Chapter 2: Description of Treatment Facilities

2.1 Introduction
This chapter defines the Milwaukee Metropolitan Sewerage District (MMSD) service area. It also describes the wastewater treatment facilities owned, operated, and maintained by MMSD; the biosolids recycling programs operated by MMSD; and gives a description of the energy facilities.

2.2 Milwaukee Metropolitan Sewerage District Service Area
The MMSD service area, shown in Figure 2.1, is divided into the areas served by Jones Island Wastewater Treatment Plant (JIWWTP), South Shore Wastewater Treatment Plant (SSWWTP), and the areas served by both treatment plants. Wastewater from areas served by both treatment plants can be diverted from one treatment plant to the other through maintenance diversions or wet weather diversions. The maintenance diversions always remain closed during normal system operations. Wet weather diversions are utilized during periods of high flow in the system. During dry weather, the wastewater flow that could be diverted by the wet weather diversions is typically treated at JIWWTP. These flows are diverted to SSWWTP during wet weather events. The conditions and means by which flow can be diverted are discussed in more detail in the Conveyance Report written in conjunction with this report.

The service area served by the city of South Milwaukee is also shown on Figure 2-1, because it is surrounded by the MMSD service area. The Southeastern Wisconsin Regional Planning Commission (SEWRPC) regional water quality management plan update, being written in conjunction with the Facilities Plan Report, includes a review of the city of South Milwaukee wastewater treatment facilities.(1)

2.3 Private Systems
No private systems have been identified within the service area; however, some private Wisconsin Pollutant Discharge Elimination System (WPDES) permit dischargers exist in the service area and are documented in Chapter 4, Watershed Assessment – Historical and Existing Conditions of the Facilities Plan Report.
2.4 The Milwaukee Metropolitan Sewerage District System

The wastewater treatment facilities owned by MMSD include the following:

- Inline Storage System Pump Station (ISS Pump Station)
- JIWWTP
- SSWWTP
- Biosolids Facilities (JIWWTP/SSWWTP/Interplant Solids Pipeline)
- Biosolids Recycle (Milorganite® and Agri-Life®)
- Energy Facilities

In addition, MMSD owns, operates, and maintains a network of interceptor sewers called the metropolitan interceptor sewer (MIS) system. The MIS system intercepts and conveys wastewater flows from locally-owned municipal sanitary and combined sewer systems within the service area to either JIWWTP or SSWWTP for treatment.

To optimize the MIS system and wastewater treatment plant capacities during wet weather events, flow can be diverted through active and passive diversions to the inline storage system (ISS), also referred to as the deep tunnel. The ISS consists of several tunnels located 300 feet below ground that have a combined capacity of 405 million gallons. The MMSD system will also have an additional 89 MG of storage in the Northwest Side Relief Sewer when it is put into service. These tunnels store wastewater until the wastewater treatment plants have available treatment capacity, at which time the tunnels are emptied at the ISS Pump Station located at JIWWTP.

A detailed discussion of the MIS and ISS systems is presented in the Conveyance Report.

2.4.1 Inline Storage System Pump Station

The ISS Pump Station has a designed pumping capacity of 150 million gallons per day (MGD). 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 for distribution to either JIWWTP or SSWWTP.

The ISS Pump Station process also includes an inline solids handling facility (ISHF) to process wastewater pumped out of the ISS that contains a high concentration of suspended solids. Operators have found that the suspended solids concentration of the wastewater in the tunnel is low enough that it is more practical to treat the flow with conventional methods. Therefore, ISHF has almost never been operated.

2.4.2 Jones Island Wastewater Treatment Plant

Most of the central portions of Milwaukee County and the city of Milwaukee are served by JIWWTP, as indicated in Figure 2-1. Located on Lake Michigan just south of downtown Milwaukee, JIWWTP receives both combined and separate sewer wastewater flows through two double-barreled siphons under the harbor entrance. The JIWWTP has been designated a National Historic Civil Engineering Landmark because the activated sludge wastewater treatment process, put into operation in 1925, was the first large scale application in the United States. Some of the original facilities exist today as the West Plant aeration basins and clarifiers.
JIWWTP has a design capacity to treat a maximum daily flow of 300 MGD and a peak hourly flow of 330 MGD. The wastewater treatment units at JIWWTP include influent flow measurement, influent pumping, mechanical bar screens, vortex type grit removal, primary clarifiers, aeration basins, secondary clarifiers, disinfection/dechlorination and effluent pumping. The site plan and a schematic of the treatment process at JIWWTP are shown in Figures 2-2 and 2-3 respectively.
Low-level and high-level screw pumps lift wastewater for gravity flow through plant.

Influent screens remove trash and screenings to landfill.

Grit removal basin.

Primary clarifiers to settle solids.

Grit to landfill.

Primary sludge to solids processing.

Wastewater from inline storage system.

Aeration basins where microorganisms consume soluble waste material (biochemical oxygen demand).

Secondary clarifier where effluent and microorganisms are separated.

Return sludge pumps return microorganisms to aeration basin.

Effluent pumps are used during high lake levels.

Secondary bypass.

Secondary clarifier where effluent and microorganisms are separated.

Waste sludge to Milorganite® production.

Disinfection basins where chlorine is added to kill harmful microorganisms.

Disinfected effluent to Lake Michigan inner harbor.

Raw wastewater.

Effluent pumps.

FIGURE 2-3
JIWWTP
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2.4.3 South Shore Wastewater Treatment Plant

Most of the wastewater generated from the southern, far western, and far northern portions of the MMSD service area as well as wastewater from the areas that can be diverted from JIWWTP are treated at SSWWTP, as shown in Figure 2-1. This facility, first completed in 1968, originally provided only primary treatment with a maximum daily capacity of 60 MGD. In 1974, SSWWTP was expanded to 120 MGD and upgraded to provide secondary treatment with the activated sludge process.

Due to additional expansions, SSWWTP currently has the capacity to treat a maximum daily flow of 250 MGD and a peak hourly flow of 300 MGD. A control gate at SSWWTP can limit the flow entering the plant during wet weather. The wastewater treatment units at SSWWTP include influent flow monitoring, mechanical bar screens, grit chambers, primary clarifiers, aeration basins, secondary clarifiers, disinfection/dechlorination, and effluent pumping. The site plan and a schematic of the treatment process at SSWWTP are shown in Figures 2-4 and 2-5, respectively. Other systems needed for treatment include waste pickle liquor storage and feed systems for phosphorus removal.

2.4.4 Biosolids Facilities

Different processes are used at JIWWTP and SSWWTP for treatment of biosolids. To allow greater flexibility in solids processing, biosolids from each plant can be pumped to the other via an approximately 11-mile long interplant solids pipeline. From SSWWTP, waste activated sludge (WAS) and digested sludge can be pumped to JIWWTP where it is incorporated into the Milorganite® production process. From JIWWTP, primary sludge is pumped to SSWWTP where it is anaerobically digested.

The solids treatment facilities at JIWWTP include gravity belt thickening, sludge equalization and blending, belt filter press dewatering, and rotary drum drying, as shown in Figure 2-6. These treatment processes typically handle raw (or undigested) waste activated sludge from JIWWTP and SSWWTP and a portion of the digested sludge from SSWWTP, though raw primary sludge from JIWWTP can also be processed. The end product is Milorganite®, a marketable fertilizer product that has been sold since 1926.

The solids handling facilities at SSWWTP include anaerobic digestion, centrifuge sludge thickening, filter press sludge dewatering, and liquid sludge storage, as shown in Figure 2-7. These facilities typically handle raw primary sludge from both JIWWTP and SSWWTP, along with a portion of SSWWTP raw waste activated sludge. If SSWWTP raw waste activated sludge is to be added to the anaerobic digesters, it must first be thickened using a dissolved air flotation thickening process. The digested sludge is sent either to JIWWTP as one component of the Milorganite® production or is thickened in the centrifuges and stored on-site. The stored thickened sludge is used as Agri-Life®, a product that is land-applied to farm fields as a liquid or as filter cake.

Milorganite® that does not meet a quality specification and excess filter cake is occasionally landfilled.
Gates at the plant Influent control the rates of flow to plant

Influent screens remove trash

Screenings dumpster to landfill

Primary sludge to digestion

Primary clarifiers to settle solids

Grit removal basin

Grit to landfill

Grit to landfill

Aeration basins where microorganisms consume soluble waste material (BOD)

Secondary clarifier where effluent and microorganisms are separated

Return sludge pumps return microorganisms to aeration basin

Waste sludge to Jones Island for Milorganite® production

Disinfection basins where chlorine is added to kill harmful microorganisms

Effluent pumps are used during high lake levels

Disinfected effluent to Lake Michigan

FIGURE 2-5
SSWWTP
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Ferric oxide is fed in a powder form and is used to maintain the Milorganite® guarantee.

Gravity belt thickeners remove some of the water from the liquid sludge.

Waste activated sludge and digested sludge from SSWWTP

JIIWWTP waste activated sludge

JIIWWTP primary sludge

Waste activated sludge receiving wet wells

Feed pumps

Filtrate to plant influent

Thickened sludge wet well

Thickened sludge pumps

Belt filter presses remove most of the water before the dryer

Dried sludge evaporates the remaining moisture, making a dry product

Dryers evaporate the remaining moisture, making a dry product

Dryer drum

Milorganite® to market

Waste heat from turbine power generation

Filtrate to plant influent

Waste activated sludge and digested sludge from SSWWTP

Interplant sludge pumps

Sludge to SSWWTP for anaerobic digestion

Equalization and blend tanks
Methane gas is produced in the anaerobic digesters and used for energy and to drive the blowers.

SSWWTP primary sludge

Anaerobic digesters reduce the volume of solids

JIIWWTP primary sludge

Thickened sludge storage

SSWWTP waste activated sludge

Dissolved air flotation thickener

Centrifuges remove most of the water

Thickened sludge pumps

High pressure air

Interplant sludge pumps

Centrate to plant influent

Sludge to JIIWWTP for Milorganite® production

Thickened sludge to presses and then to landfill

FIGURE 2-7
SSWWTP BIOSOLIDS FACILITY
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2.4.5 Recycling Biosolids (Milorganite® and Agri-Life®)

All publicly owned treatment works must comply with Title 40 of the Code of Federal Regulations, Part 503 (also known as the EPA Part 503 Biosolids Rule), which provides requirements for the management of biosolids produced during the treatment of wastewater. The rule encourages the beneficial reuse of biosolids while regulating landfill disposal and incineration. As discussed above, heat-dried sludge produced in dryers at JIWWTP is marketed as Milorganite®, a Class A biosolid as defined by the EPA Part 503 Biosolids Rule. Milorganite® is sold as a fertilizer product to a variety of end-users and due to its Class A rating, the land application of the product is largely unregulated. Milorganite® is stored in silos located at JIWWTP to accommodate seasonal fluctuations in Milorganite® sales.

As discussed above, the digested sludge produced at SSWWTP is marketed as Agri-Life®, a product that has been land applied since 1975. Agri-Life® is considered a Class B biosolid by the EPA Part 503 Biosolids Rule, and therefore is more highly regulated. The digested sludge is stored on site until it can be applied to agricultural land in either the spring or fall seasons. The MMSD owns and maintains a fleet of vehicles that both haul and land apply Agri-Life®.

2.4.6 Energy Facilities

Most of the electricity at JIWWTP is generated through 2 General Electric Frame 5 turbine generators, each rated for 15 mega watts of power. Plant loads generally require between 10 and 12 mega watts, so only one turbine needs to operate at a single time while the other turbine remains available as a back up. The two turbines were installed in the mid-1970s and were refurbished in 1996.

Waste heat from the turbines is used in the sludge drying process. During on-peak periods the turbines are operated to avoid peak demand charges. At night, the turbines produce only enough waste heat to operate the dryers with the remaining electrical power purchased from the electric company.

Electricity from the power company can be purchased and provided through the Dewey Substation or the Harbor Substation, though the Dewey Substation serves as the primary source of power. Though the same power company provides these two sources, they operate at different phases; therefore, power cannot be coming from both sources simultaneously unless the equipment receiving power from one substation is isolated from the other substation.

Natural gas provided to the site is used primarily to generate electrical power. Natural gas can also be used for sludge drying and to provide some building heat.

At SSWWTP there are two parallel electrical power supplies, either of which can serve as the primary source of power. An automatic transfer switch monitors the primary power source and will automatically transfer to the back-up power source should the primary power fail.

In addition to electrical power, the digester gas produced from the anaerobic digesters powers one or more of the process air blowers and an electrical generator. The electrical generator is used primarily for peak shaving, as it is not sized to handle the full electrical load at the treatment plant.

Heat recovered from the blowers and the electrical generator is captured by the hot water system and used to heat the digesters and some buildings.
References