This sanitary sewer design guidance is provided to assist in the design of municipal and private sanitary sewers within the Milwaukee Metropolitan Sewerage District (MMSD) planning area. This guidance is not intended to replace any requirements contained in the MMSD Rules or in the State of Wisconsin Administrative Code.

This guidance applies to design of new sanitary sewer extensions. It may also be used in the design of relay of existing sanitary sewers.

The following methodology is to be used in determining the peak sanitary flows in accordance with the MMSD 2020 Facilities Plan. The values may be utilized in sizing the sanitary sewers; however, the design of sanitary sewers is not limited to this guidance and its attachments.

Other design for municipal sewers may be acceptable to MMSD. If, due to the type of development to be served by the municipal sewer, design warrants different methodology than what is defined in this guidance, that different methodology must be approved by the MMSD.

This guidance is divided into three sections:

- Methodology;
- Flow Allocation Worksheet; and
- Design depth of flow for sanitary sewers.

In addition to the tools referenced, the MMSD annual Cost Recovery Procedures Manual is needed to determine each municipality’s then-current occupancy factor to calculate residential sanitary flows. The Manual is available on the MMSD website.

Projected growth allocated for each sewershed can be found in the 2020 Facilities Plan, Appendix 12A, which is located on the MMSD website.

Consistent with the methodology developed in the 2020 Facilities Plan to allocate flows for new development, the MMSD developed a spreadsheet entitled “2020 FP Sewershed Flow Allocation Worksheet”. A hard copy of this is attached hereto as Attachment A. All municipalities were provided with an electronic copy of this worksheet.
Sanitary sewer depth of flow is also a consideration in sewer design. Following is guidance for consideration for municipal sewer design:

<table>
<thead>
<tr>
<th>Sewer Size (inches)</th>
<th>Depth (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8, 10 and 12</td>
<td>50</td>
</tr>
<tr>
<td>15 and greater</td>
<td>65</td>
</tr>
</tbody>
</table>
COMBINED SEWER DESIGN GUIDANCE

Because the majority of the current combined sewer service area is sewered and the combined sewer area cannot be enlarged, the majority of combined sewer design is relay sewers. These designs involve the basic $Q= CIA$ formula.

For those limited instances where redevelopment will occur that will require a new sewer, a method to calculate the sanitary loadings consistent with the 2020 Facilities Plan must be utilized.

Projected growth for each combined sewershed can be found in the 2020 Facilities Plan, Appendix 12A, which is located on the MMSD website.

Attachment B is a document entitled “New and Re-development in the Combined Sewer Service Area in Sewersheds that Have No Allocation For Development” which addresses methodologies to be utilized for different scenarios in the Combined Sewer Service Area.
2020 FP Sewershed Flow Allocation Worksheet

**Population and Land Use**
Sewershed flow additions are computed based on the projected increases in population and land use.

Flows are the incremental increase in sewershed flow due to projected increase in population, commercial area, industrial area, and institutional area, not the total sewershed flow.

**Base Sanitary Flow (BSF) Component**
The population change results in an increases in the base sanitary flow is based on a per capita generation rate (the BSF rate is in gallons per capita per day, gpd).

Commercial and industrial area growth increase in the base sanitary flow in proportion to the added area (the BSF rate is in gallons per acre per day, gpd).

**Infiltration and Inflow (II) Flow Component**
The population change is classified as LOW, MEDIUM, or HIGH density to estimate the increase in infiltration and inflow (II) component of flow.

Classification of LOW, MEDIUM, and HIGH density residential developments are defined by SEWRPC by lot size or the number of housing units per gross acre.

Inputs are the additional population of residential developments or the area of the commercial, industrial, or institutional developments.

Fixed values are the generation rates and the II rates per unit area for each land use classification.

II responds to the magnitude of the wet weather event. The 5-yr peak flow rate is used as a reference point for comparison; it is not the peak flow rate for all possible conditions.

**Sum of Additional Flow Components BSF + II**
Outputs from the calculator (spreadsheet below) are the peak hourly flow rate of the additional sewershed flow.

The peak flow rate represents a peak value with approximately a 5-year wastewater recurrence interval.

<table>
<thead>
<tr>
<th>Land Use Classification of New Developments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Low Density</td>
</tr>
<tr>
<td>Residential Medium Density</td>
</tr>
<tr>
<td>Residential High Density</td>
</tr>
<tr>
<td>Residential High Density greater than 4 family</td>
</tr>
<tr>
<td>Residential less than 4 family</td>
</tr>
<tr>
<td>Commercial</td>
</tr>
<tr>
<td>Industrial</td>
</tr>
<tr>
<td>Institutional</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Population and Land Use</th>
<th>input values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Low Density</td>
<td></td>
</tr>
<tr>
<td>Residential Medium Density</td>
<td></td>
</tr>
<tr>
<td>Residential High Density</td>
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<td></td>
</tr>
<tr>
<td>Institutional</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Base Sanitary Flow (BSF) Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>BSF Generation Rates</td>
</tr>
<tr>
<td>Increase allowance in Average BSF (gpd)</td>
</tr>
<tr>
<td>Diurnal Peaking Factor</td>
</tr>
<tr>
<td>Increase allowance in Peak Hourly BSF (gpd)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Infiltration and Inflow (II) Flow Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Landuse Type</td>
</tr>
<tr>
<td>Density Factors</td>
</tr>
<tr>
<td>Year 2020 Uniform Peak II Rate (gpd)</td>
</tr>
<tr>
<td>Increase allowance in Peak Hourly II Flow (gpd)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sum of Additional Flow Components (BSF + II)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Increase allowance in Peak Hourly Flow (gpd)</td>
</tr>
</tbody>
</table>

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MMSD 2020 FACILITIES PLAN
LAND USE CATEGORIES
UTILIZED IN SEWER PLAN APPROVALS
AND REQUIRED “INCREASE IN USE” NOTIFICATION

<table>
<thead>
<tr>
<th>Land Use Types</th>
<th>Unit Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial</td>
<td>Net Acre&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>Industrial</td>
<td>Net Acre&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>Institutional</td>
<td>Net Acre&lt;sup&gt;2[2]&lt;/sup&gt;</td>
</tr>
<tr>
<td>Residential</td>
<td>Per capita*</td>
</tr>
</tbody>
</table>

**Density Designation required for infiltration component**

Examples of how a Mixed Use Development will be Assessed

For a development where commercial and residential are in the same building (such as commercial entities on the first floor and condominiums or apartments on upper floors): The Commercial Unit Designation and associated base sanitary and infiltration flow factors will be applied to the entire project area, and the residential per capita base sanitary flow will be applied utilizing the residency occupancy factor times the number of residential units. There will be no infiltration component for the residential units if they are contained in the same building as the Commercial development.

For a development where both commercial and residential components exist in the same project area but they are included in separate buildings: The commercial and residential components will be assessed based upon the each individual component, i.e., the commercial component will be addressed on the commercial site area and the residential component will be addressed on the per capita for sanitary flow and density designation for infiltration. Any common areas, such as detention basins, will be prorated based upon the percentage of area each component occupies.

[1] District Rule 7.13(2) states:

New Connections To Previously Approved Sanitary Sewers
In the event a connection is proposed to any public or private sewer tributary to the District’s Sewerage System, which either was not previously shown upon District-approved plans or constitutes an increased use of an existing connection as shown upon District-approved plans, written permission for such connection or increase must be obtained by the District prior to the connection or increase.

[2] Net area for Commercial, Industrial, and Institutional Unit Designation is defined as the entire project area for the development, excluding major roadways that may abut the property.
New and Re-development in the Combined Sewer Service Area
in Sewersheds that Have No Allocation for Development

The 2020 Facilities Plan (FP) identified new and re-development in all
sewersheds, including combined sewersheds, based on projections provided by
municipalities within the Milwaukee Metropolitan Sewerage District (MMSD) planning
area to the Southeastern Wisconsin Regional Planning Commission (SEWRPC). The
information relative to the planned development is contained in Appendix 12A of the
2020 FP.

In sewersheds where flow has not been allocated for development because no new
or redevelopment was identified by the municipality or where new or redevelopment
exceeds the municipality’s projection of growth during the planning period, development
may still occur as long as the flows tributary to the MMSD system are consistent with the
2020 FP.

In the Combined Sewer Service Area (CSSA), it is important to insure that the
flows identified in the 2020 FP are not exceeded because:
  o In dry weather, if the capacity of the tributary MMSD Intercepting Structure is
    exceeded, flows will then be diverted to the Diversion Structure and potentially
    the Inline Storage System (ISS). Dry weather diversions to the ISS result in
    unanticipated and excessive operation and maintenance costs.
  o In wet weather, additional flows may cause the MMSD to surcharge its
    Metropolitan Interceptor Sewer (MIS) system, which could result in basement
    back-ups or SSOs.
  o In wet weather, additional flows may cause the MMSD to overflow more
    frequently or may cause overflows to be of a greater volume.

MMSD does not desire to hamper development; however, it needs to insure that
its facilities are able to handle the flows from new development. Therefore, the MMSD
will employ flexibility when assessing the flows from new and re-development,
summarized as follows:
  o Sewersheds that are tributary to the same MMSD Intercepting Structure may
    share flows allocated for development;
  o Equivalent volumes or rates of flow may be removed from the area tributary to
    the same MMSD Intercepting Structure as the flows that are projected from the
    new development; or
  o Additional dry weather flow may be allowed if it does not have an adverse effect
    on the MMSD Intercepting Structure and if an equivalent volume and rate of peak
    flow is removed during wet weather.

Guidance for Calculating Hydraulic Loadings in the CSSA

Flows from the new development or increases in sanitary flow from existing
developments will need to be estimated to determine the impact on the District’s
conveyance system. There are different scenarios that require different estimation procedures. Flows from these developments and their impact on the District’s conveyance system need to be consistent with the current facilities plan and the peak flows identified in the current facilities plan.

Before choosing the scenario that best describes the proposed development, it must first be determined how much flow has been allocated to the particular sewershed from which the proposed development will discharge its sanitary flow. If there is no additional flow allocated to account for new development or re-development, then it must be determined if there are other sewersheds that have allocated flow that may be used.

These different scenarios and resulting flow calculation methods are as follows:

**Combined Sewer-Storm Water (CSSW) Designated Sewersheds**

None of the CSSW designated sewersheds had flows allocated for development because the municipality did not project development in these sewersheds during the 2020 FP planning process. If any new increase in existing flow or new or re-development is to occur in these areas, it is mandatory that all non-sanitary flow such as, but not limited to, surface drainage, sump pumps, non-contact cooling water, roof top drainage, detention ponds, be discharged to the adjacent receiving waters.

Flow from the CSSW designated areas can be further categorized as follows:

- **Lateral Connections to Existing Sewers**
  Since non-sanitary flow will be discharged to local waterways and is not to be considered for these purposes, only base sanitary flow and dry-weather infiltration needs to be determined. This can be done on a Fixture Unit basis or other acceptable method for determining base flow. Once the base sanitary flow is calculated, a peaking factor must be applied to address dry weather variability and infiltration into the system.

Since no new or re-development was identified, estimated or otherwise projected by the municipality during the 2020 FP process, no flow was allocated for development in the build-out state. Therefore, the impact of the additional flow on the District’s Intercepting and Diversion Structures needs to be determined. The analysis of the impact will be done on a case-by-case basis. If stormwater that is presently conveyed in the combined sewer conveyance system is removed from this system and conveyed directly to a receiving water or separate storm sewer, i.e., to compensate for the increase in sanitary base flow, the impact of this base flow in dry weather conditions will still need to be determined.

If the District’s Intercepting Structure cannot accept this additional baseflow (dry weather flow) without causing a dry weather diversion to the ISS, the proposed development cannot be approved unless an equal amount of baseflow is removed before being discharged to the MMSD system. If the baseflow is transferred to
another MMSD system, that addition to another system would need to be analyzed in the process defined herein.

If the private sewers (i.e., building sewers, private interceptor mains) to be installed to convey flow from the development to an existing sewer system has an inch-diameter/mile value greater than the existing private sewer that had served the area to be redeveloped, then the method of calculating the flow will be the same as is done for new development in the separate sewer area.

- **Development Requiring Sewer Extensions**

  Developments requiring sewer extensions will have the base and peak flows estimated by the same method used by the District in determining flow from separated sanitary sewersheds. Since no new or re-development was identified, estimated or otherwise projected by the municipality during the 2020 Facilities Plan process, no flow was allocated for development in the build-out state. Therefore, the impact of the additional flow on the District’s Intercepting and Diversion Structures needs to be determined. The analyses of the impact will be done on a case-by-case basis. If stormwater is removed from this system and conveyed directly to a receiving water or separate storm sewer to compensate for the increase in total sanitary flow, the impact of this flow in dry weather conditions will still need to be determined.

If the District’s Intercepting Structure cannot accept this additional baseflow (dry weather flow) without causing a dry weather diversion to the ISS, the proposed development cannot be approved unless an equal amount of baseflow is removed before being discharged to the MMSD system.

**Combined Sewer (CS) Designated Sewersheds**

In all but two 1 of the CS designated sewersheds, the 2020 FP identified a flow component for either existing flow or existing plus 2020 planned development flow. Since new development from these areas will be required to follow the District’s Chapter 13 rules for Storm Water Management, it is to be assumed that the post-development storm water conveyed by the combined sewers in this sewershed will be less than pre-development peak flow; therefore, only dry weather flow needs to be determined.

This can be done on a Fixture Unit basis or other acceptable method in determining base flow. Once the base sanitary flow is calculated, a peaking factor must be applied to address dry weather variability and infiltration into the system.

The impact of the additional flow on the District’s Intercepting and Diversion Structures needs to be determined. If the District’s Intercepting Structure cannot accept this additional baseflow (dry weather flow) without causing a dry weather

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1 The two with no flows associated with them are sewersheds that are completely comprised of roadways.
diversion to the ISS, the proposed development cannot be approved unless an equal amount of baseflow is removed from the system.

In situations where new imperviousness is less than 0.5 acres and Chapter 13 is not required, an equal amount of design wet weather flow would need to be removed from the sewersheds. If stormwater is removed from this system and conveyed directly to a receiving water, separate storm sewer, or facility that allows for infiltration into the ground, this may compensate for the increase in total flow; however, the impact of this base flow in dry weather conditions will still need to be determined and analyzed to determine if the Intercepting Structure can accept this additional dry weather flow without causing a dry weather diversion to the ISS. The proposed development cannot be approved unless an equal amount of baseflow is removed from the system.

If development will require sewer extensions, the process identified above for this situation under Combined Sewer-Storm Water Designated sewersheds will be followed.