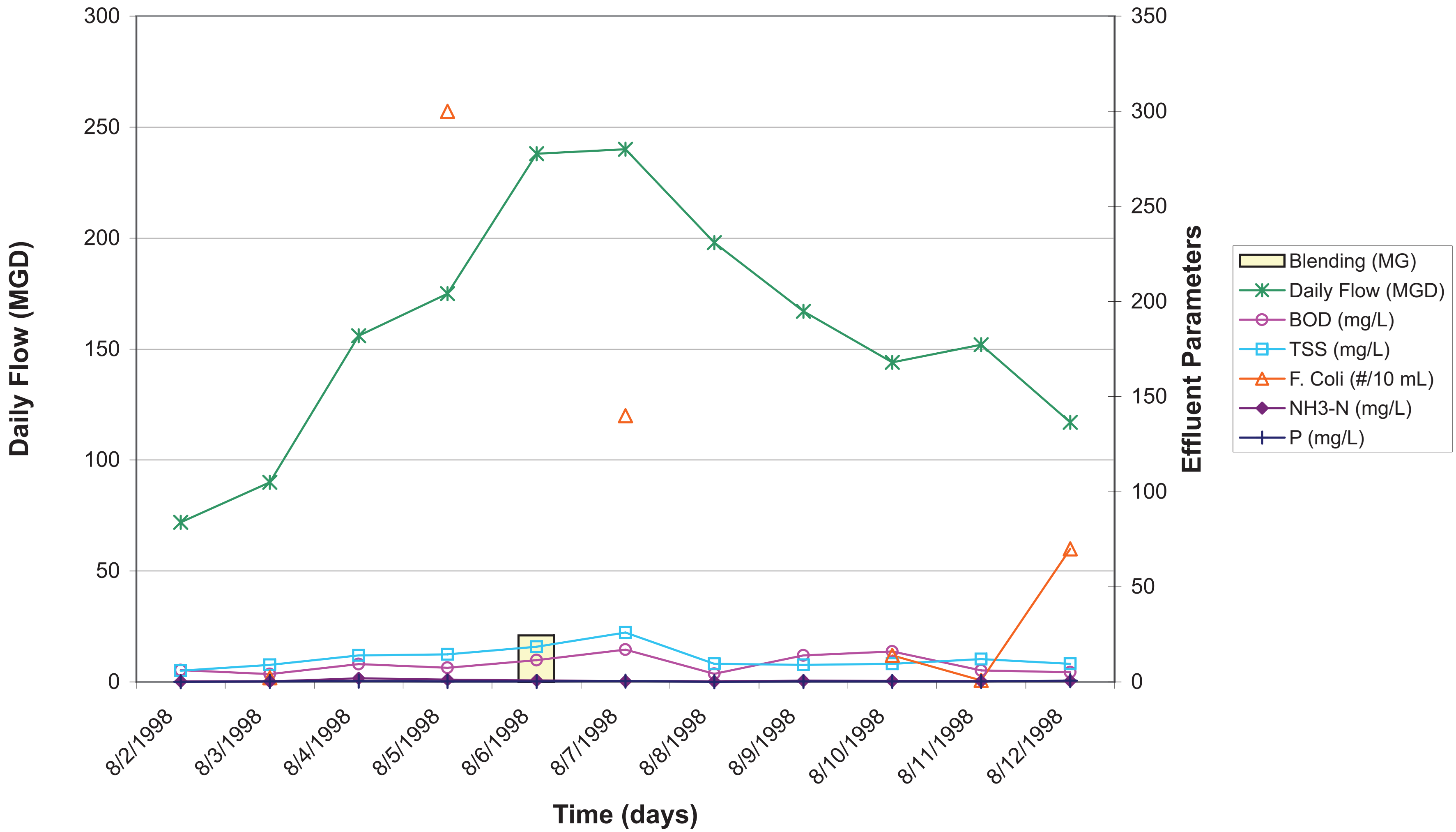
The report by the Joint Legislative Audit Committee released in 2002, *An Evaluation of Milwaukee Metropolitan Sewerage District*, did review blending (referred to as in-plant diversions in the report) in the time period from when the deep tunnel went into operation in 1994 to 2002.(173) The report found that there were at least six events where the MMSD could have used blending but did not; the report also urged MMSD to use blending as much as possible to maximize wet weather treatment capacity.

Effluent Quality Limits

The concern with wet weather events is not only that the treatment plants can process the flow, but also that the wastewater is being treated to effluent WPDES permit and UWS contract requirements during peak flow conditions. To determine if required effluent quality standards were being met during wet weather events, including those where blending occurred, daily effluent quality information for the treatment plants from DMRs was reviewed for periods when in-plant diversions occurred.(174) The main effluent limits of concern during wet weather events are BOD, TSS, and fecal coliform because the expectation is that these limits are the most likely to be exceeded. The contract and permit limits for these constituents are listed in Table 4-19. The full list of effluent discharge limits required by the WPDES permit is discussed in Chapter 6, *Regulations and Permits*. The three storms that were chosen as representative storms for the review of the 14 wet weather events in Section 4.5.1 were also chosen for as representative storms for the effluent quality analysis because blending occurred during each of the events. Figures 4-16 through 4-21 show the effluent quality parameters at each of the treatment plants for each of the storms. Data used to develop these figures are provided in more detail in *Daily Flow & Effluent Quality Data for Identified Wet Weather Events* under Appendix 4J, *Wet Weather Events Analysis*. Figures showing the effluent quality parameters for the rest of the storms reviewed are also included in Appendix 4J, *Wet Weather Events Analysis*.

Comparing the effluent BOD and TSS in these figures to the contract and permit limits listed in Table 4-19 shows that the contract and permit limit requirements were met during these storms.

After comparing both the effluent quality data and secondary treatment capacity during all fourteen of the wet weather events to the contract and permit limits listed in Table 4-19 as shown in Appendix 4J, *Wet Weather Events Analysis*, it was concluded that both treatments plants are consistently meeting permit and contract limits.



Source: DMRs, MMSD/UWS In-Plant Diversion Records

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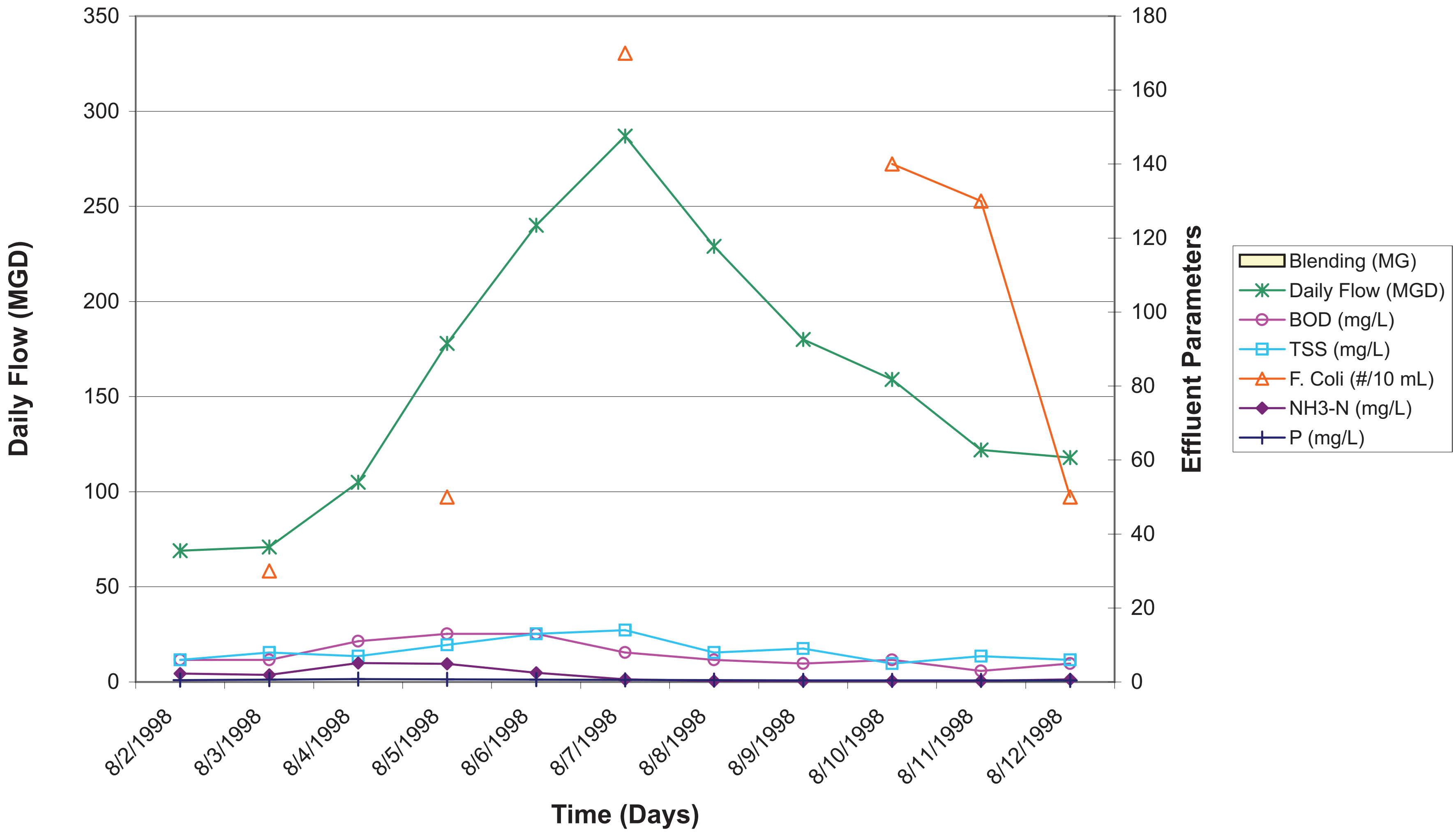
FIGURE 4-16

EFFLUENT QUALITY ANALYSIS: EVENT B – JIWWTP

2020 TREATMENT REPORT

5/22/07 TR_04.0016.07.05.22.cdr



Source: DMRs, MMSD/UWS In-Plant Diversion Records

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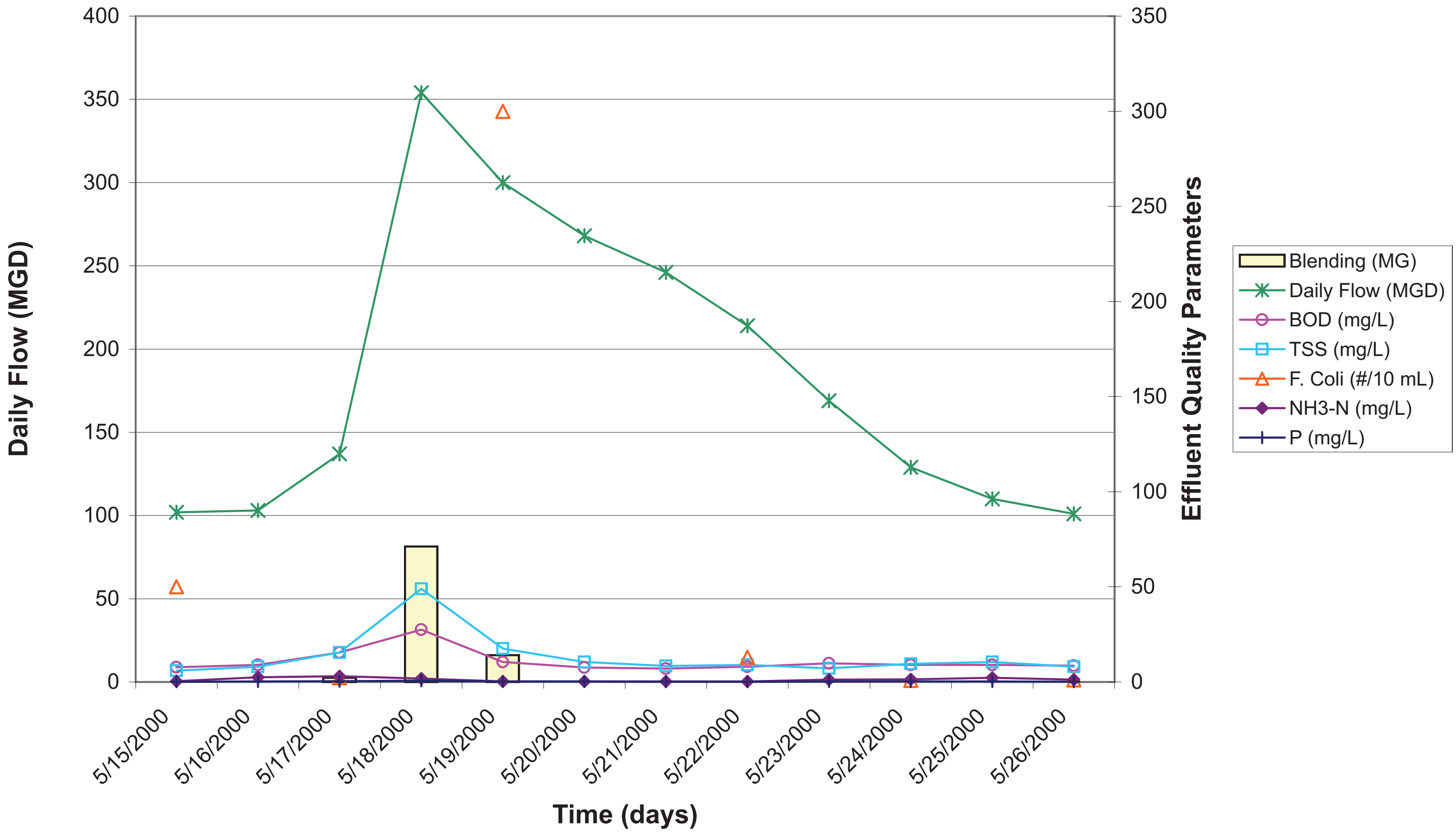
FIGURE 4-17
EFFLUENT QUALITY ANALYSIS: EVENT B – SSWWTP
2020 TREATMENT REPORT
5/22/07 TR_04.0017.07.05.22.cdr



Source: DMRs, MMSD/UWS In-Plant Diversion Records

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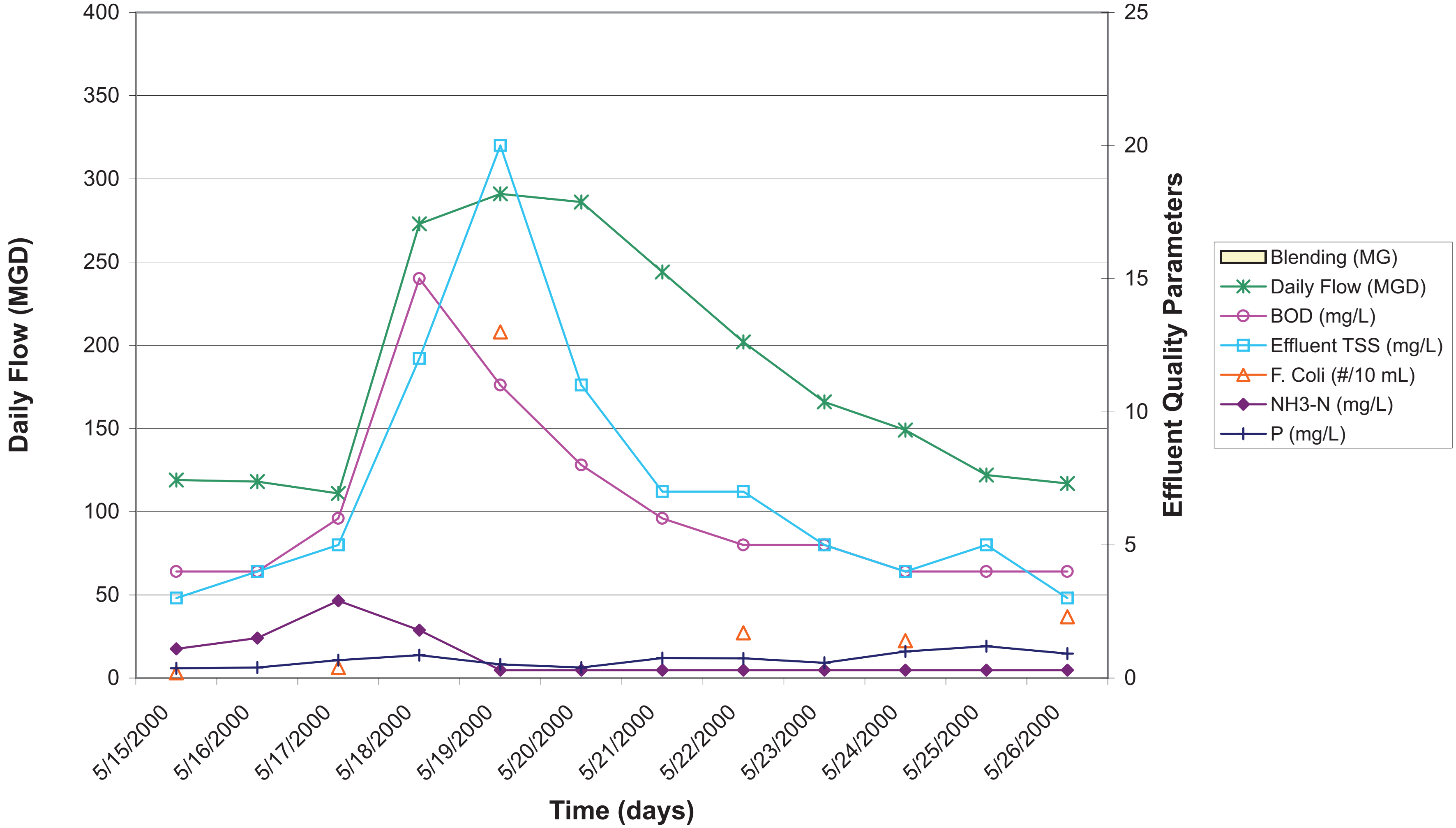
FIGURE 4-18
EFFLUENT QUALITY ANALYSIS: EVENT H – JIWWTP
2020 TREATMENT REPORT
5/22/07 TR_04.0018.07.05.22.cdr



Source: DMRs, MMSD/UWS In-Plant Diversion Records

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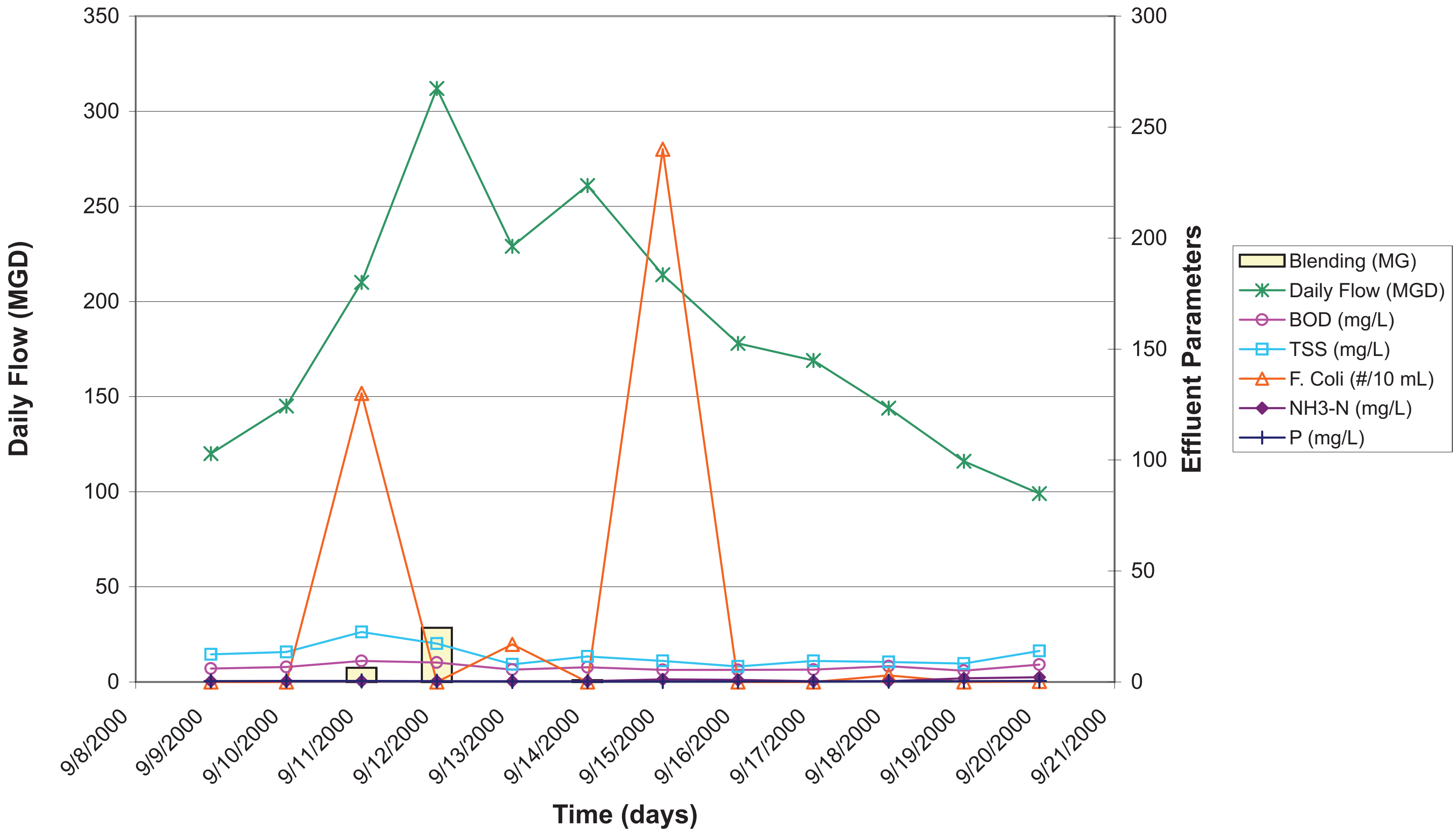
FIGURE 4-19
EFFLUENT QUALITY ANALYSIS: EVENT H – SSWWTP
2020 TREATMENT REPORT
5/22/07 TR_04.0019.07.05.22.cdr



Source: DMRs, MMSD/UWS In-Plant Diversion Records

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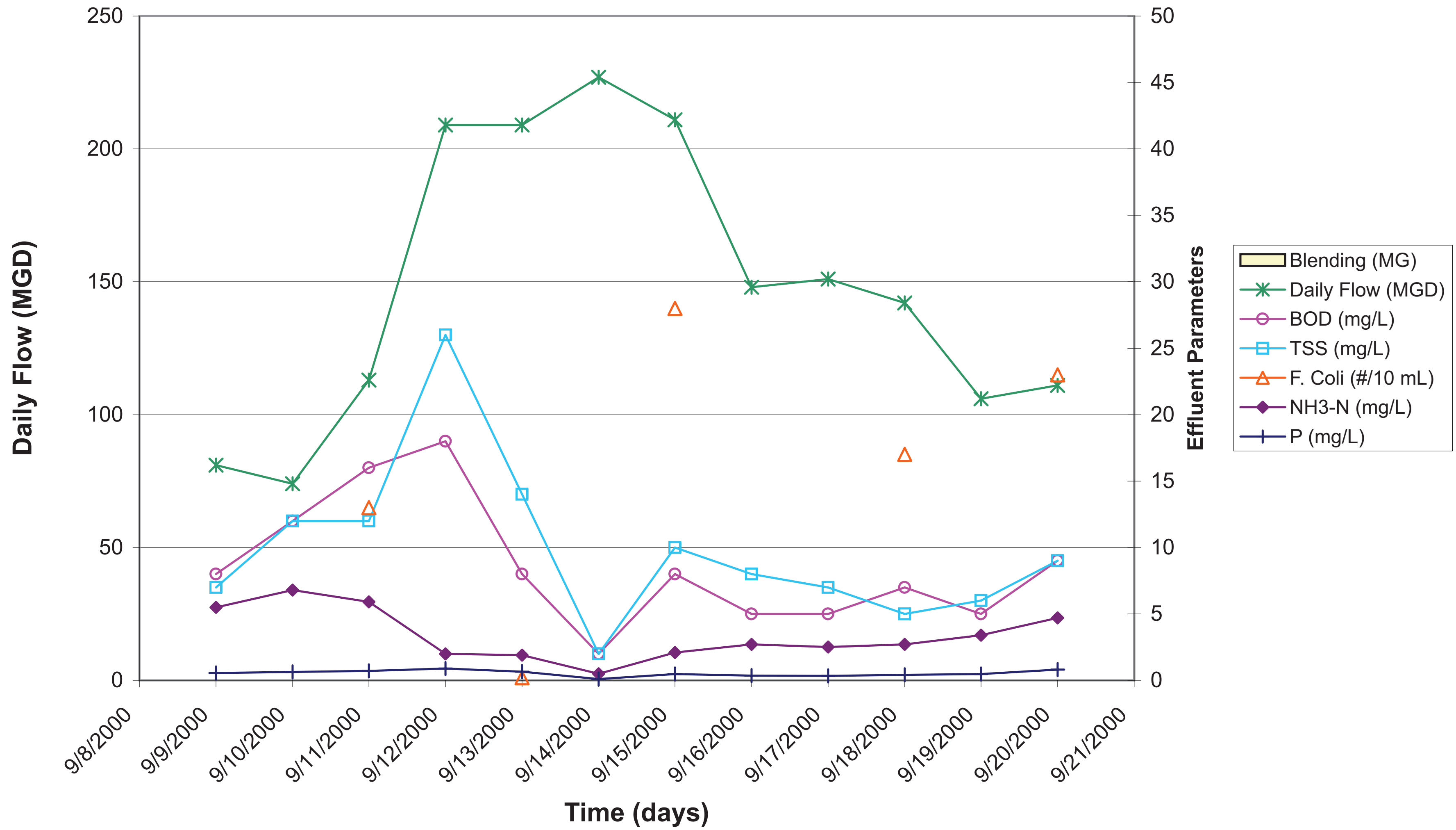
FIGURE 4-20
EFFLUENT QUALITY ANALYSIS: EVENT I – JIWWTP
2020 TREATMENT REPORT
5/22/07 TR_04.0020.07.05.22.cdr



Source: DMRs, MMSD/UWS In-Plant Diversion Records

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FIGURE 4-21
EFFLUENT QUALITY ANALYSIS: EVENT I – SSWWTP
2020 TREATMENT REPORT
5/22/07 TR_04.0021.07.05.22.cdr

4.5.3 Biosolids Production

UWS is required under its contract to produce a specified amount of Milorganite® per year and maintain a viable Agri-Life® program. Table 4-23 compares the requested Milorganite® production for each year to the amount actually produced.(175,176) The total amount produced includes Greens Grade Milorganite®, the Blenders Grade (abandoned in 2001), and Milwaukee Biosolids (started in 2002).

TABLE 4-23
MILORGANITE® PRODUCTION 1998-2003

Year	Total Amount Requested (Tons)	Total Amount Produced (adjusted) (Tons)	Total Milorganite® Year-end Inventory (Tons)	Blenders Grade Production (Tons)	Milwaukee Biosolids (Tons)	Off-spec Production (Tons)
1998[1]	30,875	51,811	12,777	5,038	N/A	0
1999	50,950	52,447	12,072	4,260	N/A	0
2000	55,050	54,171	14,940	3,384	N/A	0
2001[2]	58,433	51,201	18,040	2,631	N/A	2,355
2002	46,050	41,344	11,589	N/A	3,216	6,385
2003	48,400	47,701	14,107	N/A	2,956	0

1) The actual time frame for 1998 was less than a year by the time the first formal production request was made of UWS: for the time period from 5/1to12/31/98.

2) In 2001, the total amount requested was decreased at the end of the year from the original volume requested.

Source: CCO Annual Reports and MMSD Personnel

Table 4-24 presents the applications of Agri-Life® and Filter Cake production.(177) The WE Energies Light-Weight Aggregate program, defined in CCO Reports as Minergy, was discontinued by WE Energies in early 2001, and the land application of filter cake was initiated in 2001.(178)

TABLE 4-24
AGRI-LIFE® AND FILTER CAKE PRODUCTION 1998-2003

Year	Agri-Life® Land Applied (MG)	Agri-Life® Land Applied (Dry Tons)	Acreage Utilized	Minergy[1] (Dry Tons)	Filter Cake Land Applied (Dry Tons)	Landfill (Dry Tons)
1998	16.9	5,943	1,966	2,669	0	0
1999	20.1	8,186	2,255	2,797	0	0
2000	16.7	5,774	1,664	1,713	0	0
2001	12.2	4,241	1,134	0	1,540	0
2002	16.6	5,729	1,670	0	455	0
2003	11.1	4,503	1,476	0	1,563	0

1) WE Energies' Lightweight Aggregate Program

Source: 2003 CCO Annual Report

Review of the Agri-Life® and Filter Cake production indicates that the total amount of product land applied has been consistent in the last three years at approximately 6,000 tons per year.

4.5.4 Wisconsin Department of Natural Resources Compliance Review

All owners of publicly owned treatment plants (POTWs) are required to submit an annual *Compliance Maintenance Annual Report* (CMAR) to the WDNR. Each treatment plant is evaluated based on several criteria. All regulated treatment plants are given a score based on criteria in the CMAR. The lower the total score received by the treatment plant, the better the treatment plant performed.

The criteria that each treatment plant is scored upon, which are set out in Wis. Admin. Code NR 216, have evolved over the years. In 2003, evaluation criteria included the following:(179)

Part 1: Influent Flow/Loading

- Influent Average Monthly Flow for each month is compared against Design Maximum Monthly Flow and 90% of Maximum Monthly Flow
- Influent Average BOD is calculated based on average monthly flow and average monthly BOD concentration and is compared against Design Maximum Monthly BOD and 90% of Maximum Monthly BOD

Part 2: Effluent Quality/Plant Performance

- Effluent Average Monthly BOD is compared to the monthly average BOD permit limit and 90% of the effluent monthly average BOD permit limit
- Effluent Average Monthly TSS is compared to the monthly average TSS permit limit and 90% of the effluent monthly average TSS permit limit

Part 3: Age of Wastewater Treatment Facilities

- The POTW is scored against the last year reconstruction occurred at the plant

Part 4: Bypassing Raw or Untreated Wastewater

- POTW receives points for every overflow due to rainfall and every overflow due to equipment failure attributed to POTW – no distinction is made between CSOs and SSOs
- POTW receives points for every basement backup in service area attributed to POTW

Part 5: Sludge Storage and Disposal Sites (Sludge land-spreading plants only)

- The total number of months of sludge storage capacity is reviewed – more points for less storage time available
- The number of months that land is available for sludge application is reviewed – more points are given for less time that land is available

Part 6: Ponds/Aerated Lagoon Liner Integrity

Does not apply to MMSD.

Part 7: Land Disposal System Operation

Groundwater disposal systems only, so it does not apply to MMSD.

Part 8: New Development

- The total number of sewer extensions installed in the community is presented but not scored
- Future significant development that could result in a 10-20% increase in flow or BOD is scored

Part 9: Operator Certification and Education

- Certification and education experience of operator-in-charge is scored

Part 10: Subjective Evaluation

- Items reviewed but not scored include collection system maintenance, pond maintenance (if applicable), treatment plant operation and maintenance, preventative maintenance, sewer use ordinance, and additional comments

Part 11: Financial Status

- Items reviewed but not scored include user-charge revenues, equipment replacement fund, and financial resources for improvement/reconstruction needs

Based on the score each treatment plant receives, the WDNR determines corrective action requirements using the following scale:

0 - 70	points	Requires no action
71 - 120	points	May lead to a recommendation from WDNR that an Operations Needs Review be initiated
121+	points	The POTW is required to perform an Operations Needs Review

The scores received by the treatment plants for 1999-2003 are listed in Table 4-25 below.(180)

TABLE 4-25
1999-2003 TREATMENT PLANT COMPLIANCE MAINTENANCE ANNUAL REPORT POINT VALUES

Facility	1999	2000	2001	2002	2003
JIWWTP	37	33	46	26	6
SSWWTP	36	32	10	0	1

JIWWTP = Jones Island Wastewater Treatment Plant
SSWWTP = South Shore Wastewater Treatment Plant

Source: Compliance Maintenance Annual Reports (CMARs)

The CMAR point values improved at both plants due to adequate flow and load capacity at the plants, high quality effluent, young plant age based on completion of capital improvement projects, decreasing number of overflows in the system, and adequate solids handling capacity.

4.5.5 United Water Services Review

Contract Effluent Discharge Limits

The UWS operation of the treatment plants between the years 1999-2003 was reviewed. The year 1999 was the first full year of UWS operation under the contract. A key indication of UWS performance at the treatment plants, as established in the contract, is whether the plants meet the contracted effluent limits. Table 4-26 shows the yearly effluent quality from 1999-2003.(181)

TABLE 4-26
YEARLY AVERAGE EFFLUENT WATER QUALITY 1999-2003

	Jones Island Wastewater Treatment Plant				South Shore Wastewater Treatment Plant			
Year	Monthly BOD mg/l	Monthly TSS mg/l	Monthly TP mg/l	Fecal Coliform No./100 ml	Monthly BOD mg/l	Monthly TSS mg/l	Monthly TP mg/l	Fecal Coliform No./100 ml
Contract	15	15	0.5	100	15	15	0.5	100
Permit	30	30	1	400	30	30	1	400
Actual:								
1999	9	11	0.31	18	6	7	0.64	19
2000	9	11	0.37	45	8	8	0.72	31
2001	9.3	9.1	0.40	37	8	9	0.67	31
2002	9.9	9.0	0.42	39	11	8.0	0.76	42
2003	9.4	6.8	0.36	44	8.6	5.5	0.63	32

BOD = Biochemical Oxygen Demand
mg/l = Milligrams per Liter
TP = Total Phosphorus
TSS = Total Suspended Solids
ml = Milliliters

Source: CCO Annual Reports

United Water Services has received BOD bonuses six out of the seven years that it has operated the plants and TSS bonuses for the last two years. UWS has never received a monetary penalty for poor treatment plant operation; however, a number of Notices of Contract Non-Compliance have been issued to UWS related to system operation since contract inception. There has never been a violation of monthly WPDES permit effluent limits during UWS operation. There has been only one week where the average weekly effluent BOD was larger than the WPDES permit limits: in the fourth week of December 2000, after the partial collapse of the Hoan Bridge above JIWWTP on December 13, 2000. The Hoan Bridge separates the West Plant from the East Plant at JIWWTP, and during the subsequent repair, the East Plant had to be completely shut down. Because the East Plant treats 2/3 of the total wastewater flow through JIWWTP, a portion of the system flow typically handled at JIWWTP had to be rerouted to SSWWTP and the deep tunnel. The temporary modification affected treatment at both treatment plants. However, the WDNR did not issue a permit violation, as it was determined that the situation was out of MMSD and UWS control.

UWS Contract Performance Evaluation

In 2003, MMSD initiated a performance review as part of the five-year anniversary of the agreement with UWS. The results were documented in *United Water Performance Evaluation Final Report (2003 UWS Performance Evaluation)*.(182) The main findings and recommendations listed in that report are as follows:

Findings Related to the Operation of the Treatment Plants

- The operation of the treatment system is generally very good, as both plants in the MMSD system have received the highest possible awards for effluent quality from the Association of Metropolitan Sewerage Agencies. (Note: name changed to National Association of Clean Water Agencies (NACWA) in 2005.)
- The maintenance of the critical equipment by UWS has been consistent with wastewater industry practices and has helped to achieve the good levels of treatment and conveyance operations cited above.
- The maintenance of non-critical equipment and general facilities is not up to industry standards and a number of recommendations are made to improve that situation.
- MMSD, in partnership with UWS, is operating the MMSD system at a high level in a manner that compares favorably with similar agencies across the nation, but nevertheless finds itself in a difficult position with regards to public perception.
- The ultimate receiving water of MMSD discharges is Lake Michigan, which is viewed as one of the most important natural resources in the world and is also the source of drinking water for millions of people in the surrounding states.
- The metropolitan area experienced a few of the most intense storms in the city's history in the last few years, which simply overwhelmed the system beyond its designed capabilities.
- The use of blending (or "process diversions") at JIWWTP during periods of exceptionally high flows to maximize the treatment plant capacity while protecting the integrity of the biological treatment system has been mischaracterized by the media as "dumping" and by others as a means of avoiding proper treatment.

- MMSD contracted out the operations and maintenance of the treatment and conveyance system during this period of major change within the system in a cost reduction effort, which raised concerns that the system was not being operated properly in order to save money.
- Recent incidents, as illustrated by the release of the condoms to the waters near the outfall and the September 2002 dry weather overflow into the Milwaukee River, reinforce the overall negative perceptions.

Recommendations from the Report Related to the Treatment Plants

- Develop an agreement with UWS that establishes an acceptable level of maintenance for capital equipment that is due to be replaced or is operating in an impaired condition.
- Identify and follow up on all non-critical equipment and general maintenance issues that require improvement.
- Work to ensure that adequately trained staff is available to properly operate the system. This should include review of staff training, the levels of expertise on shift at all times, and general staffing levels.
- Improve capital project coordination by bringing UWS into capital project design and construction in a more active manner.

4.5.6 Other Milwaukee Metropolitan Sewerage District System Evaluations

Stipulation

The WDNR 2002 Stipulation between the MMSD and the state of Wisconsin was executed in May 2002, committing MMSD to implementing a large number of improvement projects to the system to improve water quality and to eliminate sanitary sewer overflows as required by law.(183) The treatment plant projects required by the WDNR 2002 Stipulation are indicated on Table 5-1 in Chapter 5, *Treatment Assessment – Future Condition*. The WDNR 2002 Stipulation is discussed in more detail in the *Facilities Plan Report*.

Capacity Assurance, Management, Operation, and Maintenance Program Strategic Plan

One of the requirements of the WDNR 2002 Stipulation is that the MMSD implement a capacity assurance, management, operations and maintenance (CMOM) plan for all areas under MMSD jurisdiction.(184) The MMSD CMOM Readiness Review and Implementation Strategy Development Strategic Plan, finalized in December 2005, summarized the CMOM strategy and what is needed to implement the strategy. The main recommendations specific to wastewater treatment include the following:

- A periodic evaluation of treatment capacity should be conducted. The latest evaluation was conducted in 2001 under the Treatment Plant Wet Weather Project, which led to a number of unit process upgrades. However, no treatment capacity evaluation performed on the MMSD system has utilized wastewater quality sampling at key points throughout the treatment plants, instead relying on available regularly scheduled sampling data. Regularly scheduled sampling data typically includes influent and effluent data as required by the WPDES permit. It is not process specific and therefore, does not provide as detailed an evaluation of actual treatment capacity as could be used to develop reliable treatment models to use in a treatment capacity evaluation.

- The MMSD performance measures should include a system renewal/replacement rate to determine infrastructure renewal/replacement needs.

An Evaluation of the Milwaukee Metropolitan Sewerage District

Other evaluations reviewed how the operation of the MMSD system has affected water quality in the local waterways. Along with the concerns listed above in the findings of the *2003 UWS Performance Review Report*, one of the major concerns with the UWS contract is that system-wide water quality might suffer when a private operator is operating the system - especially if the operator is operating the system to meet contract limits that are lower than permit limits. This concern was addressed by the Wisconsin Joint Legislative Audit Committee in its July 2002 report: *An Evaluation of the Milwaukee Metropolitan Sewerage District.(*185) The data presented in the evaluation indicate that the performance of the system has not been significantly different since UWS took over operation.

Other Review

In addition to the above mentioned reviews of the MMSD system, Milwaukee Mayor Tom Barrett directed an Audit Committee to review the operation and performance of the MMSD system during the May 2004 wet weather event.

References

(1) Milwaukee Metropolitan Sewerage District, MMSD Accounting Department Records (1997-2003)

(2) United Water Services, on behalf of MMSD, *Discharge Monitoring Report* for Permit No. 0036820-1 (1997-2003)

(3) United Water Services, *Daily/Weekly Operating Report* (1999-2003)

(4) State of Wisconsin Circuit Court, *Stipulation: State of Wisconsin, Plaintiff v. Milwaukee Metropolitan Sewerage District, Defendant*, Case No. 02-CV-2701 (May 29, 2002)

(5) Ibid

(6) Milwaukee Metropolitan Sewerage District, *Technical Services Committed Projects as of June 30, 2006* (June 30, 2006)

(7) Milwaukee Metropolitan Sewerage District, *Milwaukee Metropolitan Sewerage District 2007 Annual Budget* (November 2006)

(8) Milwaukee Metropolitan Sewerage District, *Jones Island Operations and Maintenance Manual: Plant Summary and Administration* (July 1, 1993), Section 400

(9) Milwaukee Metropolitan Sewerage District, *South Shore Operation & Maintenance Manual: Plant Summary and Administration* (March 1, 1986), Section 400

(10) Milwaukee Metropolitan Sewerage District, *MMSD Wastewater System Plan: Planning Report Vol. 1A* (June 1, 1980)

(11) Milwaukee Metropolitan Sewerage District, *Jones Island Operations and Maintenance Manual: Plant Summary and Administration* (July 1, 1993), Section 400

(12) Milwaukee Metropolitan Sewerage District, *South Shore Operation & Maintenance Manual: Plant Summary and Administration* (March 1, 1986), Section 400

(13) Milwaukee Metropolitan Sewerage District, *MMSD Wastewater System Plan: Planning Report Vol. 1A* (June 1, 1980)

(14) Milwaukee Metropolitan Sewerage District, *Cost Recovery Procedures Manual*, Annual Report (published in January each year)

(15) Ibid.

(16) Milwaukee Metropolitan Sewerage District, MMSD Accounting Department Records (1997-2003).

(17) Discharge Monitoring Report (1997-2003)

(18) Discharge Monitoring Report (1997-2003)

(19) Milwaukee Metropolitan Sewerage District, MMSD Accounting Department Records (1997-2003)

(20) Ibid.

(21) United Water Services, *Daily/Weekly Operating Report* (1999-2003)

(22) Ibid.

(23) United Water Services, on behalf of MMSD, *Discharge Monitoring Report* for Permit No. 0036820-1 (January 1999)

(24) United Water Services, on behalf of MMSD, *Discharge Monitoring Report* for Permit No. 0036820-1 (1997-2003)

(25) United Water Services, *Daily/Weekly Operating Report* (1999-2003)

(26) Milwaukee Metropolitan Sewerage District, *Jones Island Operations and Maintenance Manual: Plant Summary and Administration* (July 1, 1993), Section 400

(27) Milwaukee Metropolitan Sewerage District, *South Shore Operation & Maintenance Manual: Plant Summary and Administration* (March 1, 1986), Section 400

(28) Wisconsin Department of Natural Resources, *Wisconsin Administrative Code*, Volume 11, Chapter NR 110 (Revisor of Statutes Bureau, May 2001)

(29) Wisconsin Department of Natural Resources, *Wisconsin Administrative Code*, Volume 11, Chapter NR 204 (Revisor of Statutes Bureau, November 1996)

(30) Wastewater Committee of the Great Lakes – Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, *Recommended Standards for Wastewater Facilities* (Health Education Services Division, 2004)

(31) John Kontor (CDM), *Technical Memorandum No. 2, Jones Island WWTP Effluent Flow Measurement*, done as a part of the Instrumentation and Control Upgrades project, MMSD Contract Nos. J06014C01/S06004C01 (January 7, 2005)

(32) John Kontor (CDM), *Technical Memorandum No. 1, South Shore WWTP Effluent Flow Measurement*, done as a part of the Instrumentation and Control Upgrades project, MMSD Contract Nos. J06014C01/S06004C01 (March 14, 2005)

(33) Milwaukee Metropolitan Sewerage District, *Jones Island Operations and Maintenance Manual: Plant Summary and Administration* (July 1, 1993), Section 400

(34) Milwaukee Metropolitan Sewerage District, *South Shore Operation & Maintenance Manual: Plant Summary and Administration* (March 1, 1986), Section 400

(35) United Water Services, *Monthly Report for Milwaukee Metropolitan Sewerage District* (January 2001)

(36) Brown and Caldwell, *MMSD CMOM Readiness Review and Implementation Strategy Development Strategic Plan* (December 2005)

(37) XCG Consultants Ltd, *Wet Weather Flow Optimization Study for Jones Island and South Shore WWTP* (December 5, 2001)

(38) Brown and Caldwell, *MMSD CMOM Readiness Review and Implementation Strategy Development Strategic Plan* (December 2005)

(39) Daniel J. Sheldon (CDM), *Technical Memorandum: Item 31 – Buildings 347 and 353, W3 Pumping System*, a part of MMSD UW Plant Requested Projects 2004, South Shore Wastewater Treatment Plant Group, Contract S06005P02 (August 15, 2005)

(40) WE Energies, Wisconsin Electric – Gas Operations, Gas Service Rates, Rules and Regulations, Tariff Book [Internet]; available from http://we-energies.com/pdfs/tariffs_volXVI/WEGOtariffbk_volXVI.pdf

(41) Leonard Aprahamian, UWS, Interview with author and Greg Baker, MMSD, Milwaukee, WI (November 15, 2005)

(42) Gary Cressey (Donahue & Associates, Inc.), *Technical Memorandum: TM 13 Electrical Power Distribution*, a part of Preliminary Engineering Services for the South Shore WWTP Blower System Upgrade, Contract No. S02004E01 (October 2004)

(43) Wisconsin Department of Natural Resources, *Wisconsin Administrative Code*, Volume 11, Chapter NR 110 (Revisor of Statutes Bureau, May 2001)

(44) Ibid.

(45) *South Shore Preliminary Treatment Facilities, Building 303*, Contract No. S008GX030, Electrical One-line Diagram and Elevation, Shts E26-E27

(46) United Water Services, on behalf of MMSD, *Discharge Monitoring Report* for Permit No. 0036820-1 (1997-2003)

(47) United Water Services, *Daily/Weekly Operating Report* (1999-2003)

(48) Milwaukee Metropolitan Sewerage District, *Jones Island Operations and Maintenance Manual: Plant Summary and Administration* (July 1, 1993), Section 400

(49) Milwaukee Metropolitan Sewerage District, *South Shore Operation & Maintenance Manual: Plant Summary and Administration* (March 1, 1986), Section 400

(50) Wisconsin Department of Natural Resources, *Wisconsin Administrative Code*, Volume 11, Chapter NR 110 (Revisor of Statutes Bureau, May 2001)

(51) Wisconsin Department of Natural Resources, *Wisconsin Administrative Code*, Volume 11, Chapter NR 204 (Revisor of Statutes Bureau, November 1996)

(52) Wastewater Committee of the Great Lakes – Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, *Recommended Standards for Wastewater Facilities* (Health Education Services Division, 2004)

(53) United Water Services, on behalf of MMSD, *Discharge Monitoring Report* for Permit No. 0036820-1 (1999-2003)

(54) Milwaukee Metropolitan Sewerage District, *Jones Island Operations and Maintenance Manual: Plant Summary and Administration* (July 1, 1993), Section 400

(55) Wisconsin Department of Natural Resources, *Wisconsin Administrative Code*, Volume 11, Chapter NR 110 (Revisor of Statutes Bureau, May 2001)

(56) Wastewater Committee of the Great Lakes – Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, *Recommended Standards for Wastewater Facilities* (Health Education Services Division, 2004)

(57) Milwaukee Metropolitan Sewerage District, *Inline Storage System Operations and Maintenance Manual Part 1 : System Summary* (September 1, 1992)

(58) Ibid.

(59) Ibid.

(60) Milwaukee Metropolitan Sewerage District, *Inline Storage System O & M Manual: Part 2 Unit Process Operations vol.1 Inline Pump Station* (March 1, 1995)

(61) John Jankowski (MMSD), interview with author, Milwaukee, WI (March 17, 2006)

(62) Mike Macaulay (Brown & Caldwell), *Technical Memorandum: Project JI – 3 – ISS Pump Station Evaluation, MMSD Jones Island WWTP* (May 29, 2002)

(63) United Water Services, *Monthly Report for Milwaukee Metropolitan Sewerage District* (October 2005)

(64) Milwaukee Metropolitan Sewerage District, *Inline Storage System Operations and Maintenance Manual Part 1: System Summary* (September 1, 1992)

(65) Milwaukee Metropolitan Sewerage District, *Inline Storage System Operations and Maintenance Manual Part 1 : System Summary* (September 1, 1992)

(66) James Ibach (MMSD), correspondence with William Baumann and R.L. Larson (WDNR), Milwaukee, WI (October 26, 1982)

(67) Roger Larson (WDNR), correspondence with James Ibach (MMSD), Madison WI (2 November 1982)

(68) Mike Macaulay (Brown & Caldwell), *Technical Memorandum: Project JI – 3 – ISS Pump Station Evaluation, MMSD Jones Island WWTP* (May 29, 2002)

(69) Milwaukee Metropolitan Sewerage District, *2010 Facilities Plan* (May 1998)

(70) Michael J. Martin (MMSD), *Draft Technical Memoranda, Design of the Jones Island Wastewater Treatment Plant Preliminary Treatment Facility Upgrade Project*, MMSD Contract No. J01006D01, November 10, 2005

(71) Milwaukee Metropolitan Sewerage District, *Jones Island Wastewater Treatment Plant Operation and Maintenance Manual, Part 2, Volume 4: Grit Removal* (June 2003)

(72) Milwaukee Metropolitan Sewerage District, *2010 Facilities Plan* (May 1998)

(73) Dean Schmidtke (Metcalf & Eddy), Task-Group B.2.1.6, *Grit Handling, Final Technical Memorandum*, written as part of the Design of the Jones Island Wastewater Treatment Plant Preliminary Treatment Facility Upgrade Project, MMSD Contract No. J01006D01 (May 18, 2004)

(74) Tom Brennan (MMSD), *JI Grit Issues Memorandum*, July 3, 2006

(75) Ibid.

(76) Milwaukee Metropolitan Sewerage District, *Jones Island Operations and Maintenance Manual: Plant Summary and Administration* (July 1, 1993), Section 400

(77) XCG Consultants Ltd, *Wet Weather Flow Optimization Study for Jones Island and South Shore WWTP* (December 5, 2001)

(78) Frank Tiefert (Applied Technologies), *JI2 – Jones Island Primary Treatment Hydraulic and Treatment Capacity*, a part of Review of United Water Services Requested Projects, Jones Island Wastewater Treatment Plant, Contract No. JO6015DO3 (June 14, 2004)

(79) Tom Brennan (MMSD), *Clarifier Influent Channel*, e-mail correspondence (May 12, 2005)

(80) Jeff Schilling (MMSD), *5-11-05 Flow Request* data, March 17, 2006, provided via e-mail correspondence

(81) United Water Services, *Monthly Report for Milwaukee Metropolitan Sewerage District* (May 2005)

(82) Frank Tiefert (Applied Technologies), *JI2 – Jones Island Primary Treatment Hydraulic and Treatment Capacity*, a part of Review of United Water Services Requested Projects, Jones Island Wastewater Treatment Plant, Contract No. JO6015DO3 (June 14, 2004)

(83) Tom Brennan (MMSD), *JI Grit Issues Memorandum*, July 3, 2006

(84) Milwaukee Metropolitan Sewerage District, *Jones Island Operations and Maintenance Manual: Plant Summary and Administration* (July 1, 1993), Section 400

(85) XCG Consultants Ltd, *Wet Weather Flow Optimization Study for Jones Island and South Shore WWTP* (December 5, 2001)

(86) Donahue & Associates, Inc., Design Report for the Phase I Wet Weather Capacity Improvement Project at the Jones Island and South Shore WWTP, MMSD Contract No. J02001D001 (August 2005)

(87) XCG Consultants Ltd, *Wet Weather Flow Optimization Study for Jones Island and South Shore WWTP* (December 5, 2001)

(88) Ibid.

(89) Ibid.

(90) United Water Services, *Daily/Weekly Operating Report* (2005)

(91) Milwaukee Metropolitan Sewerage District, *2010 Facilities Plan* (May 1998)

(92) Wisconsin Department of Natural Resources, *Wisconsin Administrative Code*, Volume 11, Chapter NR 110 (Revisor of Statutes Bureau, May 2001)

(93) Milwaukee Metropolitan Sewerage District, *Wet Weather Standard Operating Procedures Memorandum* (March 20, 2003)

(94) United Water Services, *Monthly Report for Milwaukee Metropolitan Sewerage District* (March 2004)

(95) Leonard Aprahamian (UWS), *JI Effluent Pumping*, e-mail correspondence with author (March 15, 2005)

(96) United Water Services, *Daily/Weekly Operating Report* (1999-2003)

(97) Milwaukee Metropolitan Sewerage District, *South Shore Operation & Maintenance Manual: Plant Summary and Administration* (March 1, 1986), Section 400

(98) Wisconsin Department of Natural Resources, *Wisconsin Administrative Code*, Volume 11, Chapter NR 110 (Revisor of Statutes Bureau, May 2001)

(99) Wastewater Committee of the Great Lakes – Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, *Recommended Standards for Wastewater Facilities* (Health Education Services Division, 2004)

(100) Milwaukee Metropolitan Sewerage District, *South Shore Operations and Maintenance Manual Part 2 – Unit Process Operations, Preliminary Treatment, Sludge Screening, Scum Handling, Vol 1 Building 303 Preliminary Treatment, Building 309 Scum Handling* (July 2004)

(101) United Water Services, *South Shore Wastewater Treatment Plant, Plant Capacity* notice (July 15, 2002)

(102) Milwaukee Metropolitan Sewerage District, *South Shore Operations and Maintenance Manual Part 2 – Unit Process Operations, Preliminary Treatment, Sludge Screening, Scum Handling, Vol 1 Building 303 Preliminary Treatment, Building 309 Scum Handling* (July 2004)

(103) Ibid.

(104) XCG Consultants Ltd, *Wet Weather Flow Optimization Study for Jones Island and South Shore WWTP* (December 5, 2001)

(105) Donohue & Associates, Inc., *Preliminary Engineering Report for the South Shore Wastewater Treatment Plant Blower System Upgrade* (October 2004)

(106) Meeting notes, MMSD staff and author (September 19, 2006)

(107) Ibid.

(108) Gary Cressey, *Technical Memorandum: South Shore Mixed Liquor Flow Distribution Improvements*, part of Phase 1 Wet Weather Capacity Improvements, Jones Island and South Shore Wastewater Treatment Plants, Contract No. J02001D01 (Donahue & Associates, Inc., January 30, 2004)

(109) Milwaukee Metropolitan Sewerage District, *2010 Facilities Plan* (May 1998)

(110) Craig Heisel (UWS), e-mail correspondence with author RE: Outstanding JI & SS Unit Process Questions, (June 8, 2005)

(111) United Water Services, *Daily/Weekly Operating Report* (1999-2003)

(112) Milwaukee Metropolitan Sewerage District, *Jones Island Operations and Maintenance Manual: Plant Summary and Administration* (July 1, 1993), Section 400

(113) Wisconsin Department of Natural Resources, *Wisconsin Administrative Code*, Volume 11, Chapter NR 110 (Revisor of Statutes Bureau, May 2001)

(114) Wisconsin Department of Natural Resources, *Wisconsin Administrative Code*, Volume 11, Chapter NR 204 (Revisor of Statutes Bureau, November 1996)

(115) Wastewater Committee of the Great Lakes – Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, *Recommended Standards for Wastewater Facilities* (Health Education Services Division, 2004)

(116) Milwaukee Metropolitan Sewerage District Contract Compliance Office, *Annual Summary of United Water Services Performance* (1999-2003)

(117) Dean Schmidtke (Metcalf & Eddy), Task-Group B.2.1.1, *Primary Sludge Screens Final Technical Memorandum* (June 9, 2004).

(118) United Water Services, *Daily/Weekly Operating Report* (1999-2003)

(119 Milwaukee Metropolitan Sewerage District Contract Compliance Office, *Annual Summary of United Water Services Performance* (1999-2003)

(120) United Water Services, *Daily/Weekly Operating Report* (1999-2003)

(121) Milwaukee Metropolitan Sewerage District, *South Shore Operation & Maintenance Manual: Plant Summary and Administration* (March 1, 1986), Section 400

(122) Wisconsin Department of Natural Resources, *Wisconsin Administrative Code*, Volume 11, Chapter NR 110 (Revisor of Statutes Bureau, May 2001)

(123) Wisconsin Department of Natural Resources, *Wisconsin Administrative Code*, Volume 11, Chapter NR 204 (Revisor of Statutes Bureau, November 1996)

(124) Wastewater Committee of the Great Lakes – Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, *Recommended Standards for Wastewater Facilities* (Health Education Services Division, 2004)

(125) Milwaukee Metropolitan Sewerage District, Contract Compliance Office, *Annual Summary of United Water Services Performance* (1999-2003)

(126) U.S. Environmental Protection Agency, *Process Design Manual for Sludge Treatment and Disposal, EPA 625/1-79-011* (September 1979)

(127) Milwaukee Metropolitan Sewerage District, *South Shore Operation & Maintenance Manual: Plant Summary and Administration* (March 1, 1986), Section 400

(128) Metcalf & Eddy, *Wastewater Engineering Treatment and Reuse, 4th Edition* (2003)

(129) Jeff Schilling (MMSD), with assistance from Harvey Matayas (MMSD) and Dennis Dineen (UWS), interviews with author, July 7-11, 2005, Milwaukee, WI, e-mail correspondence

(130) Paul Schlecht (MMSD), e-mail correspondence with author regarding 2020 Biosolids questions (December 27, 2005)

(131) Milwaukee Metropolitan Sewerage District, *South Shore Operation & Maintenance Manual: Plant Summary and Administration* (March 1, 1986), Section 400

(132) Symbiont, *MMSD 2020 Biosolids Meeting Notes*, e-mail correspondence regarding November 16, 2005 meeting with Waste Management (November 18, 2005)

(133) Milwaukee Metropolitan Sewerage District, *Jones Island Operations and Maintenance Manual: Plant Summary and Administration* (July 1, 1993), Section 400

(134) Ibid.

(135) Milwaukee Metropolitan Sewerage District, *South Shore Operation & Maintenance Manual: Plant Summary and Administration* (March 1, 1986), Section 400

(136) Jeff Schilling (MMSD), interview with author, Milwaukee, WI, e-mail correspondence (November 17, 2005)

(137) Milwaukee Metropolitan Sewerage District, *Contract Compliance Office Monthly Report* (1998-2003)

(138) Mayor's Independent MMSD Audit Committee, *Final Report Presented to Mayor Tom Barrett* (October 1, 2004)

(139) John Jankowski (MMSD), interview with author, March 17, 2006, Milwaukee, WI

(140) Milwaukee Metropolitan Sewerage District, *Jones Island Operations and Maintenance Manual: Plant Summary and Administration* (July 1, 1993), Section 400

(141) Milwaukee Metropolitan Sewerage District, *Wet Weather Standard Operating Procedures Memorandum* (March 20, 2003)

(142) Ibid.

(143) Ibid.

(144) Ibid.

(145) Milwaukee Metropolitan Sewerage District, *South Shore Operation & Maintenance Manual: Plant Summary and Administration* (March 1, 1986), Section 400

(146) Milwaukee Metropolitan Sewerage District, *South Shore Wastewater Treatment Plant, T.O. 34, Advanced Facility Plan* (September 1981)

(147) Leonard Aprahamian (UWS), interview with author, Milwaukee, WI, e-mail correspondence (16 June 2005)

(148) Milwaukee Metropolitan Sewerage District, *Jones Island Operations and Maintenance Manual: Plant Summary and Administration* (July 1, 1993), Section 1100

(149) Conversations with UWS and MMSD staff

(150) Milwaukee Metropolitan Sewerage District, *Jones Island Operations and Maintenance Manual: Plant Summary and Administration* (July 1, 1993), Section 1100

(151) Conversations between UWS and MMSD staff and author

(152) Metcalf & Eddy, Inc., *Wastewater Engineering Treatment and Reuse*, 4th Ed. (2003)

(153) Milwaukee Metropolitan Sewerage District, SSWWTP Engine-Generator Operations Manual (November 2000)

(154) Conversations between UWS and MMSD staff and author

(155) Milwaukee Metropolitan Sewerage District, SSWWTP Engine-Generator Operations Manual (November 2000)

(156) Milwaukee Metropolitan Sewerage District, *South Shore Operation & Maintenance Manual: Plant Summary and Administration* (March 1, 1986), Section 400

(157) Conversations between UWS and MMSD staff and author

(158) Milwaukee Metropolitan Sewerage District, *MMSD Rules* [Internet]; available from http://www.mmsd.com/rules/index.cfm

(159) Milwaukee Metropolitan Sewerage District, Industrial Waste Pretreatment Program (IWPP) [Internet]; available from http://www.mmsd.com/wastewater treatment/industrial_waste_pretreatment.cfm

(160) Milwaukee Metropolitan Sewerage District, Hazardous Household Waste Collection Program [Internet]; available from http://www.mmsd.com/programs/hhw1.cfm

(161) Ibid

(162) Ibid.

(163) United Water Services, on behalf of MMSD, *Discharge Monitoring Report* for Permit No. 0036820-1 (1997-2003)

(164) Milwaukee Metropolitan Sewerage District, *Contract Compliance Office Monthly Report* (1998-2003)

(165) United Water Services, *Monthly Report for Milwaukee Metropolitan Sewerage District* (1998-2003)

(166) United Water Services, on behalf of MMSD, *Discharge Monitoring Report* for Permit No. 0036820-1 (1997-2003)

(167) Mayor's Independent MMSD Audit Committee, *Final Report Presented to Mayor Tom Barrett* (October 1, 2004)

(168) Milwaukee Metropolitan Sewerage District, *Contract Compliance Office Monthly Report* (1998-2003)

(169) United Water Services, *Monthly Report for Milwaukee Metropolitan Sewerage District* (1998-2003)

(170) XCG Consultants Ltd, *Wet Weather Flow Optimization Study for Jones Island and South Shore WWTP* (December 5, 2001)

(171) Ibid.

(172) Milwaukee Metropolitan Sewerage District, *Wet Weather Standard Operating Procedures Memorandum* (March 20, 2003)

(173) 2001-2002 State of Wisconsin Joint Legislative Audit Committee, *An Evaluation, Milwaukee Metropolitan Sewerage District* (July 2002)

(174) United Water Services, on behalf of MMSD, *Discharge Monitoring Report* for Permit No. 0036820-1 (1997-2003)

(175) Milwaukee Metropolitan Sewerage District, Contract Compliance Office, *Annual Summary of United Water Services Performance* (1999-2003)

(176) Paul Schlecht (MMSD), e-mail correspondence to Jeff Schilling, Mike Archer and author re: 2020 Facilities Plan - annual Milorganite® request (May 3, 2005)

(177) Milwaukee Metropolitan Sewerage District, Contract Compliance Office, *Annual Summary of United Water Services Performance* (1999-2003)

(178) Ibid.

(179) Milwaukee Metropolitan Sewerage District, *Compliance Maintenance Annual Reports*, provided to WDNR (1999-2003)

(180) Ibid.

(181) Milwaukee Metropolitan Sewerage District, Contract Compliance Office, *Annual Summary of United Water Services Performance* (1999-2003)

(182) Don Theiler and Brown and Caldwell, *United Water Performance Evaluation, Final Report* (June 20, 2003)

(183) State of Wisconsin Circuit Court, *Stipulation: State of Wisconsin, Plaintiff v. Milwaukee Metropolitan Sewerage District, Defendant*, Case No. 02-CV-2701 (May 29, 2002)

(184) Brown and Caldwell, MMSD CMOM Readiness Review and Implementation Strategy Development Strategic Plan (December 2005)

(185) 2001-2002 State of Wisconsin Joint Legislative Audit Committee, *An Evaluation, Milwaukee Metropolitan Sewerage District* (July 2002)

APPENDIX 4A

MMSD ANNUAL AVERAGE FLOW AND WASTELOAD REVIEW

PARAMETER	ACTUAL 1997	ACTUAL 1998	ACTUAL 1999	ACTUAL 2000	ACTUAL 2001	ACTUAL 2002	ACTUAL 2003	% of Total 2003	% Change from 1997-2003
BILLABLE FLOW BY USER CATEGORY (Units in 1000 Gallons/Year unless otherwise specified)									
RESIDENTIAL	21,970,860	21,925,500	21,897,188	21,936,098	21,741,458	21,656,523	21,483,237	52.1%	-2.2%
(MGD)	60.2	60.1	60.0	60.1	59.6	59.3	58.9		
COMMERCIAL	13,995,962	14,534,054	14,264,906	14,523,896	14,483,572	14,322,497	14,088,877	34.2%	0.7%
(MGD)	38.3	39.8	39.1	39.8	39.7	39.2	38.6		
NON-CERTIFED	11,985,728	12,240,159	11,925,638	12,096,984	12,065,114	12,012,446	11,966,565		-0.2%
CERTIFIED COMMERCIAL	2,010,234	2,293,895	2,339,268	2,426,912	2,418,458	2,310,051	2,122,312		5.6%
CERTIFIED INDUSTRIAL	8,176,761	7,597,625	7,123,121	6,854,383	5,899,904	5,789,083	5,680,189	13.8%	-30.5%
(MGD)	22.4	20.8	19.5	18.8	16.2	15.9	15.6		
TOTALS	**44,143,583**	**44,057,179**	**43,285,215**	**43,314,377**	**42,124,934**	**41,768,103**	**41,252,303**	**100.0%**	**-6.5%**
Average Billable (MGD)	120.9	120.7	118.6	118.7	115.4	114.4	113.0		-6.5%
Average I/I (MGD)	102	102	103	102	102	102	101		-1.0%
Total Flow (Billable + I/I)(MGD)	223	223	222	221	217	216	214		-4.0%
Design Daily Average (MGD)	236	236	236	236	236	236	236		
WWTP FLOW COMPARISON									
Jones Island Average (MGD)	113.2	107.2	108.9	109.5	109.8	97.0	82.9	48.71%	-26.8%
South Shore Average (MGD)	99.5	114.6	111.3	107.0	106.0	95.5	87.3	51.29%	-12.3%
Total Average (MGD)	**212.6**	**221.7**	**220.2**	**216.5**	**215.8**	**192.5**	**170.1**	100.00%	**-20.0%**
Difference: Total & WWTP Flow	10	1	1	4	2	24	44		
BOD BY USER CATEGORY (Units in Pounds per Year unless otherwise specified)									
RESIDENTIAL	56,803,460	56,686,187	56,612,990	56,713,588	56,210,365	55,990,771	55,542,761	40.6%	-2.2%
(lb/d)	155,626	155,305	155,104	155,380	154,001	153,399	152,172		
COMMERCIAL	35,164,039	36,267,903	35,547,228	36,084,052	36,294,576	35,915,127	35,416,013	25.9%	0.7%
(lb/d)	96,340	99,364	97,390	98,860	99,437	98,398	97,030		
NON-CERTIFED	30,987,900	31,645,709	30,832,544	31,275,541	31,193,144	31,056,978	30,938,356		
CERTIFIED COMMERCIAL	4,176,139	4,622,194	4,714,684	4,808,511	5,101,432	4,858,149	4,477,657		
CERTIFIED INDUSTRIAL	60,050,728	51,889,609	54,459,510	55,147,427	48,269,827	47,251,683	45,848,941	33.5%	-23.6%
(lb/d)	164,523	142,163	149,204	151,089	132,246	129,457	125,614		
TOTALS	**152,018,227**	**144,843,699**	**146,619,728**	**147,945,067**	**140,774,768**	**139,157,581**	**136,807,715**	**100.0%**	**-10.0%**
Average Billable (lb/d)	416,488	396,832	401,698	405,329	385,684	381,254	374,816		-10.0%
Average BOD from I/I (lb/d)	25,437	26,271	27,105	27,522	28,356	28,773	29,190		14.8%
Total BOD (Billable + I/I) (lb/d)	441,925	423,103	428,803	432,851	414,040	410,027	404,006		-8.6%
Design Daily Average (lb/d)	523,000	523,000	523,000	523,000	523,000	523,000	523,000		
TSS BY USER CATEGORY (Units in Pounds per Year unless otherwise specified)									
RESIDENTIAL	67,797,679	67,657,707	67,570,343	67,690,411	67,089,790	66,827,698	66,292,972	49.4%	-2.2%
(lb/d)	185,747	185,364	185,124	185,453	183,808	183,090	181,625		
COMMERCIAL	41,791,067	43,118,764	42,270,016	42,912,645	43,193,906	42,729,002	42,149,467	31.4%	0.9%
(lb/d)	114,496	118,134	115,808	117,569	118,339	117,066	115,478		
NON-CERTIFED	36,985,559	37,770,685	36,800,133	37,328,872	37,230,527	37,068,006	36,926,425		
CERTIFIED COMMERCIAL	4,805,508	5,348,079	5,469,883	5,583,773	5,963,379	5,660,996	5,223,042		
CERTIFIED INDUSTRIAL	38,378,170	26,262,537	28,412,310	25,371,625	24,378,100	25,810,418	25,659,572	19.1%	-33.1%
(lb/d)	105,146	71,952	77,842	69,511	66,789	70,713	70,300		
TOTALS	**147,966,916**	**137,039,008**	**138,252,669**	**135,974,681**	**134,661,796**	**135,367,118**	**134,102,011**	**100.0%**	**-9.4%**
Average Daily (lb/d)	405,389	375,449	378,774	372,533	368,936	370,869	367,403		-9.4%
Average TSS from I/I (lb/d)	101,748	105,084	108,420	110,088	113,424	115,092	116,760		14.8%
Total TSS (Billable + I/I) (lb/d)	507,137	480,533	487,194	482,621	482,360	485,961	484,163		-4.5%
DesignDaily Average (lb/d)	580,000	580,000	580,000	580,000	580,000	580,000	580,000		

NOTES:

1) All data originally provided by MMSD Accounting Department from their records, except WWTP flows which are the annual averages of daily flows reported in monthly Discharge Monitoring Reports

2) Section 5 of the annual MMSD Cost Recovery Procedures Manual defines the User Categories in detail; however, there are two items to note here:

- Non-certified included both commerical and industrial customers who do not produce a process stream. All waste is discharged to MMSD sewers at domestic strength
- Certified commerial and industrial customers produce process waste that is monitored

THEREFORE FOR THIS ANALYSIS: COMMERICAL = Non-Certified + Certified Commericial because Non-Certified Breakdown Unknown

3) Individual values may not equal the total value for each parameter under each column due to rounding

WWTP Average Day Wasteloads	Design, Average Day (lb/day)	Year 2003 Wasteload (lb/day)	Percent of Total Wasteload (%)	Change Since 1999 (%)
BOD				
JIWWTP	299,000	246,000	59.7	-9.8
SSWWTP	224,000	166,000	40.3	13.2
TOTAL	523,000	412,000	100.0	-1.7
TSS				
JIWWTP	314,000	190,000	46.2	-26.8
SSWWTP	266,000	221,000	53.8	19.1
TOTAL	580,000	411,000	100.0	-7.7

WWTP Maximum Wasteloads	Design Wasteload (lb/day)	Actual Wasteload, 1999-2003 (lb/day)
	Maximum Daily Wasteload	
BOD		
JIWWTP	687,000	769,000
SSWWTP	515,200	470,000
TOTAL	1,202,200	1,239,000
TSS		
JIWWTP	722,000	1,448,000
SSWWTP	611,800	842,000
TOTAL	1,333,800	2,290,000
	Maximum Weekly Wasteload	
BOD		
JIWWTP	478,000	417,000
SSWWTP	336,000	249,000
TOTAL	814,000	666,000
TSS		
JIWWTP	534,000	734,000
SSWWTP	452,200	505,000
TOTAL	986,200	1,239,000

NOTES

1) Wasteloads were provided in UWS, Daily/Weekly Operating Reports (1999-2003) [UWS DWOR] with some verification from UWS on behalf of MMSD, Discharge Monitoring Report for Permit No. 0036820-1 (1997-2003) [DMR].

2) Influent BOD data not available for JIWWTP for all days in 1999 in UWS DWORs, filled in with DMR data where had available

3) Influent data which was verified as incorrect in DMR reports was discarded. Verified UWS DWOR data with all requested DMRs.

4) Influent maximum day and week TSS loadings may not be representative of actual maximum values according to notes in specific DMRs in which maximum values were reported. However, because values were not excluded from monthly averages reported to WDNR, values are used in this report.

mmsd
Preserving The Environment • Improving Water Quality

TABLE 4A-2
WASTELOADS TO THE WWTPs
2020 TREATMENT REPORT
5/25/07 TR_4-A.T4A02.07.05.25.cdr