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TREATMENT FACILITIES

Background

MMSD owns and operates the NSWTP, which treats wastewater collected from the greater Madison metropolitan area. Figure 5-1 shows the general layout of the treatment and support facilities at the plant. Figure 5-2 shows the MMSD property in the vicinity of the NSWTP.

Nine Springs Wastewater Treatment Plant

The NSWTP receives wastewater being pumped to the plant and pumps treated effluent to Badfish Creek in the lower Rock River basin and Badger Mill Creek in the Sugar River basin via two effluent force mains. Both discharge outfalls are regulated by a WPDES Permit issued by the WDNR in 2009, which will expire in 2014. The major discharge limits are summarized in Table 5-1. The biosolids are land applied to agricultural land after anaerobic digestion. The plant has a rated average flow capacity of 57 mgd and a peak flow capacity of 140 mgd. Detailed evaluations of the existing treatment processes at the NSWTP are provided in Appendix A, TM1 – Review of Existing Treatment Facilities.

Table 5-1. Summary of Current WPDES Permit for the Nine Springs WWTP (April 1, 2009 - March 31, 2014)

Effluent Characteristics	Units	Monthly Average	Weekly Average	Daily Minimum	Daily Maximum	Geometric Mean
Badfish Creek Outfall						
BOD_5, Total	mg/L	19	20			
BOD_5, Total*	lb/day[1]	7,923	8,340			
TSS	mg/L	20	23			
TSS*	lb/day[1]	8,340	9,591			
DO	mg/L			5.0		
pH				6.0	9.0	
Phosphorus, Total	mg/L	1.5				
Fecal Coliform (April 15 – October 15)	#/100 ML					400
NH_4-N (May – September)	mg/L	1.8	4.4		17	
NH_4-N (October – April)	mg/L	4.1	10		17	
Badger Mill Creek Outfall						
BOD_5, Total (November – April)	mg/L		16			
BOD_5, Total (May – October)	mg/L		7.0			
TSS (November – April)	mg/L	16				
TSS (May – October)	mg/L	10				
DO	mg/L			5.0		
pH				6.0	9.0	
Phosphorus, Total	mg/L	1.5				
Fecal Coliform (April 15 – October 15)	#/100 ML					400
NH_4-N (October – April)	mg/L	3.8	8.7		11	
NH_4-N (May – September)	mg/L	1.1	2.6		11	
Chloride	mg/L		400			

** All loadings are calculated based on the nominal design average flow of 50 mgd.*

Liquid Treatment Facilities

The liquid treatment facilities at the NSWTP include preliminary treatment, primary clarification, nitrifying activated sludge treatment incorporating biological phosphorus removal, ultraviolet (UV) disinfection, excess flow storage and effluent pumping. Figure 5-3 shows the schematic of the liquid treatment process at the NSWTP. The liquid treatment facilities, including the primary clarifiers, aeration basins and secondary clarifiers, are divided into two complexes; the East Complex and the West Complex. The East Complex includes Plant 1 and Plant 2, and the West Complex includes Plant 3 and Plant 4. The treatment facilities included in each plant are shown in Table 5-2.

Table 5-2. NSWTP Sub-Plant Descriptions

Treatment Facility	East Complex		West Complex	
	Plant 1	**Plant 2**	**Plant 3**	**Plant 4**
Primary Clarifier	No. 1-2 No. 5-6 No. 7-16		No. 17-21	
Aeration Basin	No. 1-6	No. 7-9 No. 10-18	No. 19-24	No. 25-30
Secondary Clarifier	No. 1-6	No. 7-11	No. 12-15	No. 16-19

The detailed descriptions of liquid treatment facilities are presented as follows:

- **Headworks**
  The existing headworks include influent flow measurement, fine screening, grit removal by vortex grit basins, and a weir flow splitting structure distributing flows to the East and West Complexes. It also includes screenings and grit processing equipment, the plant water system, and the septage receiving facility. Wastewater enters the headworks facility via influent force mains. Flow is measured by Venturi flowmeters on each force main before proceeding through fine screens. After screening, the flow continues to vortex grit basins. Screenings are conveyed by a sluice trough to screenings processing units. Grit from the vortex grit basins is pumped to grit processing units. Processed screenings and grit are conveyed to roll-off containers by a reversible belt conveyor.

Flow exiting the grit basins enters the flow splitting structure and is distributed to the East and West Complexes through weir troughs with manual stop plates.

- **Flow Splitter**
  The existing flow splitter was constructed during the plant's Tenth Addition. The structure splits screened and degritted plant flow between the East and West Complexes using fixed weir flow splitting structures.

- **Primary Settling Facilities**
  There are 14 primary clarifiers in the East Complex and 5 primary clarifiers in the West Complex. All clarifiers are rectangular units with chain and flight sludge removal mechanisms. Settled primary sludge is pumped to gravity thickeners for thickening before being digested.

- **Aeration Basins**
  Biological treatment of the primary effluent occurs in the aeration basins. There are 18 aeration basins in the East Complex and 12 in the West Complex. The aeration basins are configured such that each group of three aeration basins functions as one "folded" treatment unit. Thus, there are 6 treatment units in the East Complex and 4 treatment units in the West Complex. Aeration tank effluent proceeds into the secondary clarifiers for settling. The existing secondary treatment facility is an enhanced biological phosphorus removal (EBPR) system with two process configurations being utilized – The University of Cape Town (UCT) Variation process, which is utilized for the majority of the plant, and the anaerobic/aerobic (A/O) process.

  The UCT process consists of anaerobic, anoxic and aerobic zones. Influent wastewater enters the anaerobic zone and is combined with recycle from the anoxic zone. Mixed liquor then flows into the anoxic zone that is created by pumping return activated sludge (RAS) from the final clarifiers. The mixed liquor then proceeds into the aerobic zone for further treatment.

  The A/O process is utilized in 2 of the 3 treatment units of Plant 1. In the A/O process, the anoxic zone is eliminated and RAS is combined with the influent wastewater in the anaerobic zone. Following the anaerobic zone, the mixed liquor flows to the aerobic zone.

- **Secondary Clarification Facilities**
  Effluent from the aeration tanks flows to secondary clarifiers for settling. There are 11 secondary clarifiers in the East Complex and 8 in the West Complex. The

effluent of the secondary clarifiers flows to UV disinfection facilities before being discharged. The RAS is pumped to aeration tanks while waste activated sludge (WAS) and scum are pumped to dissolved air floatation (DAF) thickeners for thickening before being digested.

- **UV Disinfection Facilities**
  UV disinfection facilities disinfect the effluent from the secondary clarifiers. The existing UV disinfection system is an open channel, low pressure mercury vapor type. There are a total of 7 channels, 5 of which are installed with UV disinfection equipment, one is reserved for future equipment, and the seventh channel is used as a by-pass channel when the UV system is out of service. Each of the five channels has two UV banks in series. Normally two to four channels are in service with one bank of lamps operational. During peak flow rates, additional UV channels are added to meet the flow demands. Channels are brought online and taken offline by automatically controlled motorized gates installed on the inlet of each channel.

- **Plant Effluent Pumping Facilities**
  The existing effluent pumping facilities were constructed during the plant's Seventh Addition. The plant effluent is pumped to Badfish Creek through a 54" force main of 5 miles and to Badger Mill Creek through a 20" force main of 10 miles. The Badfish Creek effluent pumps consist of five horizontal split case centrifugal pumps, each with an 800 hp, 880 rpm motor. Three pumps are outfitted with 25.94" diameter impellers and two are equipped with impellers trimmed to 24" to save energy when lower flow rates are practicable. The Badger Mill Creek effluent pumps include two centrifugal pumps, each with a 200 hp, variable speed motor. Each pump has a capacity of 2,000 gpm at a total dynamic head of 190 feet.

- **Effluent Storage Facilities**
  The plant has two effluent storage tanks and an effluent storage lagoon for plant effluent storage. The disinfected effluent beyond effluent pumping capacity and up to an estimated flow rate of 115 mgd overflows to effluent storage reservoirs. The effluent storage reservoirs, in turn, overflow to the effluent storage lagoon when their maximum storage capacities are reached. Flows in excess of 115 mgd (estimated) receive secondary treatment and are diverted to the effluent

equalization facilities. This estimated flow rate is based on a flow split at the flow splitter of 45 percent to the east side of the plant and 55 percent to the west side of the plant. At a total flow of 115 mgd, the East Complex flow would be 52 mgd which is the flow rate from the east side final clarifiers at which bypassing of secondary effluent was observed previously. The effluent equalization facilities (storage lagoons) have a nominal volume of 50 MG. When this volume is exceeded, an overflow structure diverts additional flows to the ditch on the north side of the lagoons. Flow in the ditch discharges to Nine Springs Creek, which in turn discharges to Lake Waubesa. Discharges to the effluent equalization facilities are pumped back to the secondary process when the plant peak flow subsides. Since the effluent storage lagoons are open to the atmosphere, effluent storage volume is reduced by 1.3 million gallons for each inch of precipitation.

Biosolids Disposal Facilities

The biosolids production facilities at the NSWTP include primary sludge thickening by gravity thickeners, waste activated sludge thickening by DAF thickeners, anaerobic digestion, digested sludge thickening by gravity belt thickeners, digested sludge dewatering by centrifuge, and onsite biosolids storage. Figure 5-4 shows the schematic of the biosolids production processes at the NSWTP.

- **Gravity Thickeners**
  Primary sludge is pumped into the gravity thickeners for thickening. The thickened sludge pumps operate continuously, typically one per thickener, to convey the thickened sludge to the anaerobic digester feed header, where it combines with thickened WAS. The combined stream is fed to the digesters. Operators manually adjust pump speed to maintain appropriate sludge blanket levels in the thickeners and minimum sludge flows to the digesters. Supernatant from the gravity sludge thickeners flows by gravity to the East Complex primary clarifiers.

- **Dissolved Air Flotation Thickeners**
  Waste activated sludge is continuously pumped to the dissolved air flotation (DAF) thickeners by the WAS pumps. Primary and secondary scum is also periodically pumped to the flotation thickener by the scum pneumatic ejectors. The flotation thickener components such as recirculation pumps, the skimmers, and the air compressor system operate continuously. The thickened sludge is transported to the thickened sludge wet well, and periodically pumped out by the DAF thickened sludge pumps. The thickener subnatant flows by gravity to the DAF Building and then to the gravity belt thickener (GBT) recycle well, or alternately to the east primary clarifiers.

- **Anaerobic Digesters**
  Anaerobic digestion occurs in two locations, the West Complex and the East Complex. The West Complex consists of three digesters (Nos. 1, 2, and 3) and two Sludge Storage Tanks (Nos. 1 and 2). The East Complex consists of four digesters (Nos. 4, 5, 6, and 7). During the Tenth Addition Sludge Storage Tank 3 was converted to Digester 6 and Digester 7 was constructed.

  A Temperature Phased Anaerobic Digestion (TPAD) system was implemented during the Tenth Addition. In this system Digesters 4, 5, and 6 were to be operated at thermophilic temperatures in a batch mode. Each of these digesters was to sequentially cycle through filling, holding, and withdrawing periods. The holding cycle time would vary between 12 to 24 hours depending on the thermophilic temperature being maintained in the digester to allow the biosolids to meet the EPA time/temperature requirements to attain Class A biosolids. The biosolids withdrawn from these digesters were to be sent to Digester 7 for a period of time to cool before they were pumped to Digesters 1, 2, and 3 for mesophilic anaerobic digestion.

  Due to various operational issues, the digestion process is being reconfigured. Currently thickened primary sludge and thickened waste activated sludge are pumped continuously into one of the seven digesters on a rotating basis. It is expected that the digestion operation will be changed to an acid-gas phased digestion system. The thickened primary and waste activated sludges will be sent to one or two acid digesters having a very short detention time. Further digestion of this material will occur at thermophilic temperatures in the seven existing digesters and a new Digester 8.

- **Digester Gas Compression, Treatment and Storage**
  Digester gas is collected from digesters Nos. 4, 5, 6 and 7, and piped to the gas control rooms in Sludge Control Building (SCB) 2. The gas from each digester passes through a dedicated foam separator and is drawn to gas boosters in SCB 2. A portion of the gas is drawn into mixing compressors, is recycled and used to mix the contents of these four digesters. Digester gas from digesters Nos. 1, 2 and 3 is piped to the same header which is tied to the gas boosters in SCB 2. The gas storage in Sludge Storage Tanks 1 and 2 is also tied to this same header, and the storage tanks serve to control the pressure in the raw gas piping. When gas pressure reaches approximately 7.5 inches water column (w.c.), the gas holder covers will begin to rise and store gas. When the cover exceeds 75 percent full, the pressure will begin to rise until it reaches 9.2 inches w.c. When the covers are full, the waste gas is flared, or the gas will release around the sides of the floating covers.

All gas produced is diverted to gas boosters that raise the gas pressure for transport to the gas treatment facilities outside of SCB 2. The boosters discharge through gas treatment which includes hydrogen sulfide removal using iron-impregnated wood chips, moisture removal using a condenser and chiller, and siloxane removal via carbon filtration. Gas from the treatment system is reheated to 80 degrees F and returned to the gas system at a pressure of 3 psi.

Treated gas is used as fuel for six hot water boilers (three in the Boiler Building and three in SCB 2) and three gas engines. Two gas engines in SCB 2 drive 475 KW induction generators. The third engine in the East Blower Building drives a positive displacement air blower. Surplus gas is flared through a waste gas flare, located near SCB 2.

When digester gas pressure and storage volume is low, a natural gas blending system is started and blended gas is used to supplement the digester gas. This gas is generally used to fuel the three boilers in the Boiler Building and the blower engine.

Natural gas is also available for direct use by the boilers in SCB 2.

- **Sludge Heating System**
  Digester heating for the East Complex is provided by heat recovered from generator engines located in SCB 2. Heat recovered from the generator engines is the primary heat source. Three boilers located in SCB 2 provide supplemental heating for the process hot water system. Each boiler has a rated capacity of 5.9 MMBtu per hour, or 50% of the total process heating requirements with one of the boilers used as a standby. These boilers can use digester gas or natural gas as a fuel source. The existing process heating system is used for heating Digesters No.1, 2, and 3. The three boilers in the Boiler Building have a rated unit capacity of 4.3 MMBtu per hour and will be sufficient for meeting the heating requirements for Digesters 1, 2 and 3 and the West Zone.

- **Digested Sludge Storage Tanks**
  The digested sludge storage tanks provide a reservoir for digested sludge and digester gas to facilitate downstream sludge dewatering and gas utilization operation. Biosolids flow by gravity from the west digesters to the storage tanks and are pumped from the east digesters to the storage tanks. Digester gas is stored in the floating gas holder covers.

- **Gravity Belt Thickeners**
  The GBT feed pumps pump digested sludge from either sludge storage tank to the GBTs for thickening. One of the GBTs also serves as a backup to the DAF thickeners in the event one of the DAF thickeners is out of service. The thickened

sludge is transferred to the Metrogro Storage Tanks. GBT filtrate and belt washwater flow by gravity to the recycle wet well. The GBT recycle pumps pump recycled water to the plant flow splitter.

The GBT polymer system consists of both a dry polymer feed process and a liquid feed process and is located in the GBT Building and the GBT Polymer Building. The polymer system is sized for two GBTs operating at peak capacity. When one of the DAF thickeners is out of service, polymer can be pumped to the operating DAF thickener to assist in thickening of the WAS.

- **Centrifuge**
  The existing centrifuge was installed during the plant's Tenth Addition to produce a dewatered cake material needed to support the development of a Class A soil-like end product (MetroMix). The centrifuge is in good condition. The centrifuge dewaters digested sludge, which is then transported to the Biosolids End-Use Production Building on a belt conveyor. One centrifuge is installed, and sufficient space is available in the Dewatering Building for a second unit. The centrifuge polymer system is sized to provide polymer for two centrifuges. To date, the centrifuge has been used on a limited basis due to the challenges the District has encountered with implementing a Class A digestion process.

- **Metrogro Storage Tanks**
  Thickened biosolids (Metrogro) are stored in the three existing Metrogro storage tanks with a total volume of 19.4 million gallons. Each tank is covered with an aluminum dome to collect odorous air and is equipped with six 15-horsepower submersible propeller mixers to provide a uniform feed for the Metrogro land application program.

- **Biosolids End-Use Production Facility**
  The Tenth Addition Facility Plan called for approximately 10-25% of the biosolids to be dewatered and mixed with amendment materials to produce a "soil-like" end product (MetroMix). The end-product is designed to complement but not compete with the Metrogro Liquid Land Application Program. Space is provided in the facility to store dewatered cake, amendment materials, and final product. The facility has a covered asphalt pad and an additional paved work area that is not covered.

- **Plant Water System**
  The existing plant water system was installed during the plant's Tenth Addition to provide non-potable water use for the treatment processes. The plant water system is equipped with booster pumps, automatic strainers, and a disinfection system.

The plant water system serves gravity belt thickeners, centrifuge, digester/storage tank cleaning, liquid ring gas compressors for the digester confined gas mixing system, headworks facility, odor beds, polymer make-up systems and general washdown.

Operation and Maintenance Facilities

The MMSD operation and maintenance facilities include Operations Building, Maintenance Shop Nos. 1 and 2; Storage Building Nos. 1, 2 and 3; Service Building, and Vehicle Loading Buildings. The plant maintenance staff has identified the following items to be addressed and improved for the operation and maintenance facilities:

Personnel Facilities:

- Laundry area
- Lunchroom
- Locker room facilities with showers
- Restrooms

Office and Support Facilities:

- Office area for supervisors
- Office area for purchasers
- Purchasing section is close to the Maintenance Shop and induction heater, which makes a lot of noise.
- Library area – O&M manuals, plans, vendor manuals, etc.
- Computer work space/desks
- Parking area
- Wireless network

Maintenance Facilities

- Work space for mechanics and electricians
- Work space for Monitoring Services/Sewer Maintenance
- Work space for Building and Grounds crew
- Welding and machining areas
- Vehicle maintenance area
- Loading dock and drive up delivery area
- Sandblasting and pump washing areas
- Painting room
- Drive-through vehicle parking areas

Storage Facilities

- Inventory area and un-inventoried parts storage area
- Tool and equipment storage for mechanics
- Tool and equipment storage for electricians
- Tool and equipment storage for Monitoring Services/Sewer Maintenance
- Tool and equipment storage for Building and Grounds crew
- Vehicle storage
- Portable pump storage
- Large parts storage area for spares, mixers, maci pumps, heads, old breakers, etc.

Plant Hydraulics Analysis

The plant consists of four main sections – headworks, West Complex treatment train, East Complex treatment train, and ultraviolet (UV) disinfection and effluent pumping. The headworks contain fine band screens, grit basins, and a weir flow splitter to control the flow distribution between the East Complex and the West Complex. Each treatment train includes rectangular primary clarifiers and aeration basins followed by circular secondary clarifiers. The UV disinfection receives flow from both the East and West Complexes and discharges final treated effluent by pumps to receiving water bodies. Gravity flow and a series of weirs govern the hydraulics of the NSWTP with the final effluent pumps and return activated sludge pumps being the only pumps affecting the overall plant hydraulics of the liquid stream.

During the master planning, a plant hydraulic spreadsheet was developed to determine the overall hydraulic capacities and to identify potential hydraulic bottlenecks at the NSWTP. The hydraulic model is programmed to allow the user to examine each section of the plant separately. Figure 5-5 shows the schematic diagram of the NSWTP hydraulics as modeled in this analysis.

The hydraulic model was utilized to estimate maximum flows under different conditions. The following 4 scenarios were analyzed to determine the maximum hydraulic capacities of the plant:

- **Scenario No.1 – Status Quo without Constraint**
  No modification was made to the existing facilities. The structure minimum freeboard was set to zero. No limit was set to the primary and secondary clarifier overflow rates.

- **Scenario No.2 – Status Quo with Constraints on Clarifier Overflow Rates**

No modification was made to the existing facilities. The primary and secondary clarifier overflow rate upper limits were set to the pre-determined values.

- **Scenario No.3 – Status Quo with Constraints on the freeboard Heights**
  No modification was made to the existing facilities. The structure minimum free board was set to be 1.0 ft. No limit was set to the primary and secondary clarifier overflow rates.

- **Scenario No.4 – Diversion from Splitter Structure to Effluent Storage Lagoon**
  In this scenario, a 72" excess diversion flow pipe was added from the flow splitter structure to the excess flow storage lagoons. Excess flow during peak flows will be diverted to lagoons. The structure minimum freeboard was set to zero. No limit was set to the primary and secondary clarifier overflow rates.

The hydraulic model analysis results are presented in Table 5-3.

Table 5-3. Plant Hydraulic Analysis Results

Parameters	Scenario #1	Scenario #2	Scenario #3	Scenario #4
Maximum Total Plant Flow (mgd)	169	76	140	249
East Complex Flow (mgd)	91	36	71	91
West Complex Flow (mgd)	78	40	68	78
Excess Flow Diverted from Flow Splitter to Lagoons (mgd)	0	0	0	80
Effluent Building Flow (mgd)	125	76	116	125
Disinfected Effluent Overflow (mgd)	44	0	34	44
Secondary Treatment Effluent Overflow (mgd)	44	0	24	44
Effluent Return Pump Pumping Rate (mgd)	82	76	82	82
East Primary Clarifier Overflow Flow (gal/sf/day)	4,600	1,500	3,439	4,600
West Primary Clarifier Overflow Flow (gal/sf/day)	3,890	2,000	3,425	3,890
East Secondary Clarifier Overflow Flow (gal/sf/day)	1,605	753	1,423	1,605
West Secondary Clarifier Overflow Flow (gal/sf/day)	915	471	806	915

With no constraints other than preventing wastewater from overflowing the treatment structures, the plant can accommodate a peak flow of 169 mgd with approximately 88 mgd being discharged to either the effluent storage lagoons or the Nine Springs Creek (Scenario #1). When constraints such as clarifier overflow rate and freeboard height, were added to the model, the overall plant hydraulic capacity dropped to 76 mgd and 140 mgd for Scenarios #2 and #3, respectively. Plant hydraulic capacity can be expanded to 249 mgd by adding a bypass pipe from the flow splitter to the effluent storage lagoon (Scenario #4). Under this scenario, the bypassed wastewater flow needs to be pumped back to the plant for treatment after wet flows subside. A detailed hydraulic analysis is included in Appendix A, TM1 – Review of Existing Treatment Facilities.

Other Regional Wastewater Treatment Plants

The following three regional wastewater treatment plants have potential to serve as satellite treatment plants for the MMSD system and decentralize the wastewater treatment operations:

- Village of Oregon Wastewater Treatment Plant
- Stoughton Wastewater Treatment Plant
- Sun Prairie Wastewater Treatment Plant

MMSD and consultants have made initial contact with those treatment plants. Currently, none of these treatment plants has shown an interest in joining MMSD.

Current Capacities and Deficiencies

A thorough evaluation was conducted in TM-1 to determine the actual capacities of each process component at the NSWTP. The projected loadings at each process component were then calculated using a mass balance model developed and calibrated during the MMSD Tenth Addition Facilities Plan. The mass balance model is configured to follow both the liquid and solids treatment trains at the plant.

The results of internal flows and loadings were then compared with the rated plant unit process capacities determined in TM-1 to determine any capacity deficiencies at different planning years. The comparison results are presented in Table 5-4.

Table 5-4. Unit Process Rated Capacity and Projected Utilizations

Parameter	Units	Rated Max Capacity	Year 2020		Year 2030		Year 2060	
			Flow & Loading	Capacity Utilization	Flow & Loading	Capacity Utilization	Flow & Loading	Capacity Utilization
Influent Flowmeter Max Hour Flow	MGD	163.3	129	79%	135	83%	173	106%
Fine Screening System Max Hour Flow	MGD	180	129	72%	135	75%	173	96%
Grit System Max Hour Flow	MGD	180	129	72%	135	75%	173	96%
Primary Tank Max Day Flow	MGD	102	66.5	66%	71	70%	84	83%
Primary Tank Max Hour Flow	MGD	102	129	126%	135	132%	173	170%
Aeration Basins Average Loading	lb O2/d	107,744	99,924	93%	117,002	109%	164,295	152%
Aeration Basins Max Day Loading	lb O2/d	154,604	153,711	99%	180,306	117%	250,329	162%
Aeration Blower Average Day Loading	scfm	88,000	46,425	53%	54,356	62%	76,327	87%
Aeration Blower Max Day Loading	scfm	88,000	71,414	81%	83,765	95%	116,296	132%
Secondary Clarifier Solids Loading	lbs/d	5,537,560	3,544,193	64%	4,321,631	78%	8,307,678	150%
Secondary Clarifier Max Day Hydraulic Loading	MGD	190	82.5	43%	87.9	46%	104.6	55%
Gravity Thickener Max Day Solids Loading	lbs/d	118,800	162,966	137%	185,438	156%	289,334	244%
Gravity Thickener Max Day Hydraulic Loading	gpm	1,980	900	45%	1,000	51%	1,400	71%
Dissolved Air Flotation Thickener Max Day Solids Loading	lbs/d	83,160	107,716	130%	123,595	149%	179,539	216%
Dissolved Air Flotation Thickener Max Day Hydraulic Loading	gpm	3,089	1,700	55%	1,800	58%	2,000	65%
Anaerobic Digester Max Month Solids Loading	lbs/d	153,000	153,746	100%	175,806	115%	264,160	173%
Anaerobic Digester Max Month Hydraulic Loading	gpd	389,000	386,461	99%	442,324	114%	661,333	170%
Gravity Belt Thickener Max Week Solids Loading	lbs/h	6,600	4,072	62%	4,994	76%	9,420	143%
Gravity Belt Thickener Max Week Hydraulic Loading	gpm	500	303	61%	346	69%	519	104%
Metrogro Biosolids Storage Tank Loading	gallon/180 d	19,403,232	25,006,320	129%	29,704,140	153%	54,649,440	282%

The unit process capacity utilization analysis shows that the projected loadings at the following facilities will exceed their respective rated capacities by 2030. These capacity deficiency issues are either being addressed by the current ongoing projects by MMSD or can be resolved by minor facility improvements:

- Primary Clarifiers (max hour flow) – As presented in TM1, the current operational data suggests that the existing primary clarifiers may be able to accommodate higher than rated hydraulic loadings and still maintain satisfactory TSS removal. Due to lack of recorded high hydraulic loading data, full scale hydraulic capacity tests are recommended to determine the actual hydraulic capacity of the existing primary clarifiers.

- Aeration Basins (average and max day organic loadings) – The capacity analysis shows that the projected average and maximum day organic loadings slightly exceed the rated aeration tank organic capacities. Design documents from the MMSD 9th Addition show that the existing aeration tanks still have space to install additional aeration diffusers. Preliminary analysis shows that, by adding additional diffusers, the organic capacity of the existing aeration tanks can be increased by 10 to 15 percent to meet the future capacity demand at 2030.

- Biosolids Disposal Facilities:
    - Gravity Thickener (max day solids loading)
    - Dissolved Air Floatation Thickener (max day solids loading)
    - Anaerobic Digester (max month solids loading)
    - Anaerobic Digester (max month hydraulic loading)
    - Metrogro Biosolids Storage Tank (not adequate for 180 days of storage)

MMSD has retained a consultant firm to review the existing biosolids disposal facilities at the NSWTP and to address the capacity needs to 2030.

Based on the previous discussion, MMSD could provide sufficient treatment capacity at the NSWTP to meet capacity needs to 2030 through facility capacity validations and minor facility improvements/upgrades. Therefore, before year 2030, any additional plant expansions or improvements will likely be driven by more stringent regulatory requirements rather than by capacity needs. After 2030, expansion of existing facilities will be required for capacity requirements. There is sufficient land available at the NSWTP site for any expansion required in the Master Plan.

Existing Facility Condition Assessment

The condition assessment of the existing building and structural facilities, mechanical equipment, and electrical equipment at the NSWTP was conducted by MMSD staff in late June and early July in 2008. A condition rating was provided for each asset considered, and an estimated year when major repair and/or replacement of the asset would be needed was also provided. The following scale was used for the condition rating:

1 – Excellent
2 – Good
3 – Adequate
4 – Poor
5 – Very Poor

The following scale as presented in Table 5-5 was used for estimating when major rehabilitation and replacement was needed:

Table 5-5. Condition Assessment Scale Definition

Period	Remaining Service Life	Years When Repair/Replacement Required
A	1-5 years	2011-2015
B	6 - 10 years	2016-2020
C	11-15 years	2021-2025
D	16-20 years	2025-2030
E	20-30 years	2040-2050
F	30-40 years	2050-2060

For the purposes of this assessment, work that would typically be included as part of the annual operations and maintenance budget was not considered major rehabilitation or replacement. For instance, the MMSD funded replacement of many building roofs at the plant in past years out of the O & M budget. The same work needed again in 20 to 30 years was not considered major rehabilitation or replacement for the purposes of the condition assessment. The asset breakdown for condition assessment matched the processes used in the Master Planning TM 1. The assets that supported particular processes were broken down into assets of a reasonable size and grouping for rating. The results of the condition assessment for the NSWTP facilities are summarized in Table 5-6. The more detailed condition assessment report is attached in Appendix L.

Table 5-6. Summary of the NSWTP Facility Condition Assessment

No.	Facility	Years When Repair/Replacement Required		
		Structural	Mechanical	Electrical
1	Headworks	F	B-F	E
2	Flow Splitter	F	F	-
3	Primary Clarifiers	C-E	A-D	B-C
4	Blower Buildings	F	C-D	A-E
5	Aeration Basins	F	A-F	D
6	Secondary Clarifiers	E-F	E	B-D
7	UV Disinfection Facilities	-	F	B
8	Sludge Control Buildings	E-F	C-F	-
9	Plant Effluent Pumping Facilities	F	C-E	E
10	Oil Storage Building	F	-	-
11	Primary Sludge Pumping Stations	F	-	-
12	Gravity Thickeners	F	D	C-E
13	Dissolved Air Floatation Thickeners	F	D	C-E
14	Anaerobic Digesters	D-F	B-F	E
15	Digester Sludge Storage Tanks	D	-	-
16	GBT Facilities	F	A-E	A-D
17	GBT Polymer Facilities	F	D-E	D
18	Centrifuge Facilities	F	D-E	D-E
19	Metrogro Storage Tanks	F	A-E	D
20	Vehicle Loading Facilities	F	A	C
21	Biosolids End-Use Facilities	F	-	-
22	Plant Water Facilities	-	C-E	D
23	Side Stream P Removal Facilities	F	C	A
24	Engine Generator			A-E
25	Gas Control Building	F	D-E	D
26	Boiler Building	E	D-E	C-D
27	Metrogro Vehicles	-	C	-
28	Nine Springs Power Distribution System	F	-	A-F
29	Process Control System	-	A-D	B-E
30	Plant Roads	B-E	-	D
31	Operations Building	F	C-D	A-C
32	Underground Piping at Nine Springs	-	A	
33	Badfish Creek Effluent Pumping Facilities	-	D-E	
34	Badger Mill Creek Effluent Pumping Facilities	-	F	
35	Maintenance Shops	F	D	C

No.	Facility	Years When Repair/Replacement Required		
		Structural	Mechanical	Electrical
36	Service Building	E	D	C
37	Storage Buildings	E-F	D	D

Budgeted Capital Improvement Projects

MMSD has prepared a list of capital improvement projects that have been scheduled for implementation between 2009 and 2018 to address the foreseeable system capacity needs and to improve the existing facility conditions. The original report is attached in Appendix K. A summary of the budgeted treatment facility capital improvement projects is presented in Table 5-7.

Table 5-7. Summary of Treatment Facility Capital Improvement Projects (2009-2018)

Account #	Project	Year of Implementation
822-00-40	Sugar River Plant Site Purchase	2009
440-00-21	Sugar River USGS Gauging Station	2009
822-00-55	Solids Handling Improvements	2009-2010
822-00-56	Septage Receiving Improvements	2009-2010
822-00-57	Eleventh Addition	TBD
822-00-59	Process Control System Upgrade	2009-2011
822-00-65	Operations Building HVAC Rehab	2011
828-55/440	MMSD Long Range Master Facility Plan	2009
828-57/440	Treatment Plant Asset Management Plan	2009
828-00-58	Solids Handling Facility Planning	2009
830-00-54	Telemetry System - Third Upgrade	2010-2011