4 Future Demand

4.1 PURPOSE

For the purposes of the 2050 Facilities Plan (2050 FP), demand is defined as the required use of an asset or asset system. The capacity of an asset or asset system to meet baseline or future demand projections (defined below) has a direct impact on asset system performance. If the demands placed on an asset exceed the capacity of the asset, it will likely result in failure to meet a level of service expectation of the asset. Therefore, understanding both baseline and future demand for asset systems is a necessary step to proactively meet demand needs and achieve level of service expectations, and is required by Wis. Admin. Code NR 110.09(j) and NR 110.10(1)(f). Demand is defined for this report as follows for each of MMSD's major asset systems:

- Conveyance and Storage – flows from wastewater dischargers (typically from upstream municipal sewers) and rainfall that enters the system
- Water Reclamation Facilities (WRFs) and Biosolids – flows from the Conveyance and Storage Asset System to the WRFs, along with the associated wasteloads
- Watercourse and Flood Management (WCFM) – flows from rainfall runoff
- Green Infrastructure (GI) – storage goals established by permit and internal organizational goals

A demand driver is a factor that could change the demand on an asset and impact asset performance. The purpose of this chapter is to summarize future demand projections for MMSD's asset systems by identifying the drivers that are anticipated to impact asset demand in the future, documenting the projected impact, and describing how demand is being managed as of 2019.

This chapter provides a summary of the asset system data. The details and background evaluations for baseline and future demand for each asset system are discussed in the following chapter appendices:

- Appendix 4A, Conveyance Future Demand
- Appendix 4B, WRFs and Biosolids Future Demand
- Appendix 4C, WCFM Future Demand
- Appendix 4D, GI Future Demand

The demand projections developed in this chapter are compared against existing asset system capacity in Chapter 5 to identify potential capacity-driven risks, which is one element of the comprehensive risk assessment conducted in Chapter 5 that also includes level of service or performance-based risks, physical mortality risks, and economic efficiency risks.

The 2050 FP establishes a planning period through Buildout, defined below, as well as the 20-year planning period of 2020 to 2040, which is consistent with WDNR facilities planning requirements. Three demand conditions were established: Baseline Conditions, Future Conditions, and Buildout Conditions. The general definitions for each of these conditions are provided below:

- **Baseline Conditions:** most recent available data set used as a reference point to compare Future Conditions and Buildout Conditions projections. For Conveyance and Storage, Watercourse and Flood Management, and Green Infrastructure Asset Systems, the 2010 population and land use data from the

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Southeastern Wisconsin Regional Planning Commission (SEWRPC) was used. The WRFs and Biosolids Asset System used WRF influent measured data from September 1, 2013 to August 31, 2016.

- **Future Conditions:** established as the year 2035 to align with MMSD's 2035 Vision and Strategic Objectives. [1] The 2050 FP assumes that conditions in 2040 will be substantially equivalent to conditions in 2035 because growth projections in the region historically have been more optimistic than actual growth; additionally, the assumption that 2040 conditions will be equal to 2035 conditions adds some justifiable conservatism to the projections.
- **Buildout Conditions:** estimated future demand conditions when the 2050 FP planning area is built out. Based on population and land use data from SEWRPC and assigned the year 2050 by MMSD for all asset system except the WRFs and Biosolids Asset System. Evaluations determined that Jones Island Water Reclamation Facility (JIWRF) Future Conditions are equivalent to Buildout Conditions. South Shore Water Reclamation Facility (SSWRF) Buildout Conditions are not anticipated to be met by 2050 based on recent data trends.

As noted above, the data used to develop each of the conditions vary between asset system. More specific details for each asset system are provided in Appendices 4A to 4D.

4.2 Factors Affecting Demand

There are several factors or demand drivers external to MMSD that can impact future demand for asset systems within the MMSD service area. The demand drivers identified in the 2050 FP are listed below.

- Service and Planning Area Changes, including economic growth, infiltration and inflow (I/I), and industrial user changes
- Climate Change
- Regulatory and Permit Changes
- Operating and Maintenance Contract Changes
- Changes in Customer Expectations
- Changes in Technology
- Conservation Efforts

The following sections provide a general description of each demand driver and list the potential ways that the drivers can impact each asset system.

Service and Planning Area Changes

Demands will be affected by changes in the area MMSD serves, the general economic growth in those areas, changes in I/I, and the addition or loss of one or more major industrial users.

Economic Growth

As stated in Chapter 1, MMSD uses two terms to describe the scope of its operations: service area and planning area. The MMSD service area is the area that is currently being served by MMSD. The MMSD planning area is the area MMSD is planning to service in the future. For the 2050 FP, the MMSD planning area as of 2019 has been expanded to include additional areas planned for possible service under Future or Buildout Conditions, which is defined as the 2050 FP planning area. The MMSD service area and 2050 FP planning area are presented in Figure 1-1 in Chapter 1. The expansion of planning area boundaries or growth within the service area can have significant impacts to demand. These additions result in additional residential, commercial, industrial, and I/I flows into the MMSD system.

Service area growth occurs through new development and re-development within municipalities. Comprehensive evaluations of future planning area growth were conducted during the facilities planning process and are outlined in this chapter. Growth within the service area is monitored regularly through MMSD's sewer plan review and approval process, which tracks actual growth against growth projections identified through facilities planning. Changes to planning area boundaries are less common and require approval by the Wisconsin Department of Natural Resources (WDNR), SEWRPC, and MMSD Commission. These changes require an analysis of impacts prior to approval and are often evaluated through a facilities planning process.

Growth projections for the 2050 FP were prepared by SEWRPC in collaboration with MMSD and municipalities within the projected future planning area. Details of the process implemented by SEWRPC and the data results are included in Appendix 1 of Appendix 4A, Conveyance Future Demand. Note that SEWRPC used different terminology in their study than what is used in the 2050 FP, which is explained in more detail in Appendix 4A. Significant details of the SEWRPC evaluation are listed below:

- Potential changes to the planning area included addition of portions of the Village of Caledonia and Town of Raymond and expansion of the planning area in Brookfield, New Berlin, and Menomonee Falls. Not all of these planning expansions have been formally applied for nor approved by the MMSD Commission, but were included to conservatively account for possible future flows.
- SEWRPC included evaluation of the City of South Milwaukee in their analysis. However, South Milwaukee has made major investments in the past 15 years based the recommendations in the SEWRPC Regional Water Quality Management Plan Update and useful life remains in those investments. [2] Therefore, flow from South Milwaukee was not included in modeling inputs for the 2050 FP. The question of whether to include South Milwaukee in the 2050 FP planning area in the future will be reviewed again during the development of the next facilities plan.

Infiltration and Inflow

Whether or not there is population and land use growth, I/I will need to be managed. If not addressed, I/I will continue to increase over time due to degradation of the entire sewer system, which will increase flows and reduce capacity for future demand while increasing the risk of basement backups and overflows and reducing MMSD's ability to meet the goal of zero overflows and zero basement backups. Consistent with WDNR requirements for wastewater facilities planning, the 2050 FP assumes that I/I from the currently-served areas (Conveyance Baseline Conditions) will remain constant and that the only I/I increase will be due to future economic growth. This assumption implies that municipalities and MMSD maintain their sewer systems so that I/I does not increase above baseline levels. An evaluation conducted during the development of the 2050 FP under a separate MMSD project determined this assumption was not realistic considering the diverging trendlines of aging infrastructure and municipal infrastructure budgets as well as the infancy state of addressing the I/I contribution from aging private sewer infrastructure. This is discussed in more detail in Chapter 5. Additionally, based on the trends documented in Climate Change Vulnerability Analysis, precipitation also is anticipated to increase I/I. [3] Alternative approaches to maintain I/I are discussed in Chapter 6. In practice, I/I reduction should be a component of any future capacity project and considered as an alternative or a component of an alternative. [4]

The future demand for I/I was computed by the Flow Forecasting System (FFS) program based on parameters described in Section 4.3. FFS is a modeling software that generates sewershed flows. In Conveyance Future

Conditions, additional growth is associated with new sewer lines and connections that contribute additional I/I. Recommendations for I/I management are included in Chapter 6. Additional information regarding the model is also provided in the Flow Generation Technical Memorandum (TM) (Appendix 4A-2).

Industrial User Changes

Another demand factor is the addition or loss of one or more major industrial users. Generally, industrial sources greater than 250,000 gallons per day (gpd) are represented in the conveyance model as point sources. The addition or loss of a major industrial user is anticipated to have a major impact on the ability of a WRF to treat flows and wasteloads. Likewise, significant changes in the amount or waste strength of a large industrial user's discharge could have a similar effect. For the 2050 FP, industrial user data within the JIWRF service area were used to evaluate the impact of the loss of a major industrial user to the influent flow rate, biochemical oxygen demand (BOD) wasteloads, and total suspended solids (TSS) wasteloads to JIWRF and the total WRFs wasteload projections. Because the impact to flow is anticipated to be small compared to the total flow in the Conveyance and Storage Asset System, this potential loss was not included in the Conveyance and Storage Asset System's future demand projections. Therefore, the impact was only reviewed under the WRFs and Biosolids Asset System due to the major decreases in BOD and TSS wasteloads (presented in Section 4.3).

The possible impacts that service and planning area changes are projected to have on demand for each asset system are presented in Table 4-1.

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TABLE 4-1: POSSIBLE IMPACTS FROM SERVICE AND PLANNING AREA CHANGES

Asset System	Impact
Conveyance and Storage	Projections for Conveyance Future Conditions indicate increases in population (16.5%), industrial (45.7%), and commercial (49.7%) growth over Conveyance Baseline Conditions. These increases are expected to increase average base sanitary flow by 34.3% in Conveyance Future Conditions over Conveyance Baseline Conditions.
WRFs and Biosolids	Projections for WRF Future Conditions indicate total increases from the WRF Baseline Conditions for the following average annual parameters: JIWRF Flow (11%), BOD (9%), TSS (10%), TP (48%), TKN (10%) SSWRF Flow (32%), BOD (27%), TSS (8%), TP (58%), TKN (33%) JIWRF is anticipated to reach Buildout Conditions by the year 2040. SSWRF is not anticipated to reach Buildout Conditions by the year 2050 but is anticipated to exceed Design Conditions for all parameters. Note that although most of these increases are due to changes in population and land use, some are due to other factors discussed later in this chapter.
Watercourse and Flood Management	Land use changes impact surface runoff and pollution generated from land surfaces that can affect flows and pollutant loads seen by the WCFM Asset System. Depending on the land use changes, increases or decreases in flows and pollutant loads can impact flooding, erosion, water quality, and overall health of the streams.
Green Infrastructure	Additional growth and increased imperviousness due to development will require additional GI assets. The GI Asset System focuses on a subset of the MMSD service area and is defined as the 20 municipalities participating in the GI Program as of February 2019, which is referred to as the "GI service area" in Appendix 4D, GI Future Demand. Although the focus of the GI program is on the GI service area, MMSD will continue to count assets throughout the entire MMSD service area toward the 740 MG GI KPI target identified in Chapter 3.

BOD – biochemical oxygen demand
GI – green infrastructure
JIWRF – Jones Island Water Reclamation Facility
TKN – total Kjeldahl nitrogen
TP – total phosphorus
TSS – total suspended solids
WCFM – Watercourse and Flood Management

Data source: Appendices 4A-4D

Climate Change

Climate change is predicted to have multiple negative impacts on water resources within MMSD's planning area. The review of historical data from 1950 to 2006 by the Wisconsin Initiative on Climate Change Impacts (WICCI), developed by the University of Wisconsin-Madison and the WDNR, indicated that southeastern Wisconsin has seen temperature and rainfall increases. [5]

The WICCI analysis was used as a resource to develop MMSD's Climate Change Vulnerability Analysis. [6] The Climate Change Vulnerability Analysis predicts an average summer temperature increase of 5 degrees Fahrenheit in the 2050 FP planning area by 2050 compared to the historical record baseline condition (1940 to 2004). The number of days with temperatures exceeding 90 degrees is predicted to increase from 12 to 25 per year. The WICCI analysis shows a pattern of increasing precipitation intensity in large events, but a decrease in the size and frequency of smaller events (i.e., more drought periods). The analysis also shows that more of the winter precipitation events are projected to be rain or freezing rain rather than snow.

The possible impacts to demand from climate change for each asset system are presented in Table 4-2.

TABLE 4-2: POSSIBLE IMPACTS FROM CLIMATE CHANGE

Asset System	Impact
Conveyance and Storage System	Climate change data from the Center for Climatic Research and the Nelson Institute of Studies at the University of Wisconsin-Madison is embedded in Buildout Conditions flows because the analysis predicted these impacts would occur by 2050, the year set for Buildout Conditions. The main impact is increased peak flows from precipitation intensity during large storms. Because the CCVA did not include projections for the year 2035, climate change data were not included in Conveyance Future Conditions (which are set at 2035).
WRFs and Biosolids	Climate change data from the Center for Climatic Research and the Nelson Institute of Studies at the University of Wisconsin-Madison is embedded in Buildout Conditions flows; wasteloads associated with those flows are also incorporated. Climate change is mostly anticipated to impact the peak flows WRFs need to process to limit overflows in the system. The impact to average annual flows and wasteloads from climate change is not anticipated to be significant when compared to system growth. Climate change data were not included in WRF Future Conditions.
Watercourse and Flood Management	Higher peak runoff from more intense precipitation events may result in a decrease in the level of protection provided by flood management facilities. Higher temperatures and extended drought periods may lead to decreased average and low flows in jurisdictional watercourses, resulting in a degradation of aquatic habitat and water quality, and a decrease in aquatic species viability. Specific impacts cannot be quantified until the watershed hydrology models are run with revised climatic data, which is not part of the 2050 FP.
Green Infrastructure	Climate change is predicted to have multiple negative impacts on water resources within MMSD's GI service area, and GI can help to mitigate these impacts. The demand for GI assets is therefore expected to increase because of greater rainfall intensity, although it is difficult to predict the specific extent.

Data source: Appendices 4A-4D

Regulatory and Permit Changes

This section focuses primarily on MMSD's WDNR Wisconsin Pollutant Discharge Elimination System (WPDES) permit and MMSD's WDNR air pollution control permits. This section also covers MMSD Rule changes and permit changes for dischargers that impact MMSD's asset systems. While permit changes do not change flows and/or wasteloads to the asset systems, they can change how MMSD reacts to demands relative to performance and operation by imposing more stringent effluent and air quality control limits. This can result in increased demand for energy, chemicals, processing capacity, or other increases in demand at the WRFs. For example, very stringent effluent permit limits could mean entirely new processes are needed. The WPDES permit, effective April 1, 2019, applies to all four asset systems. Changes to the WPDES permit and potential impacts to MMSD assets are covered in Table 4-3. MMSD Rule changes that could impact the asset systems are also included.

The air pollution control permits only apply to the WRFs and Biosolids Asset System. MMSD requested that the hourly SO2 emission limit of 1.73 pounds per hour (lb/hr) when combusting landfill gas be changed to 2.89 lb/hr

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as a part of the application for JIWRF Air Pollution Control Operating Permit # 241029250-P13. This application was completed March 4, 2018 and the permit was issued on May 7, 2019 with the revised SO2 limit. Future changes to either the JIWRF or SSWRF air permits are unknown at this time but could include greenhouse gas limits, primary comprised of carbon dioxide.

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TABLE 4-3: POSSIBLE IMPACTS FROM CHANGES IN THE WPDES PERMIT AND MMSD RULES

Asset System	Impact
Conveyance and Storage	WPDES permits for other dischargers in the 2050 FP planning area may impact flows into the MMSD system, specifically, the adoption of wasteload allocation (WLA) limits to watersheds total maximum daily load (TMDL) within the 2050 FP planning area, approved by the U.S. EPA. TMDL limits on NCCW dischargers and changes to MMSD's Chapter 11 Rule may mean that NCCW dischargers may choose to discharge to MMSD instead of directly to local waterways. Potential discharge limits on emerging contaminants or more stringent limits on conventional pollutants to other dischargers have not been implemented by WDNR but need to be tracked because implementation may have the same effect as the adoption of WLA limits discussed above.
WRFs and Biosolids	MMSD's new WPDES permit, issued April 1, 2019, includes changes to limits on Outfall 001 at SSWRF and changes to limits on Outfall 002 at JIWRF regarding discharge to the Milwaukee Outer Harbor on Lake Michigan. A major change is the adoption of WLA limits to Outfall 002, JIWRF, as included in the Milwaukee River Basin TMDL, approved by U.S. EPA. The TMDL WLAs impose weekly and monthly limits for TSS and monthly limits for TP. In addition, new sample points were added for Milorganite® at JIWRF and a new sample point was added at SSWRF for blending of flow during wet weather. Specific details regarding these changes can be found in Appendix 4B, WRFs and Biosolids Future Demand. Potential future discharge limits on emerging contaminants or more stringent limits on conventional pollutants have not been implemented as of the 2019 MMSD WPDES permit but should be tracked because implementation could have a significant impact on wastewater treatment. Changes to permitting requirements for entities within 2050 FP planning area that are anticipated to impact future wasteloads include the increase in orthophosphate added to drinking water for corrosion control by local water treatment plants, which is anticipated to increase TP to the WRFs. Changes to MMSD's Chapter 11 Rule may mean NCCW dischargers choose to discharge to MMSD instead of directly to local waterways, which will increase flow and TP to WRFs.
Watercourse and Flood Management	No impact on future demand is anticipated from the MMSD WPDES permit. TMDL limits on WPDES permits for other area dischargers may impact future demand by improving water quality within MMSD's jurisdictional streams. Changes to MMSD's Chapter 11 Rule provides another option for NCCW dischargers to reduce this source of phosphorus to the streams. MMSD will also continue to improve water quality through watercourse projects. Recent changes to MMSD's Chapter 13 Stormwater Rule require detention using GI for new impervious surfaces between 5,000 square feet (SF) and 0.5 acre (the threshold above which a stormwater management plan is required), which will further control stormwater to the jurisdictional streams.
Green Infrastructure	It is anticipated that WPDES permits issued through 2040 will include a total of 200 MG of GI retention capacity. TMDL limits on WPDES permits for other area dischargers may impact future demand. The demand for GI is also expected to increase because of new regulatory requirements in MMSD's Chapter 13 Rule that require GI for development/redevelopment that adds between 5,000 SF and 0.5 acre of new impervious surfaces (the threshold above which a stormwater management plan is required).

Data source: Appendices 4A-4D

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Operating and Maintenance Contract Changes

This section focuses on the contract between MMSD and Veolia Water Milwaukee (Veolia), along with maintenance contracts as noted in Table 4-4. The WRFs and conveyance system have been operated under an outsourced operating and maintenance (O&M) contract since 1998. Veolia, the operator as of 2019, has operated these systems since 2008. Veolia's O&M contract was extended to 2028 in a contract extension agreement dated June 27, 2016. [7] While Veolia's O&M contract requirements do not change flows or wasteloads to the asset system, a change in influent flows and wasteloads can change how MMSD manages Veolia's O&M contract relative to performance and operation. This can result in increased demand for energy, chemicals, processing capacity, or other increases in demand at the WRFs. Typically, Veolia's O&M contract requirements are more restrictive than permit limits. However, because the 2019 WPDES permit is more recent than Veolia's O&M contract, there are some limits in the 2019 WPDES permit that are more restrictive, which are discussed in this section. In addition to Veolia's O&M contract, MMSD manages watercourse maintenance contracts that are bid every three years with local contractors.

TABLE 4-4: POSSIBLE IMPACTS FROM OPERATING CONTRACT CHANGES

Asset System	Impact
Conveyance and Storage	No changes are anticipated to Veolia's O&M contract that will impact this asset system.
WRFs and Biosolids	No changes to Veolia's O&M contract are identified as of 2019. Note that some 2019 WPDES permit limits (TP and TSS mass limits at higher JIWRF flows, TP concentrations at both WRFs) are more stringent than the limits under Veolia's O&M contract.
Watercourse and Flood Management	No maintenance contract changes are anticipated. There are no plans to stop any of the watercourse maintenance contracts. In fact, work associated with these contracts continues to increase as properties to maintain are added through acquisitions or easements, MMSD assumes jurisdiction of more streams, and more stream restoration projects are completed.
Green Infrastructure	No changes to Veolia's O&M contract are anticipated. As MMSD grows its GI Asset System, it may want to develop new GI operating and/or maintenance contracts.

Data source: Appendices 4A-4D

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Changes in Customer Expectations

Although customer expectations do not necessarily impact influent flows and wasteloads, changes in customer expectations could have an impact on asset system demand. Changes in customer expectations continue to move toward a trend of higher performance. This desire for higher performance has been observed related to overflow volume and frequency, water quality, odor reduction, aesthetics of facilities, and other similar demands.

The possible impacts to demand from changes in customer expectations for each asset system are presented in Table 4-5.

TABLE 4-5: POSSIBLE IMPACTS FROM CHANGES IN CUSTOMER EXPECTATIONS

Asset System	Impact
Conveyance and Storage	Anticipate that customers' expectations will change as follows: increased expectations regarding odor, performance, the number of overflows or basement backups. Anticipate that this will result in the following impacts to the asset system: constant assessments of the asset system's level of service will be needed to determine if changes are required. Recognize that customers do not want basement backups and anticipate that this expectation will not change. The change is the increase in the risk that this expectation cannot be met under future flow demands due to projected increases in flow.
WRFs and Biosolids	Anticipate that customers' expectations will change as follows: expectations related to JIWRF odors, noise, and nuisance; potential SSWRF traffic concerns if changes are made to increase biosolids management from SSWRF; impacts to Milorganite customers; and recreational opportunities around JIWRF and SSWRF. Anticipate that this will result in the following impacts to the asset system: constant assessments of the asset system's level of service will be needed to determine if changes are required.
Watercourse and Flood Management	Anticipate that customers' expectations will change as follows: expectations that there will be fewer inundated structures and flooding considering the numerous improvements and expenditures (watercourse projects with green infrastructure included where appropriate). However, these expectations will have to be balanced with the flooding impacts of increasing stream flows. Anticipate that this will result in the following impacts to the asset system: constant assessments of the asset system's level of service will be needed to determine if changes are required.
Green Infrastructure	Anticipate that customers' expectations will change as follows: anticipate a significant increase in the demand for GI based on changes in customer expectations. Anticipate that this will result in the following impacts to the asset system: constant assessments of the asset system's level of service will be needed to determine if changes are required.

Data source: Appendices 4A-4D

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Changes in Technology

Changes in technology include new technology or existing technology being applied in new ways. Typically, changes in technology do not change demand but instead change how the demand is managed. The possible anticipated impacts from changes in technology for each asset system are presented in Table 4-6.

TABLE 4-6: POSSIBLE IMPACTS FROM CHANGES IN TECHNOLOGY

Asset System	Impact
Conveyance and Storage	The impact of GI on demand of the Conveyance and Storage Asset System should be monitored in asset management planning and in future facilities plans. Changes to technologies that would create more effective I/I mitigation or the creation of sewer materials less susceptible to I/I could reduce flow demand on the conveyance system during wet weather. Technological improvements or water conservation efforts by industrial and manufacturing facilities may reduce water consumption.
WRFs and Biosolids	If advanced industrial pretreatment technologies become cost advantageous to local industries, MMSD may see a decrease in industrial wasteloads to the WRFs. No other general changes in technology are anticipated for WRFs and Biosolids Asset System that would impact influent flows and wasteloads for the 2050 FP. The impact of GI infrastructure should be monitored in future facilities plans. In addition, implementation of cost-effective waste treatment technologies by industries prior to discharge to MMSD system should continue to be monitored.
Watercourse and Flood Management	The increase in GI is anticipated to enhance flood management practices and potentially reduce the demand on the WCFM Asset System, although the exact reduction of demand is unknown at this time. Additionally, the implementation of GI flow management technology (see below) will help enhance flood management practices. Anticipated reductions in stream flows from the introduction of increasing amounts of GI will have to be balanced with the future demands of the watersheds on the watercourses. Technological advances in GIS and hydraulic models may make floodplain mapping more efficient, making watercourse changes easier to predict and manage.
Green Infrastructure	Automatic control technology for the timing and rate of stormwater flow through existing (as of 2017) and new facilities has been developed that is anticipated to improve management of demand on GI infrastructure.

Data source: Appendices 4A-4D

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Conservation Efforts

Conservation is defined as "prevention of wasteful use of a resource." Conservation efforts that impact demand on MMSD's asset systems primarily relate to conservation of water use that reduces flows into MMSD systems. It has become common to identify water as a resource to be conserved, and MMSD has seen per capita per day residential water use decline from 68 gallons in 2002 to 54 gallons in 2016. [8] Over time, it will likely become more common to view other waste products from industry or residential use, such as phosphorus, as resources to be reclaimed, possibly upstream of entering MMSD's asset systems. This may further impact the flows and wasteload demands on MMSD's asset systems. MMSD has conservation partnerships and programs in place such as the Milwaukee River Watershed Conservation Partnership (MRWCP), which works to reduce agricultural runoff into the Milwaukee River. The Private Property Infiltration and Inflow (PPI/I) Program reduces I/I from private property sources. The GI Asset System itself is a conservation effort to reduce flow to the Conveyance and Storage and the Watercourse and Flood Management Asset Systems. The possible impacts to demand from changes in conservation for each asset system are presented in Table 4-7.

TABLE 4-7: POSSIBLE IMPACTS FROM CHANGES IN CONSERVATION EFFORTS

Asset System	Impact
Conveyance and Storage	Conservation efforts, specifically from the Private Property I/I and GI Programs, may partially offset the increased demand projected from system growth. Changes in conservation will continue to be reflected in the conveyance model through regular updates to assumptions and calibration.
WRFs and Biosolids	Conservation efforts already happening in the MMSD service area are reflected in the Future Conditions and Buildout Conditions projections.
Watercourse and Flood Management	No changes specific to the WCFM Asset System have been identified.
Green Infrastructure	No additional details specific to the GI Asset System were developed, although efforts to conserve water might lead to increased demand for GI through use of cisterns and rain barrels.

Data source: Appendices 4A-4D

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4.3 Projected Demand Trends

Background

The projected demand trends for Baseline, Future and Buildout Conditions are presented for each asset system based on the factors anticipated to impact demand as discussed in the previous section. As noted in Section 4.2, demand is defined differently for each asset system.

Words of Caution

The demand for Future Conditions was calculated by interpolating data points between the Baseline Conditions and Buildout Conditions. Interpolation is the process of estimating unknown data points between two quantities, which in this case are Baseline and Buildout Conditions, where Buildout Conditions are based on MMSD municipalities' projections of growth as documented by SEWRPC.

All forecasting models rely on historical data and relationships to produce a best estimate about future circumstances. It is important to note that forecasting is an uncertain business and the presence of uncertainty is inherent when making planning, management, or policy decisions. Forecasts invariably turn out to be different than the actual numbers that occur and these forecast errors increase with increased length of the forecast horizon. Therefore, forecasts should be updated when new data, such as the 2020 census data, become available.

When reading these projections, it is important to note that the presented numbers are ***estimates*** of future demand conditions at the time of publication of the 2050 FP based on assumptions and—where noted—on planning judgment and should not be considered precise estimates of future conditions. Actual growth will almost certainly deviate from these estimates.

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Conveyance Projections

The demand on the Conveyance and Storage Asset System is the flow that enters the asset system. Population and land use estimates provided by SEWRPC and the municipalities were input into the conveyance model to calculate average base sanitary flow, average dry weather flow, point source flow, and 5-year peak flow under Conveyance Baseline Conditions, Conveyance Future Conditions, and Buildout Conditions. The details are presented in Appendix 4A, Conveyance Future Demand and are summarized here. Some additional background on the development of the flows:

The 5-year peak hourly flow presented in this section is the peak hourly flow calculated to have a 20 percent annual probability over the 75 years of available rain event data. Chapter 5, Assessment of Existing Facilities, establishes a 5-year level of protection (LOP) for the Conveyance and Storage Asset System and compares it to the 5-year peak hourly flow. An LOP is the protection against established criteria at a defined recurrence interval.

To establish future demand projections, a base sanitary flow (BSF) of each sewershed was generated. The BSF has four components: residential, commercial, industrial, and point source flows. Future flows are the sum of the baseline flows and future flow additions as shown in Figure 4-1. The flows from the future development include increases from population, commercial, and industrial land use.

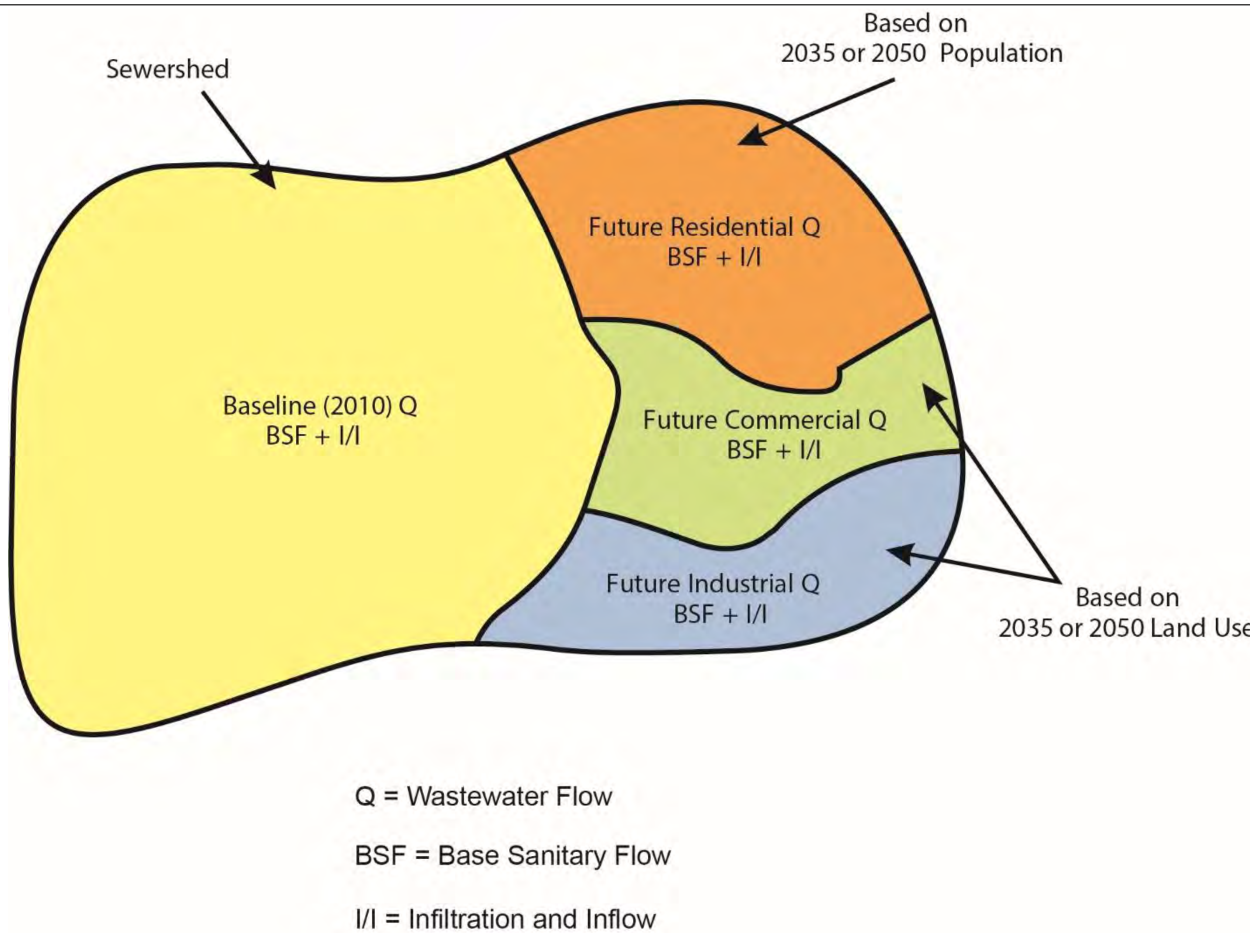

FIGURE 4-1: FUTURE FLOW BASIS

(Source: FFS User Guide October 2009)

Changes in flows for Conveyance Future and Buildout Conditions were developed by applying a set of uniform generation rates to the incremental growth in each sewershed in the conveyance model, which is provided in Table 4-8. The rates were based on water use data and other considerations, and the units presented are those set in the FFS program. The assumptions and justifications in deriving these values, which were reviewed and adjusted from the 2020 FP as appropriate, are described in the Flow Generation TM (Appendix 4A-2). Note that the full system model was not recalibrated from the 2020 FP. MMSD has started a project to perform a full system flow calibration, which is scheduled for completion in 2021.

TABLE 4-8: UNIFORM CONVEYANCE FUTURE/BUILDOUT FLOW PARAMETERS

BASE SANITARY FLOW ADDITIONS

Parameter	Conveyance Future / Buildout Value	Units1	Related To
Residential generation rate	54	gpcd	Population growth
Commercial generation rate	1500	gpad	Commercial area growth
Industrial generation rate	1500	gpad	Industrial area growth

INFILTRATION AND INFLOW ADDITIONS

Parameter	Conveyance Future / Buildout Value	Units[1]	Related To
Constant infiltration, I	0.0003	cfs / acre / in	Effective area of growth
Active groundwater, X	0.3	cfs / acre / in	Effective area of growth
Interflow, IF (Regular IRC group sewersheds)	0.15	cfs / acre / in	Effective area of growth
Interflow, IF (Low IRC group sewersheds)	0.07	cfs / acre / in	Effective area of growth
Surface runoff, PF	0	cfs / acre / in	Effective area of growth

1) Units presented for each input are the units set in the FFS program. Output of the flow data is provided in MGD. Unit definitions: gpcd = gallons per capita per day, gpad = gallons per acre per day, cfs / acre / in = cubic feet per second per acre per inch of I/I component (groundwater for active groundwater, etc.).

The model inputs and calculated outputs are summarized in Table 4-9 and presented in Appendix 4A, Conveyance Future Demand in Figures 4A-2 through 4A-8. To provide context for the data developed for the 2050 FP, data from the 2020 FP are also shown in the graphs. Note that Baseline Conditions for the Conveyance and Storage Asset System in the 2050 FP are established as the model output using reported 2010 population and land use information from SEWRPC, which uses the most recent year of U.S. Census data available. The 2000 data shown on the graphs from the 2020 FP were also census data.

TABLE 4-9: POPULATION, LAND USE, AND FLOWS FOR CONVEYANCE BASELINE, CONVEYANCE FUTURE, AND BUILDOUT CONDITIONS

Parameter	Conveyance Baseline Conditions	Conveyance Future Conditions	% change from Baseline to Future	Buildout Conditions	% change from Baseline to Buildout
Population	1,085,941	1,264,749	16.5%	1,390,181	28.0%
Industrial Area (acres)	10,119	14,274	41.1%	16,682	64.9%
Commercial Area (acres)	10,350	15,496	49.7%	18,533	79.1%
Average Base Sanitary Flow (MGD)	101	135	34.3%	151	50.2%
Average Dry Weather Flow (MGD)	137	178	29.9%	197	43.8%
Point Source Flow (MGD)[1]	8.69	16.96	95.2%	16.96	95.2%
5-year Peak Hourly Flow (MGD)[2]	1,521	1,672	9.9%	1,779	17.0%

1) 8.3 MGD increase is from non-contact cooling water
2) Though included in model, values presented in this table do not include combined area flow - see explanation below in 5-year Peak Hourly Flow section and Appendix 4A, Conveyance and Storage Future Demand

The following presents a brief summary for each trend. Reasons for the difference between the Baseline Conditions data and flows and the estimated future data and flows are also discussed below. See Appendix 4A, Conveyance Future Demand for the figures related to the items discussed below.

Population – Census data from 2000 to 2010 show a decrease, but the projections determined for the 2050 FP show a 28 percent increase between 2010 (Conveyance Baseline) and Buildout Conditions based on information provided from the municipalities to SEWRPC.

Industrial land use area – Land use data from 2000 to 2010 shows a decrease, but the projections show a 73 percent increase between 2010 (Conveyance Baseline) and Buildout Conditions based on information provided from the municipalities to SEWRPC.

Commercial land use area – Land use data from 2000 to 2010 shows an increase similar to the projection from the 2020 FP. The projected future land use area generally follows the projection from the 2020 Facilities Plan as well, with a 79 percent increase projected between 2010 (Conveyance Baseline) and Buildout Conditions.

Average base sanitary flow – Model output from 2000 to 2010 shows average base sanitary flow remaining relatively constant, but the projections show an increase of 50 percent between 2010 (Conveyance Baseline) and Buildout Conditions that correlates with the population and land use projections provided by SEWRPC.

Average dry weather flow – Model output from 2000 to 2010 shows a decrease, but the projections show a 52 percent increase between 2010 (Conveyance Baseline) and Buildout Conditions, which is similar to the rate that was estimated for the 2020 FP and correlates with the population and land use projections provided by SEWRPC.

Point source flow – Data from MMSD accounting records show a decrease from 2000 to 2010, but the projections show a 95 percent increase between 2010 (Conveyance Baseline) and Buildout Conditions. The increase is due to the estimated 8.3 MGD of new flow from non-contact cooling water sources.

5-year peak hourly flow –Table 4-9 shows the projected growth in peak flow in the separate sewer service area (SSSA). Though combined sewer service area (CSSA) flow is included in the model, the data shown in Table 4-9 do not include CSSA flow because future demand for the CSSA is calculated differently in the model that in the SSSA in that CSSA flow is tracked by the growth in base sanitary flow, with peak flow into the combined sewer system assumed to be similar to Baseline Conditions with the additional runoff captured by stormwater management practices and GI. The main difference between the 2000 flow and the 2010 SSSA 5-year peak hourly flow is caused by a different model methodology employed after the 2020 FP was completed. The projections show a 17 percent increase between 2010 (Conveyance Baseline) and Buildout Conditions, which includes climate change impacts. The projected increase is much smaller than the increase estimated for point source flow because the point source flow makes up only a small portion of the peak hourly flow under all conditions.

Although the population and land use data from 2000 to 2010 show a decrease (except for commercial land use), the future population, land use, and flow projections show significant increases. For planning purposes, these projections are used as an "upper bound." This is consistent with the methodology used in the 2020 FP and provides a conservative approach. As stated in the 2020 FP:

> *The use of the future data set is appropriate for planning conveyance facilities for two reasons:*
>
> *At least some of the communities, or portions of those communities, will realize their estimated future levels of population and land use growth.*
>
> *Conveyance facilities planning commonly accommodates a 50-year design horizon. In other words, while the future population estimates were generally unrealistic for a 20-year design horizon, they are appropriate for a 50-year design horizon associated with conveyance facilities.*

Finally, it should be noted that the while these projected future flows are helpful for evaluating individual sewersheds in the Conveyance and Storage Asset System, these flows were not used to evaluate the WRFs. The WRF evaluations use average wet weather flow over the period of record. The approach for projecting WRF flows is presented in Appendix 4B, WRFs and Biosolids Future Demand.

Water Reclamation Facilities and Biosolids Projections

The demand on the WRF and Biosolids Asset System is defined as the influent flows and associated wasteloads from the Conveyance and Storage Asset System. Projected average annual and maximum day flows and average annual, maximum day, week, and month BOD, TSS, TP, and TKN wasteloads were developed for WRF Baseline Conditions, WRF Future Conditions, and Buildout Conditions. The details are presented in Appendix 4B, WRFs and Biosolids Future Demand and Appendix 4B-1, Future Flows and Wasteloads Forecasting Methodology, and are summarized here. Additional background on the development of the flows and wasteloads is provided below:

- The Conveyance Future Conditions and Buildout Conditions flow projections based on SEWRPC population and land use projections were translated into influent flows and wasteloads to the WRFs. The SEWRPC population projections, when assuming that Buildout occurred in 2050, estimated an annual rate of increase of 0.66 percent. Buildout Conditions were compared to trendlines of the Recent Dataset (influent data from 2006 through 2017) and it was determined that growth in the JIWRF and SSWRF service and planning areas is projected to occur at different rates (see Appendix 4B, WRFs and Biosolids Future Demand for details). Therefore, the Recent Dataset trendlines were used to supplement the modeling projections in order to establish the WRF Future Conditions flow and wasteload projections.

- To verify the approach used to establish WRF Future Conditions flow and wasteload projections, the SEWRPC and Wisconsin Department of Administration (DOA) population projections were compared to each other as well as to historical values to assess the differences. It was found that the actual population growth has averaged 0.26 percent between 2010 to 2018, while the DOA projections averaged 0.31 percent. Both of these are approximately ½ of the rate of increase in population shown by the SEWRPC projections presented in the first bullet. Therefore, it was determined that the Conveyance Future Conditions were the most aggressive scenario and it was uncertain if these projections were reasonable.
- NCCW flow was assumed to add an additional 8.3 MGD of point source flow under both WRF Future and Buildout Conditions based on MMSD's review of the NCCW users in the planning area.
- To determine the maximum day flow demand at the WRFs, the 2050 FP project team assumed the baseline combined sewer overflow (CSO) frequency, determined to be 3.25 CSOs per year, would need to be maintained.[1] Modeling determined that an increase in SSWRF peak capacity would decrease baseline CSO frequency by less than 5 percent, so it is projected to remain at 300 MGD because SSWRF mostly serves the SSSA and most of the CSSA is served by JIWRF. Therefore, only peak capacity at JIWRF is shown as increasing under WRF Future Conditions and Buildout Conditions. The documentation of the modeling simulations is discussed in Appendix 4A-3, Conveyance Modeling Summary Technical Memorandum.
- Wasteloads assumptions included:
  - BOD and TSS: The annual average BOD and TSS wasteloads from residential, commercial, industrial, and I/I sources were developed. Residential and commercial unit loading rates were equivalent at 2.59 lbs BOD/kgal and 3.09 lbs TSS/kgal. Industrial unit loading rates were established as 4.62 lbs BOD/kgal and 3.57 lbs TSS/kgal. The unit loading rates for I/I were 0.312 lbs BOD/kgal and 1.246 lbs TSS/kgal.
  - TP: The future TP loadings are comprised of three parts: the incremental increase in baseflow, additional loading associated with increased use of orthophosphates for corrosion control (approximately 2 mg/L as TP and assuming that the WRF Baseline Conditions TP load from municipality drinking water represents 6 percent of the total TP found in the WRF influent), and additional loads from new NCCW sources (assumes an equivalent concentration to the drinking water sources).
  - TKN: The increase in TKN was assumed to be directly related to the incremental increase in flow by using the average Baseline concentrations of 28 mg TKN/L for JIWRF and 29 mg TKN/L for SSWRF. The TKN from NCCW was assumed to have a 1 mg TKN/L concentration associated with drinking water concentrations.

The WRF Baseline Conditions flows and wasteloads are presented in Table 4-10. The projections used to assess existing WRFs and Biosolids Asset System facilities in Chapter 5 are presented for WRF Future Conditions and

[1] *The baseline CSO frequency is established in Appendix 4A. The 2050 FP project team established the baseline CSO frequency for future demand for the WRF and Biosolids Asset System as an interim target for a phased-in approach to achieving the 0 CSOs KPI target, which will impact the Conveyance and Storage Asset System as well. The risk of not achieving 0 CSOs is also considered in Chapter 5 under the Systemwide Assessment, with analysis to address the risk presented in Chapter 6.*

Buildout Conditions in Table 4-11 and 4-12, respectively. The projected increases to average annual flows and wasteloads under WRF Future Conditions and Buildout Conditions from WRF Baseline Conditions are presented in Table 4-13.

TABLE 4-10: WRF BASELINE CONDITIONS FLOWS AND WASTELOADS

Condition	Flow (MGD)	BOD (lb/d)	TSS (lb/d)	TP (lb/d)	TKN (lb/d)
JIWRF					
Design Average Day[1]	123	299,000	314,000	5,800	37,900
Average Day	92	205,000	197,000	2,700	16,600
Maximum Day	380[2]	476,000	718,000	6,000	23,000
Maximum Week	See note[3]	290,000	354,000	3,800	18,800
Maximum Month	See note[3]	243,000	264,000	3,200	17,600
SSWRF					
Design Average Day[1]	113	224,000	266,000	5,200	See note[4]
Average Day	91	188,000	252,000	4,000	20,400
Maximum Day	295[2]	370,000	756,000	7,500	30,000
Maximum Week	See note[3]	247,000	405,000	5,100	23,700
Maximum Month	See note[3]	215,000	319,000	4,500	21,900

1) For additional design parameters, see Appendix 4B, WRFs and Biosolids Future Demand.
2) Values presented are the maximum flows during the Baseline Conditions time period. Peak flow design capacity at JIWRF and SSWRF is 390 MGD and 300 MGD, respectively.
3) Values were not used to analyze the WRFs so were not determined for the 2050 FP.
4) Design values were not provided for TKN in SSWRF O&M Manual. However, TKN values were established in the SSWRF AFP: average day 27,000 lb/d.

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TABLE 4-11: PROJECTED WRF FUTURE CONDITIONS FLOWS AND WASTELOADS

Condition	Flow (MGD)	BOD (lb/d)	TSS (lb/d)	TP (lb/d)	TKN (lb/d)
JIWRF					
Design Average Day[1]	123	299,000	314,000	5,800	37,900
Average Day	101	223,000	217,000	4,000	18,200
Maximum Day	425[2]	517,000	791,000	8,900	25,100
Maximum Week	See note[3]	316,000	390,000	5,500	20,600
Maximum Month	See note[3]	264,000	291,000	4,700	19,300
SSWRF					
Design Average Day1	113	224,000	266,000	5,200	see note[4]
Average Day	120	239,000	273,000	6,300	27,100
Maximum Day	300[2]	470,000	819,000	11,700	39,900
Maximum Week	See note[3]	314,000	439,000	8,100	31,500
Maximum Month	See note[3]	273,000	346,000	7,100	29,200

1) For additional design parameters, see Appendix 4B, WRFs and Biosolids Future Demand.
2) Values presented are the projected WRF flow capacity needed to maintain the baseline CSO frequency under WRF Future Conditions. Details of the analysis establishing these values are presented in Appendix 4B, WRFs and Biosolids Future Demand.
3) Values were not used to analyze the WRFs so were not determined for the 2050 FP.
4) Design values were not provided for TKN in SSWRF O&M Manual. However, TKN values were established in the SSWRF AFP: average day 27,000 lb/d.

TABLE 4-12: PROJECTED BUILDOUT CONDITIONS FLOWS AND WASTELOADS

Condition	Flow (MGD)	BOD (lb/d)	TSS (lb/d)	TP (lb/d)	TKN (lb/d)
JIWRF					
Design Average Day[1]	123	299,000	314,000	5,800	37,900
Average Day	101	223,000	217,000	5,500	18,200
Maximum Day	490[2]	517,000	791,000	12,200	25,100
Maximum Week	See note[3]	316,000	390,000	7,600	20,600
Maximum Month	See note[3]	264,000	291,000	6,500	19,300
SSWRF					
Design Average Day[1]	113	224,000	266,000	5,200	See note[4]
Average Day	148	310,000	389,000	10,800	32,900
Maximum Day	300[2]	610,000	1,167,000	22,700	48,500
Maximum Week	See note[3]	407,000	626,000	15,600	38,300
Maximum Month	See note[3]	354,000	492,000	13,800	35,400

1) For additional design parameters, see Appendix 4B, WRFs and Biosolids Future Demand.
2) Values presented are the projected WRF flow capacity needed to maintain the baseline CSO frequency under Buildout Conditions. Details of the analysis establishing these values are presented in Appendix 4B, WRFs and Biosolids Future Demand.
3) Values were not used to analyze the WRFs so were not determined for the 2050 FP.
4) Design values were not provided for TKN in SSWRF O&M Manual. However, TKN values were established in the SSWRF AFP: average day 27,000 lb/d.

TABLE 4-13: PROJECTED PERCENT INCREASE TO AVERAGE ANNUAL FLOWS AND WASTELOADS FROM BASELINE CONDITIONS

WRF	Percent Change to WRF Future Conditions					Percent Change to WRF Buildout Conditions				
	Flow	BOD	TSS	TP	TKN	Flow	BOD	TSS	TP	TKN
JIWRF	11%	9%	10%	48%	10%	11%	9%	10%	104%	10%
SSWRF	32%	27%	28%	58%	32%	62%	65%	54%	170%	61%
TOTAL	**21%**	**18%**	**22%**	**54%**	**22%**	**36%**	**36%**	**35%**	**143%**	**38%**

The estimated increases in flows and wasteloads presented in the previous tables, in Appendix 4B, WRFs and Biosolids Future Demand, and the associated Appendix 4B-1, Future Flows and Wasteloads Forecasting Methodology indicate the following:

JIWRF Conclusions

- Based on comparing recent data trends to Buildout Conditions, it was assumed that the Buildout Conditions for JIWRF would occur by 2040 as the recent trends in loadings exceeded the projections and because Baseline Conditions are approximately 90 percent of Buildout. Therefore, the Future and Buildout Conditions for JIWRF are the same, resulting in annual average increases of 0.5 percent, 0.4 percent, and 0.5 percent for flow, BOD, and TSS, respectively, and an estimated 10 percent increase in flow and loadings between Baseline and Future Conditions. The JIWRF service area is almost fully developed, so although trends indicate increases of 3 percent per year, it was assumed that these rates will not continue based on SEWRPC land use and population projections.
- If the Buildout Conditions projections occur by 2050 instead of 2040, the modeled annual average incremental increase from WRF Baseline Conditions to Buildout Conditions for JIWRF is 0.3 percent for flow, BOD, and TSS, respectively.
- The JIWRF has sufficient design capacity to process the projected increase with the exception of maximum day TSS wasteloads, which are estimated to exceed design capacity under both WRF Future Conditions and Buildout Conditions.
- The maximum day flow of 425 MGD presented in Table 4-11 under WRF Future Conditions and 490 MGD presented in Table 4-12 under Buildout Conditions represent the JIWRF maximum day flow capacities that would be needed to maintain the baseline CSO frequency. To calculate these projected capacities, an increase in JIWRF full peak hydraulic capacity with blending capacity held at 60 MGD (identified as Scenario 1) and an increase in JIWRF blending capacity with full peak hydraulic capacity held at 330 MGD (identified as Scenario 2) was modeled under WRF Future and Buildout Conditions. In this analysis, full peak hydraulic capacity is the peak hydraulic flow that can be passed through all JIWRF major liquid processes. The findings are presented in Table 4-14. As shown in the table, it was found that the hydraulic capacity would need to increase to 425 MGD in both scenarios for WRF Future Conditions and either 490 MGD (Scenario 1 – increased full peak hydraulic) or 480 MGD (Scenario 2 – increased blending) for Buildout Conditions, assuming that SSWRF remained at 300 MGD. All of these projected flows exceed design capacity. To be conservative, the 490 MGD value is presented in Table 4B-12.

TABLE 4-14: NEEDED CAPACITY AT JIWRF TO MAINTAIN BASELINE CSO FREQUENCY

JIWRF Capacity (MGD)	Conveyance Future Conditions		Buildout Conditions	
	Scenario 1	Scenario 2	Scenario 1	Scenario 2
Full Peak Hydraulic[1]	365	330	430	330
Blending[2]	60	95	60	150
Total	**425**	**425**	**490**	**480**

1) Full peak hydraulic capacity is the peak hydraulic flow that can be passed through all of JIWRF major liquid processes.
2) Blending capacity is the flow pumped from the ISS Pump Station to disinfection.

SSWRF Conclusions

- The annual average incremental increases are 1.8 percent, 1.9 percent, and 1.6 percent for flow, BOD, and TSS, respectively, from WRF Baseline Conditions to Buildout Conditions. This is approximately a 60 percent increase projected for Buildout Conditions.
- The annual average increases for SSWRF between WRF Baseline and WRF Future Conditions are 1.6 percent, 1.4 percent, and 1.4 percent for flow, BOD, and TSS, respectively. This is approximately a 30 percent increase in flow and loading between WRF Baseline and WRF Future Conditions.
- Average day flows as well as BOD, TSS, and TP wasteloads are estimated to exceed design capacity under WRF Future Conditions. These parameters are also projected to exceeded design capacity under Buildout Conditions.
- Maximum day TSS wasteloads exceed design capacity under WRF Baseline conditions and are projected to exceed design capacity under both WRF Future Conditions and Buildout Conditions.
- All maximum BOD and TSS wasteloads (day, week, month) are estimated to exceed design capacity under Buildout Conditions.
- Maximum week TP wasteloads are estimated to exceed design capacity under WRF Future Conditions. TP wasteloads are estimated to exceed all design values under Buildout Conditions.
- Average day TKN is estimated to exceed the values provided in the SSWRF Advanced Facilities Plan (AFP) under WRF Future Conditions. [9] Under Buildout Conditions, the average day, maximum week, and maximum month TKN are estimated to exceed the values.
- Full peak hydraulic flow through all major processes (represented as maximum day flow in the analysis) flow is limited to 300 MGD since an increase would have little impact on maintaining baseline CSO frequency. This is because SSWRF mostly serves the SSSA and most of the CSSA is served by JIWRF. (Note that if flow could be diverted from the inline storage system (ISS) or JIWRF directly to SSWRF, the results determined above for additional full peak hydraulic capacity needed at JIWRF could be applied to SSWRF instead).

WPDES Permit Considerations

As noted in Section 4.2, although permit and O&M contract changes do not change flows and/or wasteloads to the asset systems, they can change how MMSD reacts to demands relative to performance and operation by imposing more stringent effluent limits. The effluent limitations that WRFs must meet per the 2019 WPDES permit and the 2016 extension of the O&M contract with Veolia are presented in Table 4-15.

TABLE 4-15: WRF EFFLUENT LIMITATIONS[1]

Condition	BOD (mg/L)	TSS (mg/L)	TSS (lb/d)[2]	TP (mg/L)	TP (lb/d)[2]	Ammonia-N (mg/L)[3]	Fecal Coliform (#/100 mL)
JIWRF							
Weekly Average	45	45	51,332-58,862	NA	NA	NA	972[5]
Monthly Average	**15**	**15**	30,195-33,430	**0.50**	664-735	**5.0**	**100[5]**
SSWRF							
Weekly Average	45	45	NA	NA	NA	27	972[5]
Monthly Average	**15**	**15**	NA	**0.6[4]**	NA	**5.0**	**100[5]**

1) Major effluent limits are listed in this table; additional limits are listed in the 2019 WDPES permit and Veolia O&M contract. Limits in bold are the more stringent Veolia O&M contract limits.
2) Mass limits are set per month; range presented is minimum to maximum limits.
3) Effluent also subject to annual whole effluent toxicity (WET) testing, which can be impacted by effluent ammonia.
4) 24-month rolling average plus 6-month TP limit of 0.7 mg/L. (permit).
5) Geometric mean.

Impacts on Findings with Loss of Major Industrial User

There is the potential that a major industrial user could reduce its loads or eliminate loads (close the business). These loads would then be lost from the MMSD service and planning area. This could impact treatment capacity by freeing up wasteload treatment capacity and by decreasing the quantity and quality of biosolids produced. MMSD observed a significant impact when LeSaffre Yeast left the service area in 2005. MMSD has identified a specific industrial user served by JIWRF that may significantly reduce or eliminate its waste discharge, so an analysis was conducted to determine the impact that this might have on system loads.

The impact from the loss of a major industrial user on JIWRF under WRF Future Conditions and Buildout Conditions flows and wasteloads was calculated by reducing the JIWRF projections by the estimated flow and wasteload information for the specified MMSD industrial user, which is presented in Table 4-16. This methodology estimated the loading to be approximately 16 percent of average day conditions. The loss of the major industrial user does not change the conclusions covered previously. However, the reduction in loading is anticipated to have an impact on major process operations (especially secondary treatment, aeration, and biosolids) and economics due to an anticipated decrease in the sale of Milorganite because of an anticipated corresponding reduction in biosolids. This is assessed in more detail in Chapter 5.

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TABLE 4-16: FLOW AND WASTELOAD ESTIMATES FOR A LARGE INDUSTRIAL USER IN MMSD SERVICE AREA

Description	Flow (MGD)	BOD (lb/d)	TSS (lb/d)
Average Day	0.90	33,000	16,000
Maximum Day	1.49	66,000	43,000
Maximum Week	1.05	42,000	24,000
Maximum Month	1.05	42,000	24,000

Residential, Commercial, and Industrial Portions of Total Flows

For Clean Water Fund Program financing, MMSD is required to identify the portion of the design flows for a project that are allocated to residential, commercial, industrial, and I/I as part of the parallel cost percentage calculation. [10] [11] The residential, commercial, industrial, and I/I portion of WRF Baseline Conditions, WRF Future Conditions, and Buildout Conditions total flow projections are presented in Table 4-17 for use in future design projects. The details regarding these breakdowns are presented in Appendix 4B, WRFs and Biosolids Future Demand and Appendix 4B-1, Future Flows and Wasteloads Forecasting Methodology. When reviewing the table, the following information should be noted:

- The industrial portion of the total flows under any condition presented is the sum of flows from the industrial land use and the portion of point sources identified as industrial users.
- As noted in Table 4-16, the average flow from a major industrial user is projected to be less than 1 MGD, which is minor compared to the total flow and therefore the reduction in total flow from the loss of a major industrial user is not presented in Table 4-17.
- The I/I is projected to go up due to future economic growth under WRF Future and Buildout Conditions. However, I/I as a percentage goes down due to the larger projected increase of residential, commercial, and industrial portions of the total flow.

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TABLE 4-17: RESIDENTIAL, COMMERCIAL, INDUSTRIAL, AND I/I PORTION OF TOTAL ANNUAL AVERAGE FLOWS

WRF	Residential		Commercial		Industrial		Inflow/Infiltration		Total	
	Flow (MGD)	% of Total	Flow (MGD)	% of Total	Flow (MGD)	% of Total	Flow (MGD)	% of Total	Flow (MGD)	% of Total
JIWRF										
Baseline Conditions	30	33%	4	4%	8	9%	49	53%	92	100%
Future Conditions	34	34%	5	5%	12	12%	50	49%	101	100%
Buildout Conditions	34	34%	5	5%	12	12%	50	49%	101	100%
SSWRF										
Baseline Conditions	32	35%	8	9%	7	8%	44	48%	91	100%
Future Conditions	42	35%	10	9%	15	12%	53	44%	120	100%
Buildout Conditions	46	31%	19	13%	23	15%	60	41%	147	100%
Total – Both WRFs										
Baseline Conditions	62	34%	12	6%	16	9%	93	51%	182	100%
Future Conditions	77	35%	15	7%	27	12%	103	46%	221	100%
Buildout Conditions	80	32%	23	9%	35	14%	110	44%	249	100%

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Watercourse and Flood Management Projections

The demand on the WCFM Asset System is the flows and loads from rainfall runoff along with CSOs and separate sewer overflows (SSOs). The demand factors for the WCFM Asset System were not explicitly evaluated or modeled as part of the 2050 FP to determine specific future demand trends, such as future flows or impacts to flooding, based on the factors that affect demand identified above. This was due to several reasons:

- Information regarding the WCFM assets was very limited when the 2050 FP was being developed, so the focus was directed to identifying a list of approximately 40 watercourse and flood management projects that MMSD's Watercourse Section had already assembled through a series of completed planning studies and engineering projects.
- SEWRPC prepared updated floodplain maps and structure damage estimates along selected streams within MMSD's planning area for 2035 condition land use conditions as documented in a SEWRPC memorandum. [12] Information about this analysis is summarized in Appendix 4C, WCFM Future Demand. Modeling all of the watercourses with revised land use and rainfall data and determining the impact on floodplains and at-risk structures is an extensive task and was not in the scope of the 2050 FP.
- Water quality was the focus of the previous 2020 FP. Extensive modeling and data analyses were completed during that project that concluded nonpoint pollution sources are the primary source of bacteria, TSS, and other pollutants in the jurisdictional streams. Additional water quality modeling was done to determine TMDLs for TP, TSS, and bacteria (as fecal coliform). [13] Therefore, water quality modeling was not part of the scope of the 2050 FP.

Despite the lack of specific information, some general trends can be surmised, which are discussed below.

Land use trends based on SEWRPC's projections include the following:

- **Industrial land use area**. Future projections show a 41 percent increase between Baseline and Future Conditions.
- **Commercial land use area**. Future projections show a 50 percent increase between Baseline and Future Conditions.

MMSD's Climate Change Vulnerability Analysis evaluated the potential effect of climate change on MMSD facilities, operations, and performance. [6] For the WCFM Asset System, the study evaluated changes in high and low flows in two selected reaches of the Kinnickinnic and Menomonee Rivers as a result of different climate change scenarios that included baseline (existing climate conditions based on historic record, 1940 to 2004), mid-century 90 percent, and end-of-century 90 percent (where 90 percent means that these particular climate scenarios are not the most extreme but have greater than average climate change characteristics and are representative of general severity). The results included the following:

- One-hundred-year (1-percent-annual-probability) flows will increase up to 16 percent and 10-year (10-percent-annual-probability) peak flows will increase from 6 percent to 13 percent.
- Low flows will decrease by as much as 73 percent, but the absolute incremental decrease is minor relative to total contributions to the river base flows. Therefore, it is likely the lowest flows will not be impacted based on the scenarios analyzed.

The general impacts to the WCFM Asset System are expected to include the following:

- Higher peak runoff from more intense precipitation events may result in a decrease in the level of protection provided by flood management facilities.
- Higher temperatures and extended drought periods may lead to decreased average and low flows in jurisdictional watercourses, resulting in a degradation of aquatic habitat and water quality and a decrease in aquatic species viability.

Although not available or explicitly developed for all of the jurisdictional watercourses, the anticipated changes indicate a potential need for more flood management capacity for the more frequent high-intensity precipitation events. They also indicate the potential for lower low flows, which could potentially lead to the degradation of habitat and water quality, particularly in streams that have low base flows.

Hydrologic and hydraulic modeling done by SEWRPC as described in Appendix 4C, WCFM Future Demand did not include an analysis of climate change and its impact on flows, water surface elevations, and floodplain extents.

Green Infrastructure Projections

The projected demand trend for GI is that 740 MG total capacity of GI assets will be created by 2035, which is the KPI target identified in Chapter 3. This storage goal was selected because it was set by the 2035 Vision and because of the various factors driving demand described in Section 4.2. The Regional GI Plan, prepared in 2013, recommended that this increase occur linearly as shown in the left panel of Figure 4-2. [14] Based on this linear pace, approximately 40 MG/yr of GI storage capacity would need to be added each year starting in 2018. This may not be realistic given the quantities of GI that were added in 2016 and 2017 (measured in terms of gallons funded were 10.4 MG and 4.2 MG, respectively) and the inconsistent nature of project delivery. An alternative approach would be for GI to increase exponentially as MMSD and project partners add capacity, reduce costs, eliminate barriers, etc. An example of this type of projection is shown in the right panel of Figure 4-2 and was used to estimate future costs for the 2050 FP.

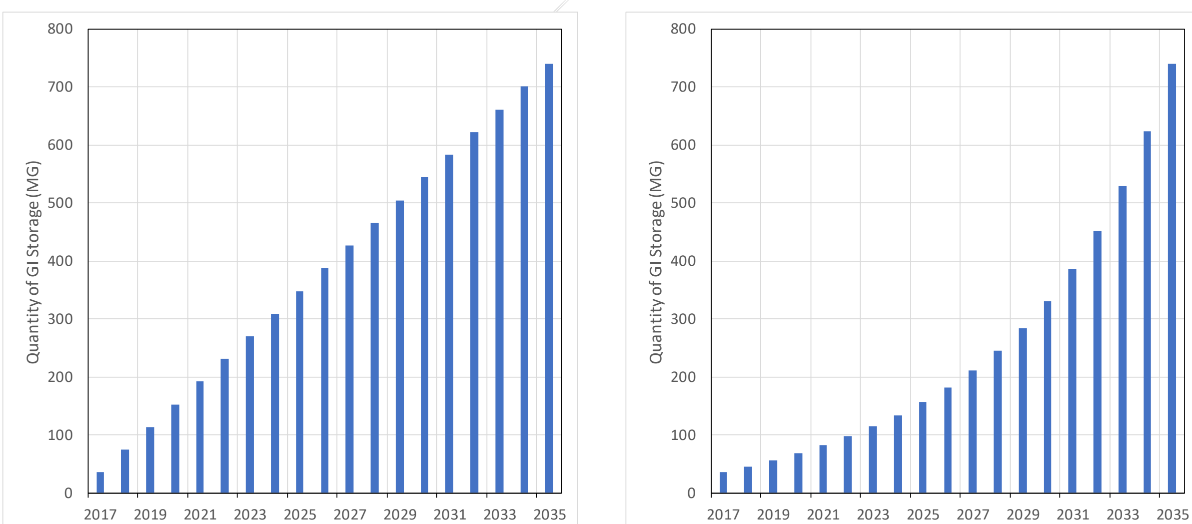

FIGURE 4-2: PROJECTED FUTURE QUANTITIES OF GI BY YEAR BASED ON LINEAR PROJECTION (LEFT) AND EXPONENTIAL PROJECTION (RIGHT)

Summary of Projected Demand Trends

Table 4-18 summarizes the projected demand trends for the potential demand factors identified in Section 4.2.

TABLE 4-18: SUMMARY OF IDENTIFIED FACTORS ON PROJECTED DEMAND TRENDS

Factor Affecting Demand	Impact on Projected Demand Trends
Service and Planning Area Changes	Most of the demand identified on the Conveyance and Storage and WRFs and Biosolids Asset Systems is due to projected growth due to service and planning area changes.
Climate Change	Some of the demand projected under Buildout Conditions is due to climate change. The qualitative portion due to climate change as compared to other factors is difficult to document as climate change is projected to result in more intense, high-frequency storms and a decrease in rainfall frequency during summer months.
Permit Changes	The review of permit changes for the 2050 FP determined that permit changes in the 2019 permit will impact the management of the demand on the asset systems and will not have much impact on projected demand itself.
Operating and Maintenance Contract Changes	Similar to permit changes, the 2050 FP determined the O&M contract has an impact on the management of the demand but not as much impact on projected demand itself.
Changes in Customer Expectations	Customer expectations are not anticipated to have a significant impact on the projected demand for the Conveyance and Storage and WRFs and Biosolids Asset Systems, but they do have an impact on the WCFM and GI Asset Systems.
Changes in Technology	Changes in technology are not anticipated to have much impact on demand.
Conservation Efforts	Conservation efforts are anticipated to have some impact on demand through regular updates of the hydraulic model.

4.4 Demand Management

MMSD manages increased/changing demand using a number of different methods, including active system management and several asset system-specific methods. The demand management techniques that are used for each asset system are listed below. Continued use of these methods for managing future demand on the asset systems is discussed in Chapters 6 and 7.

Conveyance and Storage

MMSD manages the demands on the Conveyance and Storage Asset System in several ways:

Active system management. MMSD actively manages the Conveyance and Storage Asset System during rainfall events to minimize basement backups and overflows.

In September 2014, MMSD updated the ISS operating strategy for wet weather events. [15] The strategy is based on an established set of priorities. Six priorities were determined and ranked by MMSD. The operating strategy assumes that, if needed, the priorities would be sacrificed in order from lowest to highest priority. The priorities are listed below from highest priority (No. 1) to lowest priority (No. 6):

1. ISS overfilling
2. Flooding of water reclamation facilities
3. Impacts to municipal connections
4. MMSD SSOs
5. CSOs
6. Blending at WRFs (both)

Assessments of the model-based LOP for various sets of MMSD conveyance, storage, and treatment systems under the Conveyance Baseline, Conveyance Future, and Buildout population and land use conditions were evaluated. This work is documented in the Conveyance Modeling Summary TM (Attachment 4A-3).

Flow monitoring. MMSD's expanded flow monitoring capabilities in the Conveyance and Storage Asset System help MMSD track actual changes in flows versus estimated future changes. While this is still an inexact science, improvements in the technology are constantly improving the measurements. MMSD will continue to invest in monitoring improvements that will inform decisions on necessary projects to address capacity changes in the future.

I/I management. I/I increases due to degradation of the entire system (including private property laterals as well as municipality and MMSD sewers) increase the risk of basement backups and overflows and impact MMSD's ability to meet the goal of zero overflows and zero basement backups. MMSD focuses on upgrades to its conveyance system and works with service area municipalities to reduce I/I as a source of flow into the system through the Wet Weather Peak Flow Management Program (WWPFMP) and the PPI/I Program.

WRFs and Biosolids

MMSD manages the demand on the WRFs and Biosolids Asset System in several ways:

Active system management. MMSD actively manages the WRFs, and during rainfall events this is particularly important to process as much flow as possible in order to minimize overflows in the system while also meeting effluent permit requirements to protect system waterways. Historically, active management has included up to 60 MGD blending at JIWRF. In the 2019 WPDES permit, blending at SSWRF is now also allowed. The maximum blending available is reviewed against existing facilities in Chapter 5.

Interplant solids pumping (ISP). The ISP provides the flexibility to transfer solids between JIWRF and SSWRF to maximize the quantity and quality of Milorganite produced while minimizing landfilled biosolids.

Energy. MMSD uses internal and external resources to manage influent flows and wasteloads in a manner that reduces energy usage and increase the use of renewable resources to generate energy at the WRFs. A major example of this commitment is the use of landfill gas to produce renewable electricity and heat at JIWRF. Another example is the decision to use the ISS Pump Station to pump stored wastewater during off-peak periods to minimize electrical costs.

Watercourse and Flood Management

MMSD uses a number of different methods to manage increased and changing demand on the WCFM Asset System, including:

Watercourse management planning and flood management projects. MMSD identifies flooded structures, evaluates options to manage the flooding, and designs and implements projects to reduce the risk of flooding and reduce damages. The watercourse management plans synchronize projects based not only on these benefits but also by how the projects work together to result in approvable revised Federal Emergency Management Agency (FEMA) floodplain maps.

Operation and maintenance of jurisdictional streams. MMSD performs general maintenance of various watercourse channels and riparian properties, including routine maintenance of turf and natural vegetation areas, removal of debris and woody vegetation, species management, and insect control where applicable. These activities help maintain stream conveyance capacity for the 100-year (1-percent-annual-probability) storm.

Programs and policies. MMSD has several programs and policies that are used to manage WCFM demands, including:

- *Chapter 13: Surface Water and Stormwater Rules.* [16] MMSD manages the impact of increased stormwater runoff from new development and redevelopment on flood flows through Chapter 13. The purpose is to 1) reduce the unsafe conditions, property damage, economic losses, and adverse health effects caused by flooding, 2) maximize the effectiveness of flood abatement facilities and watercourse improvements, 3) reduce the number and magnitude of releases of sewage to the environment from sanitary and combined sewers and protect sewage collection and treatment facilities from high flows, 4) promote comprehensive watershed planning and intergovernmental cooperation, and 5) restore and enhance opportunities to use and enjoy watercourses.
- *Greenseams®.* Greenseams is an innovative flood management program that permanently protects key lands containing water absorbing (hydric) soils. By storing and draining water into the ground naturally, Greenseams helps alleviate future flooding and water pollution while supporting and protecting MMSD's structural flood management projects, which are infrastructure investments that are worth hundreds of millions of dollars. The program makes voluntary purchases of undeveloped, privately-owned properties in areas expected to have major growth in the next 20 years and open space along streams, shorelines, and wetlands. There are Greenseams sites in Milwaukee, Ozaukee, Washington, and Waukesha Counties.
- *Working Soils Program®.* The Working Soils Program acquires easements on agricultural land in the Milwaukee River watershed to preserve floodplains and improve soil health so it can store rainwater, recharge groundwater, and reduce water pollution. In collaboration with the MRWCP project partners, MMSD's Working Soils Program supports the acquisition of eight agricultural easements across 800 acres.
- *Greater Milwaukee Regional Conservation Partnership Program (GMRCP)* – The purpose of this project is to work with agricultural producers and landowners to place voluntary easements on undeveloped, privately-owned properties along streams, shorelines, and wetlands in areas expected to have major growth in the next 20 years. This limited-time, innovative flood management program permanently protects key lands containing water-absorbing soils.

In addition, MMSD has completed significant water quality monitoring, studies, and improvements. An example is the water quality study completed under the Regional Water Quality Initiative with SEWRPC as part of the 2020 FP. This project led to MMSD developing third-party TMDLs for the Menomonee River, Kinnickinnic River, and Milwaukee River watersheds as well as the Milwaukee Harbor estuary. The Water Quality Improvement Plan (WQIP) submitted to WDNR by March 1, 2020 is focused on beginning implementation of the TMDL and establishing a monitoring plan to document water quality successes in the watercourses.

Green Infrastructure

Demand management for the GI Asset System is defined as where and what type of GI infrastructure is installed. Existing GI infrastructure (as of 2017) has been installed based on what residents, businesses, or municipalities were interested in installing. As part of meeting the 740 MG GI KPI target, the 2050 FP project team assessed the GI service area and prioritized sewersheds located in the CSSA as well as those in the SSSA with TMDLs, those with high rates of infiltration and inflow, and/or those where GI can help promote urban biodiversity. In the CSSA, the types of GI assets focus primarily on volume control, whereas in the SSSA, the desired types of GI can vary depending on the purpose, with some optimized for reducing pollutant loads, some for I/I treatment, some for biodiversity, and some for volume control.

Non-Asset-Based Methods

In addition to asset-based methods, MMSD has several committed programs, operational improvements, and policies that help to manage demands on the asset systems, including:

- **Household Hazardous Waste Collection Program**. Manages wasteloads prior to entrance into Conveyance and Storage Asset System, reduces potential damage to sewers and demands on WRF assets
- **Industrial Waste Pretreatment Program**. Manages wasteloads prior to entrance into Conveyance and Storage Asset System, reduces potential damage to sewers and demands on WRF assets

4.5 APPENDICES

The following appendices are provided for this chapter:

- Appendix 4A, Conveyance Future Demand
- Appendix 4B, WRFs and Biosolids Future Demand
- Appendix 4C, WCFM Future Demand
- Appendix 4D, GI Future Demand

4.6 References

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