5.1 System Evaluation and Capacity Assurance Plan Development

The Milwaukee Metropolitan Sewerage District (MMSD or District) has prepared this System Evaluation and Capacity Assurance Plan (SECAP) in response to a stipulation agreement (Stipulation) entered into between the District and the State of Wisconsin in May of 2002. The SECAP describes the actions that the District has taken and will take to evaluate system capacity and undertake capacity enhancement measures.

Capacity, Management, Operation, and Maintenance (CMOM) principles were proposed by the United States Environmental Protection Agency (USEPA) as a part of the draft Sanitary Sewer Overflow (SSO) rule that was subsequently withdrawn. The withdrawn SSO rule, although never formally adopted, was considered in the development of the District SECAP. However, the language regarding CMOM in the Stipulation and the District's objectives were the primary considerations.

This SECAP is a further development of the SECAP Strategy that was documented in the *MMSD CMOM Readiness Review and Implementation Strategy Development* (*CMOM Strategic Plan*) completed in December 2005. There are many items that were identified during the readiness review and strategy development and documented in the *CMOM Strategic Plan* that have been partially or completely addressed as of the completion of this document. These items are still included to provide background information and continuity to the evolution of the SECAP from readiness review to strategy development to final plan. In addition, the activities described in this Plan will be subject to change and refinement as the District continues implementing and gains experience with the CMOM Program.

The Stipulation requirements, withdrawn SSO rule and District objectives are discussed below.

5.1.1 Stipulation Requirements

The 2002 Stipulation agreement between the State of Wisconsin and the Milwaukee Metropolitan Sewerage District (Stipulation) requiring the CMOM program contains a SECAP requirement. The Stipulation states:

"7. While sanitary sewer overflows in the District's system have been significantly reduced, there are still sanitary sewer overflows within the District's and its satellite municipalities' sanitary sewer systems. To continue the District's program to reduce with the goal of eliminating all non-permitted sanitary sewer overflows, the District shall implement the regional Capacity, Management, Operation and Maintenance (CMOM) program. The regional CMOM shall be comprised of four integrated components:"

The third component listed is:

"C. *System Evaluation and Capacity Assurance Plan*. A Plan for system evaluation and capacity assurance for peak flow conditions. This plan shall identify necessary capital improvements to meet the projected flows and an implementation plan that describes timing and responsibilities for implementing each capital project."

The actions listed here are satisfied by the District SECAP, mainly through completion of the 2020 Facilities Plan.

5.1.2 Principles from Withdrawn SSO Rule

In the withdrawn SSO rule that had been proposed by the USEPA, a SECAP must be prepared and implemented if peak flow conditions are causing SSOs. The following is the text of § 122.42 (e) (2) (viii) of the withdrawn SSO Rule:

"System Evaluation and Capacity Assurance Plan. You must prepare and implement a plan for system evaluation and capacity assurance if peak flow conditions are contributing to an SSO discharge or to noncompliance at a treatment plant unless you have already taken steps to correct the hydraulic deficiency or the discharge meets the criteria of paragraph (f) (2) [Discharges Caused by Severe Natural Conditions] of this section. At a minimum the plan must include:

A) Evaluation. Steps to evaluate those portions of the collection system which you own or over which you have operational control which are experiencing or contributing to an SSO discharge caused by hydraulic deficiency or to noncompliance at a treatment plant. The evaluation must provide estimates of peak flows (including flows from SSOs that escape from the system) associated with conditions similar to those causing overflow events, provide estimates of the capacity of key system components, identify hydraulic deficiencies (including components of the system with limiting capacity) and identify the major sources that contribute to the peak flows associated with overflow events.

B) Capacity Enhancement Measures. Establish short- and long-term actions to address each hydraulic deficiency including prioritization, alternatives analysis, and a schedule.

C) Plan Updates. The plan must be updated to describe any significant change in proposed actions and/or implementation schedule. The plan must also be updated to reflect available information on the performance of measures that have been implemented."

Although the withdrawn SSO rule was never promulgated, these principles were considered, in the absence of other guidance, in developing the SECAP.

5.1.3 District Objectives

Chapter 1 – Facilities Plan Report of the District's 2020 Facilities Plan contains background information related to previous facilities plans (that include system evaluations) and the reasons for preparing the 2020 Facilities Plan.

The CMOM Program Management Plan (Chapter 2 of this document) has several strategies and tactics listed to achieve objectives that are related to the SECAP.

Conveyance strategies and tactics

- ✓ Adopt rule changes as discussed in the 2020 Facilities Plan that provide for improved management of municipal discharges during peak wet weather flow conditions

- ✓ In collaboration with the Technical Advisory Team (TAT), establish a Wet Weather Peak Flow Management Program
- ✓ Implement the recommended studies and projects from the 2020 Facilities Plan for the conveyance system as defined by the 2020 Implementation Plan

Treatment Plant Objectives, Strategies and Tactics

- ✓ Continue to minimize process diversion events, consistent with the discharge permit
- ✓ Continue to optimize effectiveness of wet weather treatment capacity
- ✓ Continue to provide effluent quality that meets or exceeds WPDES [Wisconsin Pollutant Discharge Elimination System] permit requirements and effluent quality goals
- ✓ Implement the recommended studies and projects from the 2020 Facilities Plan for the treatment plants as defined by the 2020 Implementation Plan

Watercourse Objectives, Strategies, and Tactics

- ✓ Undertake updates to the District's Watercourse Management Plans (WMPs) on a scheduled basis
- ✓ Develop and implement design and construction of solutions that ensure watercourse conveyance and storage capacities will minimize the damage from the one-percent probability flood event
- ✓ Ensure that new development and redevelopment do not result in habitable structures being added to the one-percent probability floodplain or diminish the protection provided by District watercourse projects
- ✓ Continue to acquire ownership or conservation easements on land identified as providing natural water quality and quantity benefits

The wastewater conveyance, storage and treatment system has been addressed by the 2020 Facilities Plan. The watercourse system has been addressed by the WMPs that were completed in 2000. Further discussion of the WMPs is included below in section 5.2.3.

5.1.4 SECAP components

The District has recognized that CMOM principles apply to all of its service areas. Because of this, the CMOM Program and the SECAP chapter include sections on: 1) Wastewater collection, conveyance, and storage (conveyance) (5.2.1); 2) Wastewater treatment (5.2.2); and 3) Watercourse systems (5.2.3). The SECAP will be divided up by these three service areas. For each area, there will be included a section on:

- A description of the system/service area
- The Level of Protection
- Generation of flows and loadings
- Modeling of the system response to flows and loadings
- Identification of deficiencies
- Prioritization and implementation plan

There will also be a section describing the updates to the SECAP (5.2.4).

5.2 System Evaluation and Capacity Assurance Plan

The System Evaluation and Capacity Assurance Plan (SECAP) contains a section for each of the District service areas of Conveyance (5.2.1), Treatment (5.2.2), and Watercourse (5.2.3), and a section on SECAP updates (5.2.4).

5.2.1 Conveyance System

The MMSD conveyance system serves 29 satellite sanitary and combined sewer system owners (28 municipalities plus Milwaukee County) in the counties of Milwaukee, Ozaukee, Washington, Waukesha and Racine. The MMSD service area is largely developed and will not require significant expansion of facilities to serve new areas. New facilities are generally constructed to eliminate conveyance restrictions, reduce overflows and replace aging facilities.

5.2.1.1 System Description

The MMSD conveyance system consists of the Metropolitan Interceptor Sewer (MIS) system, Near Surface Collector (NSC) system, Inline Storage System (ISS) and the Combined Sewer Outfall system. The MIS system collects flow from both combined sewers and separate sanitary sewers and conveys it to the MMSD wastewater treatment plants. The NSC system collects flow that exceeds the capacity of the MIS system from both the combined and separate sewer service areas and delivers it to drop shafts where the flow enters and is stored in the ISS. Sewage stored in the ISS can be pumped to either of the two MMSD wastewater treatment facilities as capacity is available. The combined sewer outfall system lets flow out of the system and into the rivers and lake during wet weather events that exceed the system capacity.

The 2020 Facilities Plan – Conveyance Report (6) Chapter 2 contains a more detailed description of the MMSD conveyance system.

5.2.1.2 Level of Protection

The 2020 Facilities Plan – Facilities Plan Report Chapter 9 Appendix F contains the complete discussion of Level of Protection (LOP), including definitions. The discussion includes a review of the LOP used by other wastewater utilities in Wisconsin and the United States, as well as the projected impact to local water quality for different District Levels of Protection. The 2020 Facilities Plan is recommending the adoption of a 5-year wastewater recurrence interval for the LOP as a criterion for designing and operating the District conveyance, storage and treatment system (Wastewater System).

Two related topics that are being addressed are the District's Wet Weather Peak Flow Management Program and Satellite system SECAP requirements. Each is discussed below.

5.2.1.2.1 Wet Weather Peak Flow Management Program

Also as part of the 2020 Facilities Plan, there is a recommendation to continue the development of the Wet Weather Peak Flow Management Program (WWPFMP), with the input of the Technical Advisory Team (TAT – includes District, satellite, and

regulatory representatives). As taken from the 2020 Facilities Plan – Facilities Plan Report, Chapter 10, section 10.2.2, "The WWPFMP will establish peak wet weather flow standards, outline provisions for the repair of deteriorated sewersheds, and incorporate other activities that will serve to keep I/I [infiltration and inflow] from growing beyond current levels." The implementation and enforcement of this program is intended to maintain the District's ability to provide the desired LOP.

The 2020 Facilities Plan – Facilities Plan Report Chapter 10, section 10.2.2 discusses the WWPFMP.

5.2.1.2.2 Satellite SECAP

The District has completed a limited SECAP for each satellite system to provide information for the 2020 Facilities Plan. The limited SECAP included most sanitary sewer lines 12 inches and larger and any systems with known capacity issues or overflows. The objectives of this effort were to:

- Identify satellite municipality system capacity deficiencies;
- Estimate satellite system bypass volumes and flow rates for a selection of wet weather events that are relevant to the 2020 Facilities Plan analysis; and
- Summarize peak flows delivered to the District's system for the same wet weather conditions.

The first item was used to estimate the cost to the region related to elimination of overflows (whether they are District or satellite). The last two items are the most important relative to the District's SECAP. Understanding additional detail regarding peak flow sources improves the District's ability to plan necessary facilities and implement actions to avoid District overflows. In addition, local overflow volumes were used in water quality calculations.

The District may require a satellite system to prepare a SECAP for a portion of or for their entire sewer system, as described in District Rules, Chapter 3, section 3.105. The limited SECAP that was completed by the District would serve as a starting point for this work.

5.2.1.3 Flow Generation

The District service area, for the 2020 facilities planning effort, is divided up into sewersheds. For each sewershed, the District has obtained projected land use and population from the communities and from the Southeastern Wisconsin Regional Planning Commission (SEWRPC). The District uses a two part method for determining total modeled flows into the MIS system. The first part is the sanitary flows which are determined based on population in residential and commercial areas and acreage in industrial areas. The second part is the wet weather related flows, both in combined and sanitary sewer systems. To generate these, the District first uses a model built with the Hydrologic Simulation Program – Fortran (HSPF) to generate surface and sub-surface flows. The surface and sub-surface flows are then input into the District's Flow Forecasting System (FFS), which generates total flow into the MIS system.

The 2020 Facilities Plan – Conveyance Report Chapter 3 contains a more detailed discussion of the generation of wastewater flows in the conveyance system.

5.2.1.4 Hydraulic Modeling

The District has built hydraulic models in three levels of detail of the entire system. The simplest model is called MACRO and is a water balance for estimating total overflow volumes. This model uses the outputs directly from the HSPF model. The other two models are built using the Modeling of Urban Sewers (MOUSE) software with medium (Mini-MOUSE) and high (Streamline-MOUSE) levels of detail. These models use the outputs of the FFS. Mini-MOUSE is used for long-term simulation, whereas Streamline-MOUSE is used for single event simulation. They can both be used for determining hydraulic grade lines (water levels) and overflow volumes at various locations throughout the system.

The 2020 Facilities Plan – Conveyance Report Chapter 3 contains more detailed discussion of the hydraulic modeling of wastewater flows in the conveyance system

5.2.1.5 Identification of Deficiencies

The conveyance system was modeled with 2020 conditions for a 5-year and 10-year LOP (estimated by particular historic events). This analysis resulted in the identification of locations where the MIS system had a hydraulic deficiency (did not provide an adequate outlet for local connections or resulted in a conveyance-related SSO) based on the particular LOP. Problems caused by the Inline Storage System filling and closing were not considered hydraulic deficiencies. These locations were based on the projected flows for 2020 growth and are not necessarily deficient for existing conditions.

The 2020 Facilities Plan – Conveyance Report Chapter 9 contains a map and list of all of these identified locations for both the 5-year LOP (Figure 9-1 and Table 9-3 in the Conveyance Report) and 10-year LOP (Figure 9-2 and Table 9-4 in the Conveyance Report).

5.2.1.6 Prioritization of Deficiencies and Implementation Plan

The 2020 Facilities Plan – Conveyance Report Chapter 10 contains the recommended conveyance facilities, programs, operational improvements and policies (FPOPs). Because all of the locations identified with hydraulic deficiencies are dependent upon the growth in flow due to development, the implementation plan will be based on monitoring of growth, development, and system flows.

The 2020 Facilities Plan – Facilities Plan Report Chapter 11 discusses the implementation of the recommendations.

5.2.2 Wastewater Treatment Plants

The District has two regional treatment plants, the Jones Island Wastewater Treatment Plant (JIWWTP) and South Shore Wastewater Treatment Plant (SSWWTP). The District service area is divided into areas tributary to JIWWTP, areas tributary to SSWWTP, and areas tributary to both plants. The areas that are tributary to both plants can be diverted during wet weather, for maintenance purposes or for capital improvement projects.

5.2.2.1 System Description

JIWWTP serves the combined sewer system, located in the central portion of the City of Milwaukee and the eastern portion of the Village of Shorewood, as well as portions of separate sewer systems from the other satellite systems. It has a maximum daily flow capacity of 300 million gallons per day (MGD).

The SSWWTP primarily serves satellite systems that have separate sewers, although combined sewer flow can be diverted to the SSWWTP. It has a maximum daily flow capacity of 250 MGD. Both treatment plants utilize primary treatment, secondary treatment and disinfection. The treatment processes differ though, and result in different classes of the resulting biosolids.

The 2020 Facilities Plan – Treatment Report Chapter 2 contains an in-depth description of the District wastewater treatment facilities and unit processes.

5.2.2.2 Level of Protection

Working in conjunction with the conveyance and storage systems, the wastewater treatment plants must have sufficient capacity, for hydraulics and processing, to provide for a 5-year Level of Protection against sanitary sewer overflows from the Wastewater System. While processing these flows, the District also has the objectives (see the Management Plan, Chapter 2 of this document) of minimizing process diversion events (used to increase JIWWTP capacity to 360 MGD) and maximizing wet weather treatment capacity (to avoid filling the ISS). The District must at all times comply with permit effluent quality requirements, whether a diversion is occurring or not.

The 2020 Facilities Plan – Treatment Report, Chapter 10 includes a discussion of Level of Protection as it relates to the treatment plants.

5.2.2.3 Flow and Wasteload Analysis

In order to begin the analysis to determine if the JIWWTP and SSWWTP have adequate facilities for 2020 conditions, a prediction of the flow and wasteloads to each plant was projected. The wasteload is determined using the Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS) parameters.

The 2020 Facilities Plan – Treatment Report Chapters 4 and 5 and the associated appendices contain the full discussion of the flow and wasteload analysis for year 2000 and year 2020 conditions.

5.2.2.4 Unit Hydraulic and Process Capacity Analysis

A review and analysis of the JIWWTP and SSWWTP unit process capacities has been conducted as part of the 2020 Facilities Plan. These values were compared to year 2000 and year 2020 flows and wasteloads to determine deficiencies (relative to the selected Wastewater System LOP) at the treatment plants.

The 2020 Facilities Plan – Treatment Report Chapters 4 and 5 and the associated appendices contain the full discussion of the capabilities and deficiencies of the treatment plants for year 2000 and year 2020 conditions.

5.2.2.5 Prioritization of Deficiencies and Implementation Plan

The two major items that are recommended to be addressed during the 2020 implementation horizon are increasing the capacity of the Inline Pump Station and additional secondary treatment capacity at the SSWWTP. Similar to the conveyance system, the implementation plan will be based on monitoring of growth and development in the area, as well as system flows.

The 2020 Facilities Plan – Treatment Report Chapter 10 contains the projects recommended for the treatment plants. The 2020 Facilities Plan – Facilities Plan Report Chapter 11 discusses the implementation of the recommendations.

5.2.3 Watercourse Systems

The District has discretionary authority to construct watercourse system improvements within its jurisdictional watercourses. There are approximately 124 miles of watercourse system within the District's jurisdiction.

The District completed a Phase I study of each of the watercourse systems under its jurisdiction in the year 2000. These studies are called the Watercourse Management Plans (WMPs) (7) and are documented in five volumes. The volumes are titled:

1) Milwaukee River tributaries and Fish Creek (Lake Michigan Direct Drainage) - Phase I Watercourse Management Plan
2) Menomonee River - Phase I Watercourse Management Plan
3) Kinnickinnic River - Phase I Watercourse Management Plan
4) Oak Creek - Phase I Watercourse Management Plan
5) Root River - Phase I Watercourse Management Plan

The Milwaukee River study only included the Brown Deer Park Creek tributary as all other tributaries had been addressed in previous District studies. It also did not include the Milwaukee River main stem (MMSD did not take jurisdictional authority of the Milwaukee River main stem until 2003). Each of the other studies included the main stem and all of the major tributaries. These studies were conducted in a manner similar to a capacity study for a sewerage system and satisfy the intent of the SECAP as it is being applied to the District's watercourse system. These studies are not available online but have been previously submitted to the Wisconsin Department of Natural Resources (WDNR).

5.2.3.1 System Description

The District's jurisdictional watercourse systems include approximately 24 miles of improved channel and 100 miles of natural channel. These are located along the:

1. Milwaukee River and its tributaries (28.2 miles);
2. Menomonee River and its tributaries (37.5 miles);
3. Kinnickinnic River and its tributaries (12.8 miles);
4. Oak Creek and its tributaries (17 miles);
5. Root River and its tributaries (24.1 miles); and
6. Lake Michigan direct drainage area (3.9 miles).

Appendix 5-1 provides a listing of the District jurisdictional watercourse systems. This listing is taken from the District's Surface Water and Storm Water rule (Chapter 13, District Rules). The listing and all of the District's rules are available at www.mmsd.com/rules/index.cfm.

5.2.3.2 Level of Protection

The District's Level of Protection goal with respect to watercourse systems is to cost-effectively remove structures from the 100-year floodplain and minimize the damage from the one-percent probability flood event. The District recognizes that further development in upstream areas may impact the ability of current and future District

watercourse improvements to provide this Level of Protection. There are two programs to deal with future impacts: 1) Implementation of rules to limit stormwater runoff from new and redevelopment (District Rules, Chapter 13 - Surface Water and Storm Water rule); and 2) Purchasing key lands containing water absorbing soils (Greenseams program, see below).

5.2.3.2.1 Surface Water and Storm Water rule

The District developed and implemented the Surface Water and Storm Water rule (Chapter 13 – District Rules) in 2001. The intent of the rule is to:

- Reduce the effects of flooding;
- Maximize the effectiveness of District watercourse systems and flood abatement facilities;
- Reduce the impacts of flooding to the sanitary sewerage system;
- Promote comprehensive watershed planning; and
- Restore and enhance the use of regional watercourses.

The rule applies to new developments and redevelopments within the District's service area that increase the amount of impervious surface by 0.5 acre or more, with some limitations and exclusions. All of the District's rules are available online at http://www.mmsd.com/rules/index.cfm

5.2.3.2.2 Greenseams Program

The intent of the Greenseams program is to permanently protect key lands containing water absorbing soils and preserve land along stream corridors. The purpose of these protections is to preserve the land's natural abilities to assimilate storm water runoff, while simultaneously providing wildlife habitat and recreational opportunities. Further information on the Greenseams program is available at www.mmsd.com/floodmanagement/greenseams.cfm.

5.2.3.3 Flow Generation

During the preparation of the WMPs, models were constructed using the Hydrologic Simulation Program – Fortran (HSPF). These models were then used to generate flows that reach the MMSD jurisdictional watercourses for various events, including the one-percent probability flood event. There was a model developed for each watershed (Milwaukee River, Menomonee River, Kinnickinnic River, Root River, Oak Creek and Fish Creek) that was composed of sub-watersheds and sub-basins. The inputs for the watershed models were meteorological time series, hydrologic and basin parameters. The models were based on 2020 land uses, and so are consistent with the planning horizon for the 2020 Facilities Plan.

Chapter 3 in each volume of the WMP describes the procedures used to construct the HSPF model, which was done in a similar fashion for each watershed. Chapter 3 from the Menomonee River WMP volume is included as Appendix 5-2.

5.2.3.4 Hydraulic Modeling

The HSPF models that were built for each watershed provide flow hydrographs at certain locations along the length of the watercourse channels. These flow hydrographs then become the input into another model that represents the watercourse conveyance channels. These models were all built using the Hydrologic Engineering Center – River Analysis System (HEC-RAS) model. These models were also completed during the preparation of the WMPs. The HEC-RAS models require channel dimensional information, roughness coefficients, bridge opening data (and other restrictions along the watercourse reaches), and the input flow hydrographs and locations. The HEC-RAS models then calculate water surface profiles.

The water surface profiles are used to determine the extent of the floodplain and the structures that will be impacted by an event, which is the one-percent probability flood event as the District's Level of Protection.

Chapter 3 in each volume of the WMP describes the procedures used to construct the HEC-RAS model, which was done in a similar fashion for each watershed. Chapter 3 from the Menomonee River WMP volume is included as Appendix 5-2.

5.2.3.5 Identification and Prioritization of Deficiencies

The result of the Phase I WMPs, which included the modeling described above, alternatives analysis and cost considerations, was a recommended list of watercourse projects for each watershed. Included in the scope of projects are:

- Watercourse conveyance improvements
- Surface water storage facilities
- Floodproofing structures
- Purchasing structures
- Implementing watershed-wide stormwater management regulations
- Preserving existing natural storage

The specific recommendations for each watershed from the WMPs are included in the Appendices:

Appendix 5-3 – Milwaukee River tributaries and Fish Creek
Appendix 5-4 – Menomonee River
Appendix 5-5 – Kinnickinnic River
Appendix 5-6 – Oak Creek
Appendix 5-7 – Root River

The projects that were the result of earlier studies and are not in the WMPs, such as Lincoln Creek improvements and storage facilities along Southbranch Creek and Indian Creek are not included in the appendices.

5.2.3.6 Implementation Plan

Beyond the previously completed WMPs, the District has been implementing further studies, which include:

1. Additional Phase I studies (of watercourses not previously completed)

2. Phase II studies (detailed analysis and investigation of the proposed projects and flood management facilities proposed in the WMPs)
3. Sediment transport and geomorphic studies

The further studies include:

- Milwaukee River main stem – Phase I Watercourse Management Plan (in progress)
- Menomonee River – Phase II Watercourse Management Plan (completed)
- Menomonee River – Sediment Transport Study (completed)
- Kinnickinnic River – Phase II Watercourse Management Plan (completed)
- Kinnickinnic River – Sediment Transport Study (budgeted)
- Oak Creek – no further watercourse management studies planned
- Root River – Phase II Watercourse Management Plan (in progress)
- Root River – Sediment Transport Study (in progress)
- Fish Creek – Geomorphic Study

The majority of the watercourse improvement projects that were identified in the Phase I Watercourse Management Plans have either been studied further with a phase II plan, implemented a preliminary engineering phase, or both. Design and Construction contracts have been awarded for the following projects:

1. Valley Park levee, storm water pump station and floodwall (completed)
2. Hart Park floodplain modifications (in progress)
3. County Grounds floodwater management basins (in progress)
4. Timmerman Field detention basin (completed)

5.2.4 SECAP Updates

The SECAP is a major effort for the District. As the 2020 Facilities Plan and the Watercourse Management Plans have used the year 2020 as the planning horizon, there should not be a need to undertake additional efforts until after the CMOM Program Audit is completed in 2012. The CMOM Program Audit Report will contain information on the timing of planning efforts that are being considered at that point.