

RESOLUTION
AMENDING ARTICLE XXIV OF THE RULES AND REGULATIONS OF
THE METROPOLITAN SEWER DISTRICT OF GREATER CINCINNATI
BY ADDING SECTION 2409 TO ADOPT
MSDGC HYDRAULIC MODELING STANDARDS,
INCLUDING CALIBRATION AND VALIDATION

WHEREAS, the Board of County Commissioners, Hamilton County, Ohio ("Board") entered into two Consent Decrees ("Consent Decree") on June 9, 2004 in a matter pending in the United States District Court for the Southern District of Ohio, Case No. C-1-02-107 captioned *United States of America, et al. v. The Board of County Commissioners of Hamilton County, Ohio, et al.*; and

WHEREAS, the Metropolitan Sewer District of Greater Cincinnati ("MSDGC") is a County Sewer District organized under Chapter 6117 of the Ohio Revised Code; and

WHEREAS, Hamilton County ("County") owns the MSDGC and the City of Cincinnati ("City") operates the MSDGC, subject to the exclusive control and direction of the Board under the terms of an agreement ("Agreement") entered into in 1968; and

WHEREAS, the County has authority under Chapter 6117 of the Ohio Revised Code and the Agreement to adopt rules and regulations, and the Agreement provides that the County may amend such rules and regulations from time to time after public hearing; and

WHEREAS, the Consent Decree holds that the Board acts as the principal for MSDGC, while the City serves as the agent for the County in the management and operation of MSDGC; and

WHEREAS, the Consent Decree plaintiffs are the United States Environmental Protection Agency ("USEPA"), Ohio Environmental Protection Agency ("OEPA"), and Ohio River Valley Water Sanitation Commission ("ORSANCO")(collectively, the "Regulators"); and

WHEREAS, the Regulators have approved a Final Wet Weather Implementation Program ("WWIP"), dated November 9, 2009, which sets forth certain projects and terms for implementation of certain aspects of the Consent Decree, including addressing combined sewer overflows ("CSO") and sanitary sewer overflows ("SSO") from the sewer system; and

WHEREAS, the Board has responsibility to ensure that the WWIP is implemented in compliance with the Consent Decree and applicable law, and to oversee debt financing and expenditures for the use and benefit of MSDGC ratepayers; and

WHEREAS, MSDGC's System-wide Model (Model) is used, in part to predict CSO and SSO hydraulic flow and overflow frequency, and to evaluate proposed and implemented CSO and SSO control solutions under the Consent Decree and WWIP; and

WHEREAS, MSDGC has spent more than \$30 million over the past 12-15 years on Model development and updates; and

WHEREAS, the Regulators require such Model to be properly calibrated and validated so that it accurately predicts volume of flow and frequency of overflows, among other things; and

WHEREAS, the Model will be used to demonstrate that implemented SSO and CSO solutions comply with the Consent Decree and WWIP; and

WHEREAS, in November 2011, MSDGC prepared a *Modeling Guidelines and Standards Manual* that is currently in Version 3 (“MSDGC Modeling Standards”) which is based on the United Kingdom’s Wastewater Planning User’s Group (WaPUG) Code of Practice for the Hydraulic Modeling of Sewer Systems, 3rd Edition (“WaPUG Modeling Standards”); and

WHEREAS, the County Monitor has advised the Board that the WaPUG Modeling Standards are the generally and widespread accepted modeling standards for the wastewater utility industry and are appropriate for use in connection with the MSDGC sewer systems; and

WHEREAS, the County Monitor has further advised the Board that MSDGC’s Modeling Standards varies from the WaPUG Modeling Standards in certain key areas, including in the calibration and validation of model results, and that MSDGC’s adherence to the MSDGC Modeling Standards or WaPUG Modeling Standards has been inconsistent; and

WHEREAS, the County Monitor has determined, based on review of MSDGC Reports and Documents, that the Model has only been calibrated and validated for approximately 2% of the MSDGC modeled separate and combined sewer service areas in accordance with the MSDGC Modeling Standards or WaPUG Modeling Standards; and

WHEREAS, the County Monitor has further determined that inconsistent application of the modeling standards and lack of calibration and validation of the Model (and sub-versions of the Model) have resulted in inaccurate or insufficient data for Consent Decree/WWIP project planning, design and construction that has resulted in substantial cost increases, inappropriately sized facilities, and significant future risks, including but not limited to, failure to demonstrate compliance with the Consent Decree and WWIP; and

WHEREAS, the County Monitor has further determined that certain large and high profile projects have been negatively impacted by the inconsistent application of modeling standards and lack of calibration and validation of the Model, including the Lick Run Valley Conveyance System (which is part of the LMCPR project), Upper Duck Bundle projects, Oakley Station project, and the SSO 700 Storage and Treatment Facility project; and

WHEREAS, the Board as a matter of policy desires to ensure the proper and consistent use of the Model for all MSDGC projects, including asset management and Consent Decree/WWIP projects, and to require compliance with the MSDGC Modeling Standards and WaPUG Modeling Standards where the MSDGC Modeling Standards do not completely address an issue; and

WHEREAS, the Board finds that it is necessary and appropriate to adopt an MSDGC rule establishing Modeling standards, including standards for calibration and validation, that shall be followed by MSDGC for all MSDGC projects unless the Board decides otherwise for a specific project.

NOW, THEREFORE, BE IT RESOLVED, by this Board of County Commissioners of Hamilton County, Ohio that the MSDGC Rules and Regulations are hereby amended by adopting and adding

Article XXIV, Section 2409 – MSDGC Hydraulic Modeling Standards, including Calibration and Validation as set forth in Attachment A, said amendment being adopted and effective immediately, and which shall be followed by MSDGC for all MSDGC projects.

BE IT FURTHER RESOLVED, that this Board of County Commissioners hereby finds and determines that all formal actions relative to the adoption of this Resolution were taken in an open meeting of the Board of County Commissioners and that all deliberations of this Board of County Commissioners and of its committees, if any, which resulted in formal action were taken in meetings open to the public, in full compliance with applicable legal requirements, including Section 121.22 of the Ohio Revised Code.

BE IT FURTHER RESOLVED, that the Clerk of the Board be and hereby is authorized and directed to certify copies of this resolution to Christian Sigman, Hamilton County Administrator, Harry Black, City Manager of the City of Cincinnati, Gerald Checco, Executive Director of the MSDGC, and Jeff Aluotto, Hamilton County Assistant Administrator.

ADOPTED at a regular adjourned meeting of the Board of County Commissioners of Hamilton County Ohio, this ___ day of _____, 2016:

Mr. Monzel _____ Mr. Portune _____ Mr. Deters _____

CERTIFICATE OF CLERK

IT IS HEREBY CERTIFIED that the foregoing is a true and correct transcript of a resolution adopted by the Board of County Commissioners in regular session this ___ day of _____, 2016.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the Official Seal of the Office of the Board of County Commissioners of Hamilton County, Ohio this ___ day of _____, 2016.

, Clerk
Board of County Commissioners
Hamilton County, Ohio

ATTACHMENT A

**MSDGC RULES AND REGULATIONS
ARTICLE XXIV, SECTION 2409**

**MSDGC HYDRAULIC MODELING STANDARDS,
INCLUDING CALIBRATION AND VALIDATION**

Hydraulic modeling for projects shall comply with the MSDGC Modeling Standards for Hydraulic Modeling of Sewer Systems (Version 3) in effect as of October 1, 2015. Where the MSDGC Modeling Standards Version 3 do not completely address a subject or issue, the Wastewater Planning User's Group (WaPUG) Code of Practice for the Hydraulic Modeling of Sewers (Version 3.001) in effect as of December 2002, shall be followed for that subject or issue [note, WaPUG is part of the Chartered Institution of Water and Environmental Management (CIWEM)]. With respect to achieving model calibration and validation under these standards, the standards checked below in Table 1 shall be followed for the listed model calibration and validation step (where "Partially Addressed" is noted in Table 1 for a step, an explanation for clarity is included in the footnotes to the table). The modeling standards shall be followed by MSD unless the Board of County Commissioners decides otherwise for a specific project.

Table 1

Model Calibration and Validation (CV) Step	Follow WaPUG Modeling Standards	Follow MSDGC Modeling Standards (Ver. 3)
1. Select flow meter sites that are critical to ensure the model accurately represents the measured flows in the system.	✓	Not Addressed
2. Select a sufficient number of time periods within the flow meter data set to reasonably calibrate and validate the results; use a single continuous flow record where there is significant rainfall induced variation in inflow and infiltration.	✓	Partially Addressed ^[1]
3. Select dry weather days to evaluate the model's Dry Weather Flow performance against measured flows		✓
4. Using the selected rainfall time periods, continuous flow record and dry weather days, compare measured and modeled flows, volumes, and depths for meter sites from Step 1.	✓	Partially Addressed ^[1]
5. For at least 2/3rds of the rain events selected in Step 2, the measured results must match model results within WaPUG Standards for all selected flow meter sites.	✓	Partially Addressed ^{[1][2]}

6. Confirm the model accurately represents the measured system flows in terms of frequency and volume at the major CSO & SSO locations selected in Step 1.	✓	Partially Addressed ^[3]
7. Flooding during calibration & validation storms should be reproduced by the model	✓	Not Addressed
8. Historic flooding location(s), severity and frequency should generally be reproduced by model	✓	Not Addressed

^[1] The MSDGC Modeling Standards mention using a range of storm events; however, it directs to select only 3 to 5 events for model calibration and validation. Sufficient storm events should be used that are representative of the range of frequency, antecedent moisture effects, and storm events interaction, and should not be limited to only 3 to 5 storm events.

^[2] The MSDGC Modeling Standards use the same peak flow and volume Calibration and Validation criteria as listed in the WaPUG Standards. However, the MSDGC Modeling Standards use different Calibration and Validation criteria for depth. The depth standards provided in the WaPUG Standards listed below shall be utilized:

Depth of Surcharge = +1.6 feet to -0.3 feet

Unsurcharged Depth at Key Locations where this is important having regard to the objectives of the model (e.g. at combined sewer overflows) = ± 0.3 feet.

^[3] The MSDGC Modeling Standards mention comparing overflow location activity (frequency of overflow) where data is available, but the manual does not focus on measuring overflow volumes and selecting major CSO & SSO locations. When major CSOs and SSOs are within the area being modeled, frequency and volume data from these locations shall be used in the model calibration and validation effort. If it can be demonstrated that monitoring a CSO or SSO outfall directly is unsafe or not possible, the upstream flow and associated underflow shall be monitored to allow for proper calculation of the overflow volume from the monitoring data and for use in model calibration and validation.

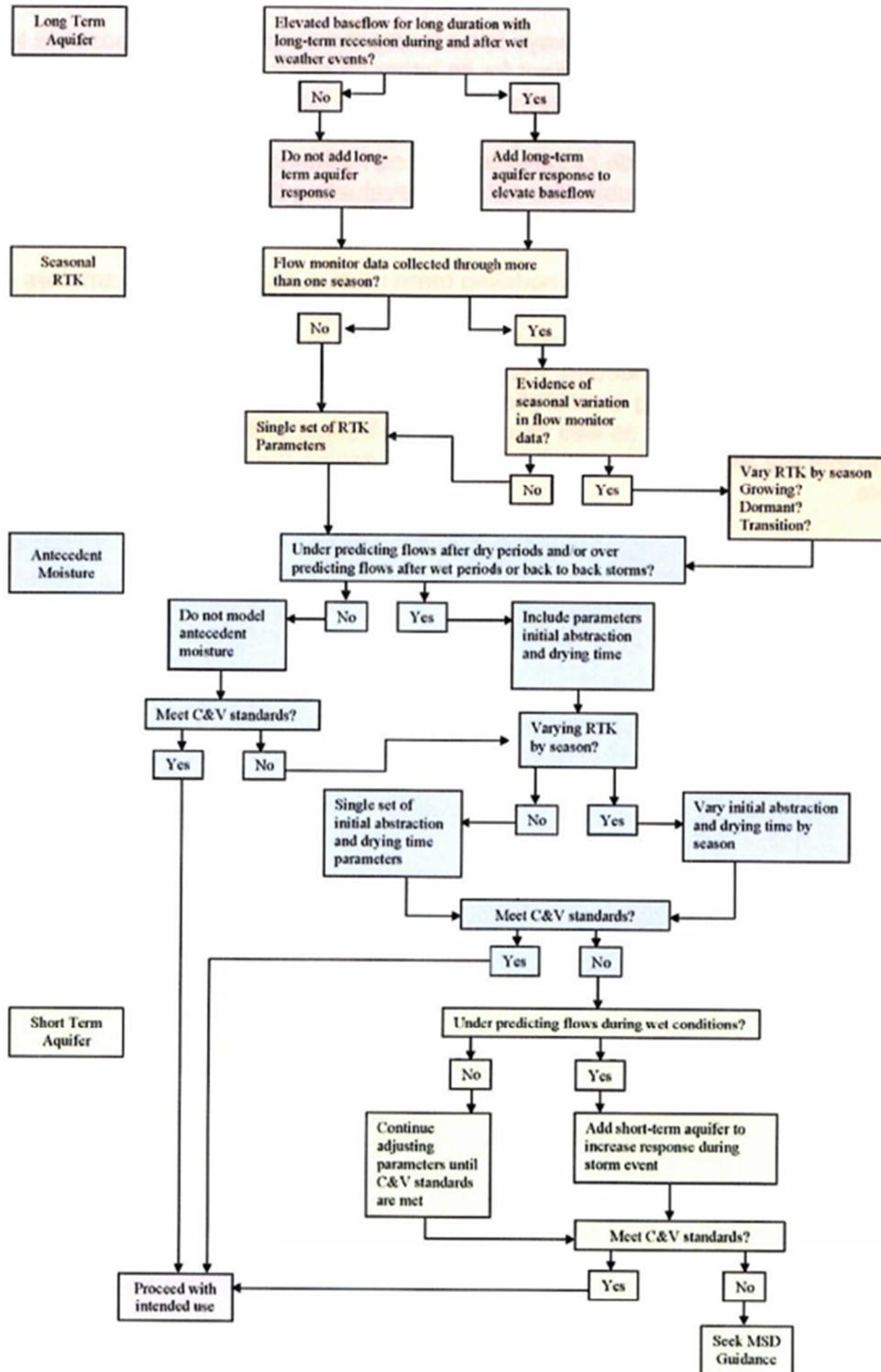
When continuous calibration is used, the modeled results must at a minimum match 2/3rds of the storm events in the continuous series for all three parameters (Peak Flow, Volume and Depth) within the limits established by the WaPUG Standards. In all cases the storm events, as indicated above, must represent the range of storm frequencies for which the model is intended to be used.

Validation storm events shall be selected prior to the beginning of the calibration effort, in order to avoid the appearance of bias in selecting storm events. Of the storm events selected, 2/3rds of the events must match the monitored data for each flow monitor, for all three parameters (Peak Flow, Volume, and Depth) within the limits established by the WaPUG Standards. The storms selected for validation shall to the extent possible represent the storm events for which the model is intended to be used.

In all cases, the validation of the model shall be performed using storm events different from the storm events or continuous series used for calibration, unless an exception is approved by the Hamilton County Administration. When continuous calibration is used, a different continuous series of storm events shall be used for validation.

In order to address back-to-back storm events and antecedent moisture effects in calibrating and validating the model or a sub-model, the MSDGC decision flowchart below shall be followed (identified as Figure 17 – Parameter Selection Guidance for SWM Modeling of Sanitary System). (Reference note: this flowchart was developed by MSDGC and its consultant, and was followed to successfully calibrate and validate a portion of the Upper Duck Basin model to address antecedent moisture effects for the sewer system in accordance with MSDGC and WaPUG Standards. For more information, see Upper Duck All Bundle (UDAB) Task No. 800, SSO 228 Refined Calibration & Validation Final Technical Memorandum (April 29, 2015)).

Figure 17 – Parameter Selection Guidance for SWM Modeling of Sanitary Systems



MSDGC Fact Sheet

Amendment to MSDGC Rules and Regulations to adopt and add MSDGC Hydraulic Modeling Standards, Including Calibration and Validation (January 5, 2016)

PROJECT NAME: AMEND RULES AND REGULATIONS FOR THE METROPOLITAN SEWER DISTRICT OF GREATER CINCINNATI ("MSDGD") TO ADOPT AND ADD MSDGC HYDRAULIC MODELING STANDARDS, INCLUDING CALIBRATION AND VALIDATION

LEGISLATIVE REQUESTS:

1. Resolution to amend the Rules and Regulations of the Metropolitan Sewer District of Greater Cincinnati ("MSDGC"), Article XXIV, "ADMINISTRATIVE RULES," to adopt and add Section 2409, "MSDGC Hydraulic Modeling Standards, including Calibration and Validation"

PROJECT DESCRIPTION:

A public hearing is required to receive public comments on a proposed Resolution to amend the MSDGC Rules and Regulations at Article XXIV, "ADMINISTRATIVE RULES," to adopt and add Section 2409, "MSDGC Hydraulic Modeling Standards, including Calibration and Validation." Details on the public notice and hearing are provided below.

The proposed amendment adopting and adding Section 2409 is necessary as a matter of policy to formalize and clarify the existing hydraulic modeling standards and to ensure that necessary and proper modeling and model calibration and validation standards be followed to plan, design and construct wastewater infrastructure projects, especially projects required by the Consent Decrees and WWIP, and ultimately to demonstrate compliance with the Consent Decrees and WWIP.

RECENT MODEL HISTORY:

The current MSDGC hydraulic model ("Model") has been identified as a significant source of risk and concern by the County Monitor and the Board of County Commissioners ("Board"). The Model is used to size the capacity and define the scope of WWIP and Asset Management projects and in establishing Wastewater Treatment Plant flows. A review of MSDGC Model Reports by the County Monitor determined that only 2% of the MSDGC modeled area has been calibrated and validated in conformance with the MSDGC Modeling Guidelines and Standards Manual - Version 3 ("MSDGC's Modeling Standards")(See attached Map). The quality and accuracy of wastewater infrastructure design is directly impacted by the quality of the flow data and the accuracy of modeling tools being utilized to plan and size projects. This risk impacts the costs of projects, the Board's Capital Improvement Program

and Operating Budget for MSDGC, sewer rate increases, and compliance with the Consent Decrees and WWIP. In January 2014, MSDGC commenced improvements in planning and implementing the Model in compliance with MSDGC's Modeling Standards and accepted industry standards adopted in 2002 by the United Kingdom's Wastewater Planning User's Group Code of Practice for the hydraulic modeling of sewer systems ("WaPUG Modeling Standards"). However, progress to improve the Model has slowed while uncertainty over the application of the Model and potential changes have increased.

CURRENT MODEL REVIEW PROCESS:

On behalf of the Board, the County Monitor regularly asks MSDGC about the Model status when projects are brought forward by MSDGC for legislation. Unfortunately, MSDGC consistently reports that either the Model is calibrated and validated with exceptions, or that the Model has not been calibrated and validated to MSDGC's Modeling Standards. This results in MSDGC and the Board trying to minimize the risks of an improperly sized project due to inaccurate or insufficient model results. Often this risk must be evaluated in a cursory and expedited manner so that the project may advance, in some cases, to meet a WWIP deadline. The review of the Model at the time when approval of legislation is requested is not efficient or cost effective, and has led to disagreements between the County Monitor and MSDGC staff. This practice is no longer acceptable due to increasing financial and legal risks. The Board considers this an exceptionally high and unacceptable risk.

CURRENT MODEL STANDARDS:

The WaPUG Modeling Standards have been widely adopted and utilized in the United States, and are a rigorous set of standards for performing modeling, and properly calibrating and validating hydraulic models. These standards serve as the basis for the MSDGC guidelines and standards. In November 2011, upon recommendation of the County Monitor, MSDGC developed a manual for modeling guidelines and standards that generally follows the WaPUG Standards with some exceptions. MSDGC is currently on Version 3 of the manual. The WaPUG Modeling Standards are widely accepted as the industry standard, and the rationale behind the standards is based on sound engineering practices.

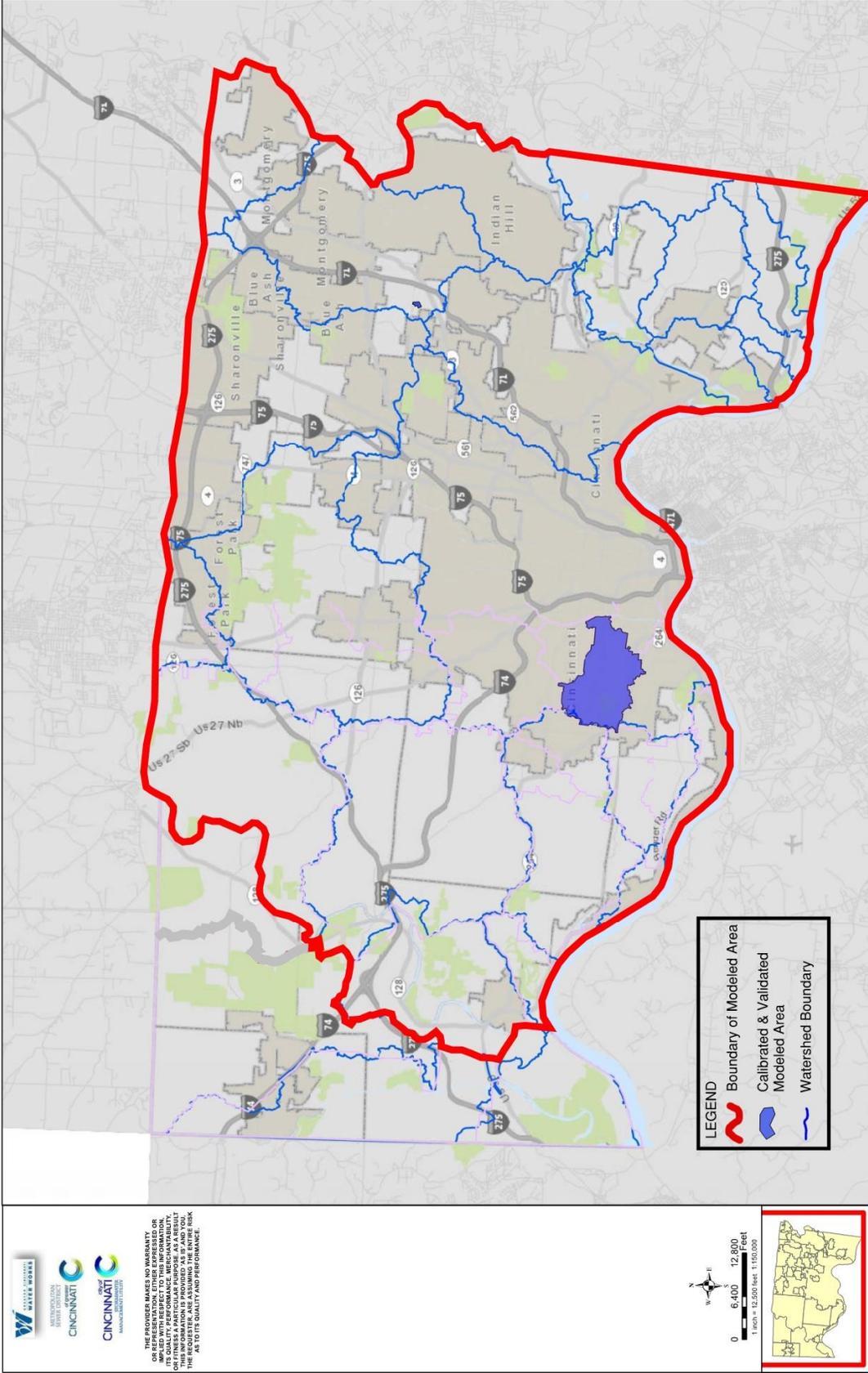
PROPOSED ACTION:

The amendment to the MSDGC rules and regulations adopts MSDGC's existing modeling standards, including calibration and validation, into a formal rule and supplements them with appropriate WaPUG modeling standards where the existing MSDGC modelling and calibration and validation standards do not completely address an issue or subject. These modeling standards shall be used in MSDGC projects being advanced for approval legislation.

PUBLIC NOTICE AND HEARING:

The Board scheduled a public hearing on the proposed new rules at a public meeting of the Board on _____, 2016 at _____ AM in accordance with the 1968 City – County Management Agreement for MSDGC, thereby affording all interested parties the opportunity to comment. Notice of the public hearing was advertised in the *Cincinnati Enquirer* newspaper on _____, 2016. In addition, the proposed amended MSD rules and public hearing notice were posted on the Hamilton County Board of Commissioners website, <http://hamiltoncountyohio.gov/hc/bocc>.

MSD Sewer Sheds Calibrated and Validated



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