Notice of Proposed Change	Metropolitan Government of Nashville and Davidson County METRO WATER SERVICES

Date: September 30, 2015 **Division: Stormwater** **CM-SW04**

Proposed Change:
Metro Water Services is revising Volumes 1, 4, and 5 of the Stormwater Management Manual (SWMM) to comply with Metro Nashville's National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Permit, to align the SWMM with sections of the *Tennessee Permanent Stormwater Management and Design Guidance Manual*, to clarify and improve our policies, and to update our Green Infrastructure Practices (GIP) specifications.

Description of Change:
This change will make the management of the first inch of rainfall on a site a requirement as mandated by Metro Nashville's MS4 Permit. Sites designed in accordance with Volume 5 of the SWMM, the LID Manual, meet the one inch requirement. Projects with certain site limitations will be allowed to waive the one inch requirement, but will still be required to treat to the 80% Total Suspended Solids (TSS) removal standard.

Volume 1 of the SWMM will also now contain Metro's Single Family Residential Infill Requirements. These regulations were mandated by Ordinance NO. BL2014-910 and have be in place since November 2014.

Highlights of Other Changes:

- A reduction of the runoff reduction credit of Level 1 Bioretention, Level 1 Urban Bioretention, and Green Roofs to align the credit with national research.
- The replacement of the filter fabric layer in infiltrative Green Infrastructure Practices with a choker layer consisting of sand and stone to prevent the practice from clogging.
- A change in the Bioretention Media composition to 70%-85% sand; 10%-20% Silt + Clay, with no more than 10% Clay; 5%-10% Organic Matter and a decrease in the porosity to 0.25.
- Increased As-built requirements to include electronic submittals, video inspection, water quality buffers, and LID Site Design Sheets.
- Replacement of the Stormwater Control Measures (SCMs) inspection checklists with one general sheet and one sheet for proprietary units.
- The only type of permeable pavement that can receive credit for a contributing drainage area (CDA) is Level 1 Permeable Interlocking Concrete Pavers. The CDA is only equal to the permeable surface area.

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Summary of Known Effects of the Proposed Change:
The LID Manual was released in August 2012 and the one inch requirement has been an available water quality compliance path. Since March 2013, 24% of the grading permits issued have used the LID Manual to design their project. This voluntary compliance has provided over 137 demonstration sites for the development community and given design engineers the opportunity to learn the new methodology. The one inch requirement has been in effect in Franklin, TN since January 2014, and no projects have waived the requirement. Stormwater will also offer a 25% reduction to the one inch requirement for previously developed sites to help encourage redevelopment and provide relief to sites with existing impervious areas. These factors should help mitigate the impacts of the change.

Notification/Transition:
This Notice of Proposed Change (CM-SW04) meets the requirements of the Change Management Plan and complies with the notification requirements.

The "Notice" is posted on the following MWS websites:

http://www.nashville.gov/Water-Services.aspx

http://www.nashville.gov/Water-Services/Developers/Stormwater-Review/Stormwater-Management-Manual.aspx

The comment period regarding the proposed changes is 30 days. Comments will be reviewed and proposed changes updated as appropriate.

Effective Date of Change: The updated SWMM will be released following approval by the Mayor. The changes will go into effect no later than February, 1, 2016.

Comments:
Please send written comments to:

Sue Amos and Rebecca Dohn, Metro Water Services, 1600 Second Avenue North, Nashville, TN 37208
sue.amos@nashville.gov and rebecca.dohn@nashville.gov

Metro Stormwater Management Manual 2016 Revisions

Volume 1, Universal Change: Best Management Practices (BMPs) to Stormwater Control Measures (SCMs)
Volume 1, Universal Change: Fines and civil penalties to administrative penalties

Volume 1, Chapter 1
1.2 Most Recent Addition, pg. 1-1: Add, "In 2016, Volumes 1 and 5 were revised to comply with Metro's MS4 permit runoff reduction requirement." before the last sentence.

Volume 1, Chapter 2
2.5 Other Stormwater Quality Management Practices, pg. 2-6: Delete 2nd paragraph

Volume 1, Chapter 3
3.4.1 Exemption for Approved Subdivision or PUD Grading Plan
Insert the following as the second paragraph:
"Regulated Residential Infill is the creation of 800 to 15,000 square feet of additional net impervious area (IA) through single family residential development, redevelopment, or rehabilitation in existing neighborhoods. These projects follow a different regulatory path than traditional Grading Permits and the Residential Infill Permit is issued as part of the building permit. Please see Chapter 8 and Appendix H for more information.
3.9 As-Built Certifications, pg. 3-13: Delete last sentence and replace with, "The as-built plan should be submitted as a CAD file on a CD and should be registered to the TN State Plane Coordinate System, North American Datum 1983 (NAD83). Data should be placed in separate layers and should be labeled for easy identification."
3.9 As-Built Certifications, pg. 3-14: Add to end of first paragraph on page, "Any water quality buffers shall also be surveyed and included with the as-built submittal. Any project stormwater infrastructure that is to become the responsibility of Metro to maintain shall be video-inspected to verify proper installation with the video recording submitted as part of as-built record. Additional testing may be required as/if warranted by video inspection. The as-built submittal for sites designed in accordance with Volume 5 of the SWMM, the LID Manual, shall include a copy of the site design spreadsheet and include a site plan showing the site envelope and any areas counted towards the site weighed runoff coefficient."

Volume 1, Chapter 4
4.2.2.4 Sinkhole and Drainage Well Information, pg. 4-7: #2, Replace "floodplain" with "volume" (2 instances)
4.2.2.4 Sinkhole and Drainage Well Information, pg. 4-7: #3, Change first phrase to "Proposed stormwater control measures located within the sinkhole."
4.2.2.4 Sinkhole and Drainage Well Information, pg. 4-8: #5, Delete "floodplain"
4.2.2.4 Sinkhole and Drainage Well Information, pg. 4-8: #6, Delete "flood"

4.2.3.2 Tennessee Department of Environment and Conservation, pg. 4-9: Add “There are also cases where stormwater infiltration practices are regulated as injection wells. They include some proprietary subsurface detention vaults that are designed to capture and infiltrate stormwater. Please contact TDEC for additional information.” To the last paragraph.
4.3.3 EPSC Professional, pg. 4-10: Add bullet, “Must notify MWS if continued/ongoing deficiencies are found during 3 consecutive inspections.”
4.4.3 Site Inspections, pg. 4-14: Add paragraph before last paragraph in section, “If continued/ongoing EPSC deficiencies are found during 3 consecutive inspections, the EPSC Professional must notify MWS in writing of the issues within two business days. The EPSC Professional’s inspection reports shall be included as part of the written notification.”

Volume 1, Chapter 6
6.2.4 Easement Width, pg. 6-4, Table 6-1: Delete “10 feet greater than top width of channel, with minimum of 5 feet on one side” and replace with “5 feet on both sides”
6.6 Stormwater Quantity Detention, pg. 6-6 – 6-7, Delete section text and replace with the following: “The purpose of stormwater detention is to protect downstream properties from flood increases due to upstream development. The design is required to control peak flow at the outlet of a site such that post-development peak flows are equal to or less than pre-development peak flows for the 2-year, 5-year, 10-year, 25-year, 50-year and 100-year design storms.

In the event that Metro has developed a master plan for the area, the recommendations within the master plan will establish the requirements for detention. Metro retains the right to require detention in areas of known flooding when detention will not exacerbate downstream flooding. Metro also retains the right to waive detention where detention is proven to exacerbate flooding or will have no proven impact on flooding.

The release rate from any detention facility should approximate that of the site prior to the proposed development for the 2-year through 100-year storm events, with emergency overflow capable of handling at least the 100-year discharge except where waived or altered by MWS. Detention systems must be constructed during the first phase of major developments to eliminate damage to adjacent properties during construction. In this regard, the detention systems shall be designed to function as sediment traps and cleaned out to proper volumes before completion. If siltation has occurred, detention systems must be restored to their design dimensions after construction is complete and certified as part of the as-built submittal (see Section 3.9).”

6.8 Sinkholes and Drainage Wells, pg. 6-9: Delete “and their associated floodplains” from the first sentence
6.8 Sinkholes and Drainage Wells, pg. 6-10: Insert, “Any lost sinkhole volume from the 100-year storm event will need to be compensated within the development or demonstrate that no adverse conditions will occur.” after the first sentence.
6.8 Sinkholes and Drainage Wells, pg. 6-10: Delete the last three paragraphs in the Section.

6.9.3 Preservation of Water Quality Buffers, pg. 6-13: Add the following before the last sentence in the section, “Septic systems cannot be located within 25’ of a community water. This distance is not appealable to the SWMC. A variance will be required if they are located in Zone 1 outside of the 25’ setback.”
6.9.5 Uses in the Buffer that are permissible with Conditions, pg. 6-15: Replace, “Greenways and trails, including trails in accordance with Metro’s approved Greenway Plan” with “Metro Greenways” and add “Trails that do not require the removal of buffer vegetation and are made of mulch or other pervious materials are permitted.”

Volume 1, Ch. 7
Delete Section 7.1 and replace with:

7.1 Overview

Metro’s comprehensive stormwater management program addresses stormwater runoff during construction through Erosion Prevention and Sediment Control (EPSC) practices and after construction through stormwater quantity and quality controls. After construction has been finished on a site and the site is stabilized, pollutants can be washed into the storm drain system and into receiving streams off of hardened or impervious surfaces, such as driveways, roads and roofs. Typical stormwater runoff from stabilized urban sites contains sediments, nutrients and metals, as well as gross solids such as litter. These pollutants are carried into streams and other water bodies. Major metropolitan areas, including Metro, are required under Federal and State law to reduce the discharge of these stormwater pollutants to achieve stormwater treatment goals set by the U.S. Environmental Protection Agency. Projects that disturb greater than 10,000 square feet and are new developments, significant redevelopments, and/or grading permit sites are therefore required to design, install, and maintain stormwater quality and quantity controls.[1] In the case of significant redevelopment, the entire footprint of the significantly redeveloped structure shall count toward the total disturbed area. Stormwater quality and quantity controls should be integrated into a development’s conceptual design early in the design process.

Metro has established a post-construction stormwater quality program that applies a consistent standard that seeks to achieve pollutant removal primarily by runoff reduction practices regardless of the type of development. This chapter describes the post-construction stormwater quality program and associated requirements including:

- Runoff reduction requirement;
- Pollutant removal requirement (to be utilized if runoff reduction is demonstrated to be infeasible);
- Water quality treatment volume requirement for new development;
- A listing of pre-approved structural Best Management Practices (SCMs);
- Testing requirements for proprietary SCMs.

The Stormwater Management Manual, Volume 5 Low Impact Development (LID) and Volume 4 Best Management Practices, Section 6, contain detailed design, inspection and maintenance information as well as design examples for the pre-approved Stormwater Control Measures (SCMs) listed in this chapter. A site design tool that can be used in developing the post-construction stormwater quality plan can be accessed from Metro's Stormwater website.

[1]Please see Chapter 8 and Appendix H for residential infill requirements.

Delete Section 7.2 and replace with:

7.2 Runoff Reduction

The site design shall provide, in combination or alone, management measures that are designed, built, and maintained to infiltrate, evapotranspire, harvest, and/or use, at a minimum, the stormwater runoff generated at a site by the first inch of every rainfall event preceded by 72 hours of no measureable precipitation. A site designed in accordance with the Stormwater Management Manual, Volume 5, The LID Manual, that meets the 80% runoff reduction goal contained therein is presumed compliant with this goal.

7.2.1 Redevelopment Credit

Projects on previously developed sites can reduce their runoff reduction requirement from 80% to 60%. A site is considered previously developed if its pre-development site weighted runoff coefficient is greater than 0.4. Please see Section 3.2 of the LID Manual for more information on runoff coefficients.

7.2.2 Site Limitations

MWS staff may approve alternative practices to runoff reduction when site limitations exist. Criteria to determine the circumstances under which alternatives are available shall not be based solely on the difficulty or cost of implementing practices. The determination may be based on the following site limitations:

1. Where the potential for introducing pollutants into groundwater exists, unless pretreatment is provided;
2. Where pre-existing soil contamination is proven to be present in areas subject to contact with infiltrated runoff;
3. Presence of sinkholes or other karst features on a site;
4. Where pre-development infiltrative capacity of soils precludes runoff reduction measures;
5. A site-use that is inconsistent with capture and reuse of stormwater or a green roof.

Site limitations should be assessed per site post construction drainage area. Please see the *Tennessee Permanent Stormwater Management and Design Guidance Manual* for additional information on limitations to runoff reduction.

If a project is requesting an exemption from the runoff reduction requirement for any of the site drainage areas, the project engineer must submit adequate justification as determined by Metro

Stormwater that one of the aforementioned limitations applies. This may include, but is not limited to soil maps, geotechnical reports, infiltration testing, soil logs, and environmental site assessments.

7.3 Pollutant Removal

Site drainage areas that cannot meet the runoff reduction requirement must be designed to remove at least 80% of the average annual post-construction total suspended solids (TSS) load. It is presumed that the drainage area complies with this performance standard if:

- It is sized to capture and treat the water quality treatment volume, which is defined as the runoff volume resulting from the first 1.1 inches of rainfall from a site; and
- Appropriate structural stormwater controls are selected, designed, constructed, and maintained according to the specific criteria in the SWMMs.

More information about the pollutant removal methodology can be found in the SWMM Vol. 4, Section 6. Please contact MWS' Development Review Section for TSS removal efficiency requirements for sites located in Metro Nashville's combined sewer area.

Delete Section 7.3 and move it to SWMM Vol. 4, Section 6

Delete Section 7.4

Delete Section 7.5 and replace with:

7.4 Pre-Approved SCMs

Stormwater Control Measures (SCMS) are structural and non-structural practices designed to reduce the pollutants leaving a site. For the purposes of this manual, SCMs are divided into Green Infrastructure Practices (GIPs) and Permanent Treatment Practices (PTPs). GIPs are designed for runoff volume reduction and typically have two runoff reduction levels based on design. Table 7-1 lists the accepted GIPs and the runoff reduction credit given to each. PTPs are designed for pollutant removal and are rated by their ability to removal Total Suspended Solids. Table 7-2 presents a pre-approved listing of PTPs and their assigned TSS removal capability. Design and maintenance information for each SCM can be found in the SWMM Volume 5, LID Manual, and SWMM Volume 4, Permanent Treatment Practices (PTP) Section 6.

Table 7-1 GIPs for use in Metro

Green Infrastructure Practice	% Rainfall Volume Removed/Captured RR Credit							
	Level 1				Level 2			
1. Bioretention	40				80			
2. Urban Bioretention	40				N/A			
3. Permeable Pavement	45				75			
4. Infiltration Trench	50				90			
5. Water Quality Swale	40				60			
6. Extended Detention	15				N/A			
7. Downspout Disconnection	25				50			
8. Grass Channel	10/20				20/30			
9. Sheet Flow	50				75			
10. Reforestation (A, B, C, D soils)	96	94	92	90	98	97	96	95
11. Rain Tanks/Cisterns	Design dependent							
12. Green Roof	45				60			

Table 7-2 PTPs for use in Metro

PTP Removal Efficiency for Total Suspended Solids (TSS)	
Structural Control	**TSS Removal (%)**
Wet Pond	80
Stormwater Wetland	80
Bioretention Area	80
Sand Filter	80
Enhanced Swale	80
Filter Strip	50
Grass Channel	50
Organic Filter	80
Underground Sand Filter	80
Submerged Gravel Wetland	80
Infiltration Trench	80
Gravity (Oil-Grit) Separator	40
Proprietary Structural Control	Based on Testing (see Section 7.5)
Dry Detention / Dry ED Basin	60

Section 7.6: change to 7.5, delete 3rd sentence in 1st paragraph, and add the flowing sentence after the first sentence of paragraph 2, “Please contact Stormwater staff for the current list of approved devices.”
Section 7.7: Change to 7.6 & add “Volume 5 and“, at the beginning of the 2nd sentence.
Delete Section 7.8
Section 7.9: change to 7.7

Volume 1, Chapter 8: insert new Chapter

Chapter 8
REGULATED RESIDENTIAL INFILL REQUIREMENTS AND PERMIT PROCEDURES

8.1 Overview

Land development can permanently alter the way in which stormwater flows across a site due to grading, compaction, and the installation of impervious cover. In order to mitigate these impacts, Metro requires, in accordance with the stormwater ordinance, that stormwater management measures be utilized when construction of a home or an addition meets the definition of regulated residential infill.

8.2 Definition and Requirement

Regulated Residential Infill is the creation of 800 to 15,000 square feet of additional net impervious area (IA) through new single family residential development, redevelopment, or rehabilitation in existing neighborhoods.

Exemptions from Regulated Residential Infill regulation are projects that:

(1) add less than 800 square feet of net new IA,

(2) add more than 15,000 square feet of net new IA,

(3) are on lots larger than 40,000 square feet, or

(4) are on lots with a grading permit previously issued by Metro, as long as the post-construction IA conforms to the original grading plan.

Note a previously issued grading permit does not automatically result in an exemption. There may be sites that have had a grading permit in the past but the drainage system is currently inadequate to handle design discharges. The existence of a past grading permit allows the developer to omit use of the one-inch criteria in favor of use of any designed, constructed and maintained competent drainage system already in existence per section 8.2.2. The developer must still insure the downstream system is competent to handle the increased discharge. If the system is not competent the developer may choose to follow normal Tier I, II or III steps, or may choose simply to restore and/or improve the drainage system to handle the increased discharge from the infill site. For Tier III sites detention will still be required.

Projects on lots larger than 40,000 square feet may seek infill classification on a case-by-case basis at the discretion of MWS.

There are three tiers of infill development for non-exempt projects:

- Tier I - Projects creating between 800 and 2,500 square feet of net additional IA with the total lot IA percentage exceeding 30% must treat, by means of capture of the first inch of rainfall runoff, an IA equal to the net increase of added IA.
- Tier II - Projects creating between 2,500 and 8,000 square feet of net additional IA, without regard to total lot IA percent, must treat, by means of capture of the first inch of rainfall runoff, an IA equal to the net increase of added IA.

- Tier III – Projects creating between 8,000 and 15,000 square feet of net added IA, without regard to total lot IA percent, must treat, by means of capture of the first inch of rainfall runoff, an IA equal to the net increase of added IA. Additionally, the project design must insure there is no increase in the 10-year storm peak flow from the site, and the design must be certified by a professional engineer.

8.2.1 One-Inch Capture Requirement

The size and type of stormwater management practices implemented must be in accordance with Appendix H, Regulated Residential Infill Guidance. These post-construction stormwater management practices must be designed to capture the first inch of rainfall runoff from an impervious area equal to the net added impervious area.

8.2.2 Alternatives to One-Inch Capture

The owner/developer of a project meeting the definition of regulated residential infill shall endeavor to treat the first 1" of rainfall runoff from net added impervious. If this treatment proves impractical two alternatives are offered to the one-inch capture requirement for each tier as described below:

A) Tier 1 Alternatives (Net addition of between 800 and 2,500 square feet of impervious area)

1. Demonstrate that an adequate drainage system is present downstream by using the simple method described in Appendix H.
2. If an adequate drainage system does not exist downstream, work with MWS and a licensed engineer to devise a solution to improve the drainage downstream to accommodate the increase in flow resulting from the added impervious area.

B) Tier 2 Alternatives (Net addition of between 2,500 and 8,000 square feet of impervious area)

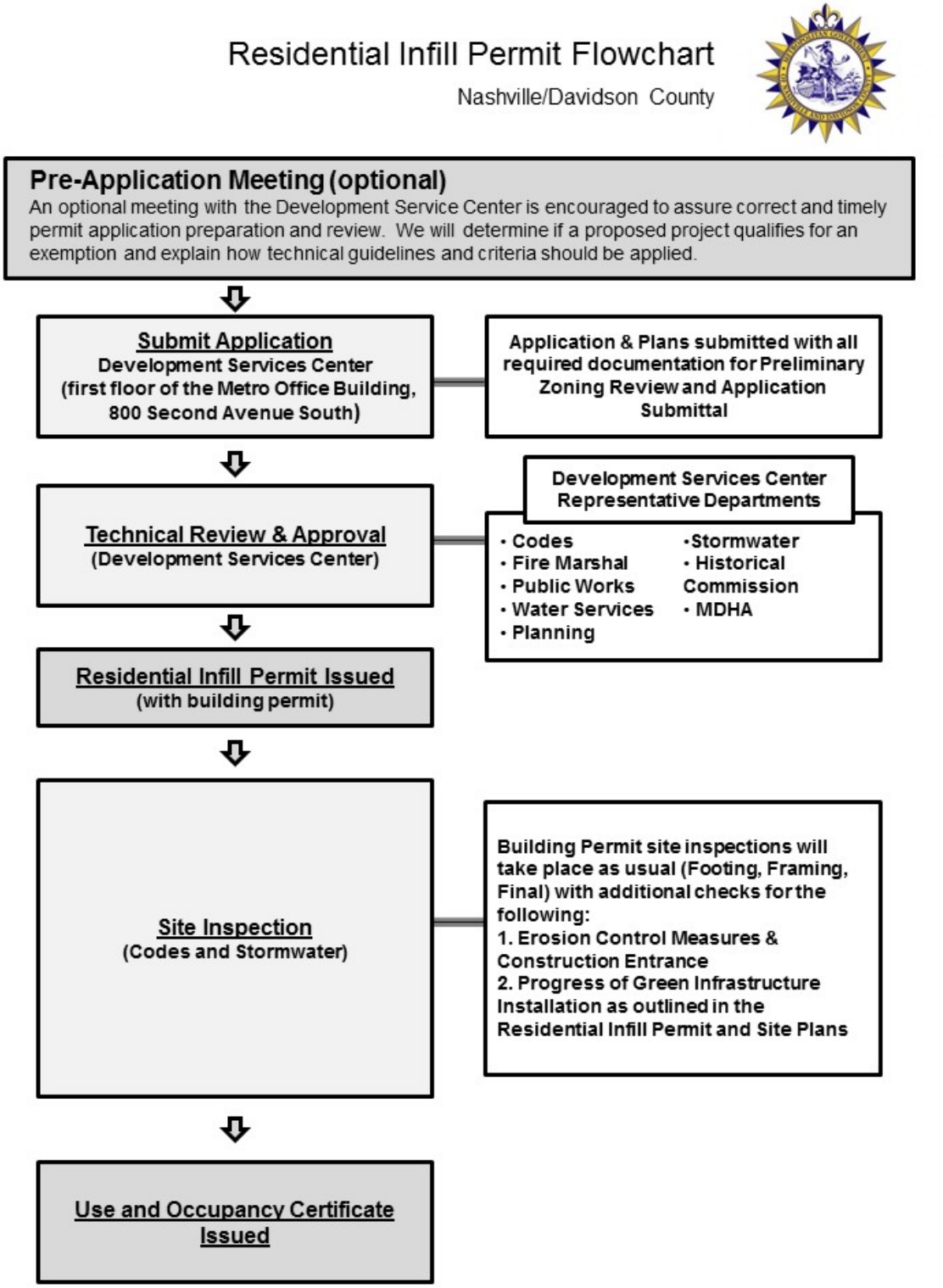
1. Demonstrate that an adequate drainage system is present downstream by analyzing the on and off site drainage as described in the residential infill guidance document (requires a licensed engineer).
2. If an adequate drainage system does not exist downstream, work with MWS and a licensed engineer to devise a solution to improve the drainage downstream to accommodate the increase in flow resulting from the added impervious area.

C) Tier 3 Alternatives (Net addition of between 8,000 and 15,000 square feet of impervious area)

1. Demonstrate that an adequate drainage system is present downstream by analyzing the on and off site drainage as described in the residential infill guidance document (requires a licensed engineer).
2. If an adequate drainage system does not exist downstream, work with MWS and a licensed engineer to devise a solution to improve the drainage downstream to accommodate the increase in flow resulting from the added impervious area.

8.3 Permitting

Permitting of residential infill properties will take place through Metro's Development Services Center as outlined below.



8.3.1 Pre-Application Meeting

All applicants may schedule a pre-application meeting with MWS to discuss their proposed projects. While not mandatory, a pre-application meeting is encouraged to assure correct and timely permit application preparation and review. This meeting will also aid the applicant in identifying water quality buffers, special site challenges, and residential infill requirements. During this meeting, staff can determine if a proposed project qualifies for an exemption and explain how technical guidelines and criteria should be applied.

8.3.2 Required Information and Checklist

Each application for a Residential Infill Permit shall contain site preparation plans and a completed Stormwater Checklist for Residential Infill Lots containing the following items: identification of all impervious surface areas pre- and post-development, the net increase in impervious area, proposed drainage infrastructure in right of way, lot/building layout with dimensions, contours (existing and proposed), erosion and sediment control measures (silt fence, construction entrance), green infrastructure control specifications sheets, easements, all points where stormwater leaves the site, culvert/drainage pipes in right-of-way with size, capacity and material and if applicable, buffers (stream, floodway) zones, any trees receiving the infill credit, 100-yr floodplain boundary, scale on drawing, proof of zero increase in 10-year peak runoff, proof of competent downstream drainage, and a previously assigned grading permit.

8.3.3 Application Processing

The Development Services Center will review the application and issue a permit based on the completeness and correctness of the application.

8.3.3.1 Initial Receipt and Resubmittals

When residential infill projects are referred or submitted to MWS, they are logged in by date and assigned a tracking number. The applicant must complete a Stormwater Checklist, included in Appendix H, for the infill project. Failure by the applicant to complete the Stormwater Checklist upon initial submission or to include the tracking number in resubmittals will result in a delay in the review of the proposed plans.

8.3.3.2 Staff Review and Recommendation

MWS first conducts a sufficiency review of the Residential Infill Checklist and Site Plan to determine if all basic information has been included. If it is determined that the application is incomplete, the application will be returned to the applicant along with a request for additional information needed. The returned application will include the application tracking number that must accompany a resubmittal.

When all basic information has been supplied pursuant to section 8.3.3.1, MWS staff will conduct a technical evaluation of the permit application. This technical evaluation will be based on the technical criteria outlined in Appendix H.

8.3.3.3 Installation of Erosion Control Measures

Initial measures should be installed as detailed in the EPSC plan. No land-disturbing activities, except what is necessary to install initial EPSC measures, shall begin prior to the issuance of a residential infill permit.

8.3.3.4 Residential Infill Permit Issuance and Expiration
A Residential Infill Permit shall expire one year from the date of issuance. The permit holder may request an extension to the expiration date of up to 6 months. No more than two extensions can be requested for any site unless adequate justification for additional extensions is proven.

When an extension is requested, MWS staff can require additional information or additional measures on the site. Extensions will not be granted for projects not in compliance with these regulations.

8.3.3.5 Revisions to Approved Plans
If changes are anticipated prior to or during construction that would constitute a revision of plans already approved by MWS, the approved plans shall be revised and signed by a registered engineer (if applicable) and resubmitted. The resubmission shall include a letter stating why such changes from the approved plans are necessary, the residential infill permit number, and a completed Residential Infill Checklist for the project. MWS reserves the right to waive this requirement or to re-review the entire set of plans in the light of requested changes. Plan revisions must be approved by MWS prior to implementing changes to approved plans in the field. MWS reserves the right to require installed stormwater features to be removed and/or replaced that are not per approved residential infill permit plans and/or are not performing as designed.

8.4 Construction Procedures

8.4.1 Posting of Permit
Work requiring a Residential Infill Permit shall not begin until the permit holder or his agent posts the Residential Infill Permit, or a copy of the permit, in a conspicuous place on the front of the premises. The permit shall be protected from the weather. The permit shall remain posted by the permit holder until the Department of Codes Administration has issued the Use and Occupancy Certificate or until Development Services Center staff verifies that the site has reached final stabilization.

8.4.2 Effect of Permit
A Residential Infill Permit issued pursuant to this section shall be construed to be a license to proceed with the work and shall not be construed as authority to violate, cancel, alter, or set aside any of the provisions of these regulations, nor shall issuance of a permit prevent MWS or the Department of Codes Administration from thereafter requiring a correction of errors in plans, construction, or a correction of violations of these regulations. In addition to Metro Residential Infill Permit requirements, certain land disturbance activities that will impact “Waters of the State”, “Wetlands”, and/or “Sinkholes” may be required to meet certain State and Federal regulations. All such applicable regulations must be met prior to the initiation of land disturbance activities. This includes the receipt of any necessary permits

8.4.3 EPSC Permit Holder Responsibilities
The Residential Infill Permit holder is ultimately responsible and shall be held accountable for all EPSC requirements.

8.4.4 Site Inspections
Inspections will be conducted by Development Services Staff to ensure EPSC requirements and green infrastructure practices are being installed per the submitted plan.

8.4.4 Use and Occupancy
The Use and Occupancy Certificate will be issued after all Development Services Center departments have signed off on the property.

Volume 1, Appendix A
Pg. A-8: Add the following to Item #1: "The total disturbed area is: _____ Acres."

Volume 1, Appendix B
Add the following definition:
"Impervious area" shall mean the portion of a parcel of property that is covered by any material, including without limitation roofs, streets, sidewalks and parking lots paved with asphalt, concrete, compacted sand, compacted gravel or clay, that substantially reduces or prevents the infiltration of storm water. Impervious area shall not include natural undisturbed surface rock."
Add the following acronyms:
303(d) – State's List of Impaired Waterways (Below Water Quality Criteria for Use Classifications)
CSS – Combined Sewer System
LID – Low Impact Development
SCM – Stormwater Control Measure
SWO – Stop Work Order

Volume 1, Appendix C
Long Term Maintenance Plan Inspections, pg. C-19: Replace first bullet with, "Description of the stormwater system components and a site map showing the location of each. For sites designed in accordance with the SWMM, Volume 5, the LID Manual, this includes a site map showing areas of open space that received credit for lowering the site weighted runoff coefficient. Ongoing site SCM inspection and maintenance compliance shall include verification that such areas remain as open space as indicated on the plans."
Long Term Maintenance Plan Inspections, pg. C-19: Replace second bullet with, "Schedule of inspections and the techniques used to inspect and maintain the systems to ensure that they are functioning properly as designed. Documentation checklists are found in this appendix and should be included in the LTMP."
Long Term maintenance Plan Inspections, pg. C-19: Add to bullet #4, "Landscape plans should also be included for bioretention areas."

Pg. C-21: Delete text and replace with, “Stormwater Control Measure (SCM) Checklists (Component of Long-Term Maintenance Plan)”
Pgs. C-23 to C-60: Delete checklists and replace with the following two report templates:

Metro Nashville Stormwater Control Measure (SCM) Inspection Report

SCM Site Information

Document Review

Review associated documentation for the SCM, noting any differences with what you find on site.

Long Term Maintenance Plan: Reviewed Y / N _____

As-built plans: Reviewed Y /N _____

Landscape planting plans, if needed: Reviewed Y / N_____

Last inspection report: Have previously noted maintenance needs been addressed? Y /N

Comments:_____

_____

SCM Inspection Checklist

Complete one checklist per stormwater control measure. Submit checklists per site.

SCM TYPE: _____
(dry detention pond, wet detention pond, bioretention/rain garden, grass channel, water quality swale)

Date of Last Rain: _____

Please note whether feature is satisfactory, maintenance needed, unsatisfactory / non-functioning. Clarify with your own comments. Note locations of photographs.

Inspection Key *S= Satisfactory*: Feature is functioning as designed; *M= Maintenance needed*: Feature has mild to moderate routine maintenance needs, but is still functioning; *U= Unsatisfactory*: Feature requires immediate major remedial maintenance to restore function; *N/A*= Feature does not apply

Feature	**S-M-U Rating**	**Comments**
Inlet structure/headwall stable?		
Inlet sediment accumulation or erosion?		
Flow path vegetation per plans?		
Flow path bare soil/erosion?		

Banks/ Perimeter stable?		
Outlet Structure stable?		
Outlet orifice blocked?		
Outlet sediment accumulation or erosion?		
Emergency Spillway stable?		
Stormwater Detention volume		
Stormwater Infiltration rate		
Underdrain Cleanout		

General Comments:

_____
_____
_____
_____

Date of Next Inspection:_____

Inspector's Signature:_____ Date:_____

Owner's Signature:_____ Date:_____

_____

Metro Nashville Stormwater Control Measure (SCM) Inspection Report for
Underground Water Quality Units (WQU)

WQU Site Information

Document Review

Review associated documentation for the WQU, noting any differences with what you find on site.

Long Term Maintenance Plan: Reviewed Y / N _____

As-built plans: Reviewed Y /N _____

Manufacture's Maintenance Recommendations: Reviewed Y / N_____

Last inspection report: Have previously noted maintenance needs been addressed? Y /N

Comments:_____

_____

[1]**Please see** https://www.osha.gov/Publications/osha3138.pdf **for more information.**

Water Quality Unit/ Proprietary Device Inspection Checklist

Complete one checklist per stormwater control measure. Submit checklists together per site.

WQU Make and Model: _____
Number of Filter Cartridges, if present: _____

Date of Last Rain: _____

Please note whether feature is satisfactory, unsatisfactory or non-functioning. Clarify with your own comments. Note locations of photographs.

Feature		**Comments**
Inlet structure stable?	Y / N	
Trash rack free of debris?	Y / N	
Area draining to WQU stable?	Y / N	
Outlet Structure stable?	Y / N	
Downstream of discharge point stable?	Y /N	
Is there associated Underground Detention?	Y / N	
Depth of accumulated sediment (note inches or feet)		
Depth of accumulated sediment in underground detention (note inches or feet)		
Manufacturer's recommended pump-out volume/ sediment depth		
Total volume of sludge removed if (Attach copy of waste manifest for disposal)		

General Comments:
_____
_____
_____

Date of Next Inspection:_____

Inspector's Signature:_____ Date:_____

Owner's Signature:_____ Date:_____

Volume 1, Appendices D and E

Match MCL

Volume 1, Appendix F

Add the following section:

F1.8 Election of Officers

The Committee shall elect one of its members as chairman and another as vice-chairman, who shall serve for a period of two (2) years or until their respective successors shall have been chosen.

Volume 1, Appendix H

Insert http://www.nashville.gov/Water-Services/Developers/Stormwater-Review/Stormwater-Management-Manual.aspx

Volume 4, Section 6

Delete 6.1 and replace with the following:

6.1 Introduction

This section presents the Stormwater Control Measure (SCM) specifications for Permanent Treatment Practices (PTP). PTPs are intended to treat stormwater runoff in the long-term. PTPs are designed for pollutant removal and are rated by their ability to removal Total Suspended Solids (TSS). Table 1 presents a pre-approved listing of PTPs and their assigned TSS removal capability. Some of these PTPs can be designed to achieve both stormwater quantity and quality management objectives.

Structural Control		TSS Removal %
PTP – 01	Stormwater Wet Ponds	80
PTP – 02	Constructed Wetlands	80
PTP – 03	Bioretention Are	80
PTP – 04	Surface Sand Filters	80
PTP – 05	Water Quality Swales	80
PTP – 06	Dry Ponds	60
PTP – 07	Filter Strips	50
PTP – 08	Grass Channels	50
PTP – 09	Greenroofs	*
PTP – 10	Underground Sand Filters	80
PTP – 11	Perimeter Sand Filters	80
PTP – 12	Organic Filters	80
PTP – 13	Gravity (Oil-Grit) Separators	40
PTP – 14	Infiltration Trenches	80
PTP – 15	Permeable Pavements	*

*For the purposes of water quality volume calculations, the area of the green roof or pervious pavement is subtracted from the site's impervious area and only the area of the practice is considered to receive 80% TSS Removal.

Each specification has a quick reference guide outlining selection, design, and implementation requirements.

The PTPs presented in this section are intended to serve as permanent treatment measures. Additional details are provided in sections covering Temporary Construction Site Management Practices (TCPs) for practices that are intended to function on a short-term basis (lasting only as long as construction activities) and covering Permanent Erosion Prevention and Sediment Control (PESC) that are intended to function on a long-term basis.

Insert the following after Section 6.1:

6.2 Water Quality Volume Overview

Metro's water quality treatment standard is designed to capture 85% of the annual stormwater runoff. Water quality systems must be designed to treat the runoff from the first 1.1 inches of rainfall. Each site's water quality treatment volume is also based upon its percent impervious cover. The treatment standard is the same for all sites throughout the community unless other secondary pollutant reduction goals are established, for instance, through the establishment of Total Maximum Daily Loads (TMDLs). Metro's water quality treatment methodology is as follows:

$$WQv = P \times Rv \times \frac{A}{12}$$

Where:

WQv = water quality treatment volume, ac-ft
P = rainfall for the 85% storm event (1.1 in)
Rv = runoff coefficient (see below)
A = drainage area, ac

$$Rv = 0.015 + 0.0092I$$

Where:

I = drainage area impervious cover, % (50% imperviousness would be 50)

Section 6.2: Change to 6.3 and replace "BMP" with "PTP"
Section 6.2.1: Delete last sentence, "This site meets Metro's requirements of 80% TSS removal for the site."

Volume 5, Chapter 1

Section 1.1 How to Use the Manual, pg. 5: Delete "a standalone" and replace with "an"; add the following sentence after the list of Volumes, "Please see Volume 1 for information about site development, permitting procedures, and post-construction Stormwater Control Measure (SCM) requirements."

Section 1.3 Brief Regulatory and Historical Background, pgs. 6-7: Delete section and replace with:

"As of 2016, Metro's National Pollutant Discharge Elimination System (NPDES) Phase I Municipal Separate Storm Sewer System (MS4) Permit requires that new development and significant redevelopment sites utilize Green Infrastructure (GI) for post development stormwater control where possible. The design requirement is to infiltrate, evapotranspire, or capture and reuse the first inch of rain preceded by 72 hours of no measureable rainfall. Metro Water Services (MWS) commissioned this Manual to encourage and incentivize GI and LID design in Metro before its use became a requirement. The LID Manual was originally released in 2012, with minor revisions adopted in 2013. MWS has used the period since the Manual's release to test the methodology while the compliance path was voluntary."

Pg. 7: Delete Section 1.4 How does Volume 5 relate to other SWMM Volumes

Pg. 9: Delete Section 1.6 Looking Ahead: Volume Control

Volume 5, Chapter 2

Section 2.2 Incentives, pgs. 12-13: Delete section content and replace with the following:

"The following incentives are currently offered for Green Infrastructure in Metro:

- Stormwater User Fee Credit: Sites designed in accordance with the LID Manual can receive a 75% downward adjustment in their Stormwater User Fees.
- Redevelopment Credit: Certain previously developed sites can meet a Runoff Reduction goal of 60% instead of 80%. A site must have a current, pre-development runoff coefficient (Rv) greater than 0.4 to qualify.
- Green Roof Rebate: MWS provides a credit of up to $10 per square foot of green roof installed within the combined sewer system. The credit is applied to the site's sewer bill for up to five years. Please visit the MWS Stormwater Website for more information.
- Reduced Detention Requirement (see Section 3.2.5): Certain sites designed in accordance with the LID Manual can reduce their required stormwater detention quantity.

Certain GIPs will also help sites earn credits under the LEED certification system. Please consult the LEED Reference Guides for more information.

Section 2.3 Operations and Maintenance Overview, pg. 13: Delete section.

Volume 5, Chapter 3

Section 3.1.1 Background, pg. 15: Delete "The current pollution reduction…" from the second paragraph and replace with, "Site drainage areas that cannot meet the runoff reduction requirement due to site limitations must be designed for pollutant removal. Please see Section 7.2 of Volume 1 for more information on site limitations. This…"

Section 3.1.2 Objectives, pg. 15: Delete 4th bullet and associated footnote

Section 3.2.1 STEP 1: Land Use Rv Values, pg. 18: Replace “steep slopes” with “slopes greater than 25%”
Section 3.2.2 STEPS 2 AND 3: Green Infrastructure Practice Rv Values, Table 3: Change Bioretention and Urban Bioretention Level 1 to 40% and Green Roof to 45% and 60%.
Section 3.2.4 Sizing of Media-Based GIPs: Change Porosity of Soil-Based Media to 0.25

Volume 5, Chapter 4
Section 4.2 Permitting Process, pg. 27: Delete text and replace with, “The process for obtaining a Grading Permit is detailed in Chapter 4 of Volume 1 of the SWMM. Appendix A of Volume 1 also contains a Grading Permit process flow chart and an application checklist. Section 6.7 and Appendix C of Volume 1 detail the post construction requirements.”

Please note – only the changes that have the potential to impact the design of GIPs or their application are noted below. Some verbiage and figures may change before the public comment period begins.

Volume 5, GIP-01 Bioretention:
Change Level 1 Runoff Reduction Credit from 60% to 40%: pgs. 1, 2, & 3
Change ponding depth to a maximum of 12 inches: pgs. 2 & 3
Change Media composition to 70%-85% sand; 10%-20% Silt + Clay, with no more than 10% Clay; 5%-10% Organic Matter: pgs. 3, 18, & 27
Section 3: DESIGN TABLE, Footnote 1: Change Void Ratio (Vr) to Porosity (n)
Section 3: DESIGN TABLE, Footnote 2: Move to Section 5.1, Setbacks
Section 3: DESIGN TABLE: Add the following footnote for “Maximum Ponding Depth[2]”, “[2]A ponding depth of 6 inches is preferred. Ponding depths greater than 6 inches will require a specific planting plan to ensure appropriate plant selection (Section 6.8)”
Section 6.1.1 Stormwater Quality: Change Bioretention Soil Media porosity from 0.40 to 0.25
Section 6.5 Conveyance and Overflow: Change 1st bullet to read, “The overflow associated with the 2 and 10 year storm design…”
Section 6.6 Filter Media and Surface Cover: Change 2nd bullet to read:
• ***General Filter Media Composition***. The recommended bioretention soil mixture is generally classified as a sandy loam on the USDA Texture Triangle, with the following composition by volume:
• Sand 70% to 85%;
• Silt + Clay 10% to 20%, with no more than 10% clay; and
• 5% to 10% organic matter
Section 6.6 Filter Media and Surface Cover: Add the following bullet:
• ***Filter Media for Tree Planting Areas***. A more organic filter media is recommended within the planting holes for trees, with a ratio of 50% sand, 30% topsoil, and 20% acceptable leaf compost
Section 6.7 Underdrain and Underground Storage Layer: Change “18 inches” to “12 inches” in the first paragraph.
Section 6.7 Underdrain and Underground Storage Layer: Add the following after the first paragraph:
The infiltration sump can consist of a 12-inch stone layer underneath the perforated underdrain pipe. The infiltration sump can also be created with an internal water storage zone (IWS) configuration of the

underdrain. An IWS can increase nitrogen removal and infiltration in bioretention areas. IWS can also reduce the cost of construction since the bioretention areas can be shallower in some instances and the invert of the outlet is not as deep. The IWS configuration places the perforated underdrain at the bottom of the stone reservoir layer, with the outlet elevated to the same elevation as the top of the sump / IWS. The IWS should be at least 12 inches from the top of the bioretention media. Figures 6.** illustrate this design variant. The IWS will dewater by percolating into the native soils. A minimum field-verified infiltration rate of 0.5 inches per hour is required in order to count the stone reservoir as storage volume.

The IWS can be created by the addition of an elbow in the underdrain piping at a 90 angle vertically perpendicular to the horizontal underdrain. In another IWS configuration, the underdrain transitions to a solid wall pipe prior to exiting the stone reservoir layer and is directed towards an outlet manhole or other structure. (This run of pipe should be straight, or include cleanouts at 45 degree (maximum) horizontal bends, and be set at a minimal grade.) In order to create the higher outlet elevation, the outlet manhole is configured with an internal weir wall with the top of the weir set at the same elevation as the top of the stone sump. This design variant can also include a drain orifice in the bottom of the weir to allow the sump to be drained if, over time, the exfiltration into the soil becomes restricted. This orifice should be covered with a plate that is clearly marked to indicate that it remain blocked under normal operating conditions.

Section 6.9 Bioretention Material Specifications, Table 1.9: Add the following row:

Choking Layer – Lay a 2 to 4 inch layer of sand over a 2 inch layer of choker stone (typically #8 or #89 washed gravel), which is laid over the underdrain stone.

SECTION 7: SPECIAL CASE DESIGN ADAPTATIONS, 7.1 Shallow Bedrock and Groundwater Connectivity: Add the Internal Water Storage (IWS) Layer option

SECTION 7: SPECIAL CASE DESIGN ADAPTATIONS: Add the following:

7.3 Karst Terrain

Karst regions are found in much of Middle Tennessee, which complicates both land development and stormwater design. While bioretention areas produce less deep ponding than conventional stormwater practices (e.g., ponds and wetlands), Level 2 bioretention designs (i.e., infiltration) are not recommended in any area with a moderate or high risk of sinkhole formation (Hyland, 2005). On the other hand, Level 1 designs that meet separation distance requirements (3 feet) and possess an impermeable bottom liner and an underdrain should work well. In general, bioretention basins with contributing drainage areas not exceeding 20,000 square feet are preferred (compared to bioretention with larger drainage areas), in order to prevent possible sinkhole formation. However, it may be advisable to increase standard setbacks to buildings.

Volume 5, GIP-02 Urban Bioretention:

Change Level 1 Runoff Reduction Credit from 60% to 40%: pgs. 1, 3, 4

SECTION 3: DESIGN TABLE, Table 2.2: Change “Filter media depth minimum” from “30 inches” to “24 inches”

Section 6.1 Sizing of Urban Bioretention: Change Bioretention Soil Media porosity from 0.40 to 0.25

Section 6.2 General Design Criteria for Urban Bioretention: Change soil media depth to “24 inches”

Volume 5, GIP-03 Permeable Pavement:

Description, pg. 1: Change first sentence to, "Porous paving systems have several design variants that include: Permeable Interlocking Concrete Pavers (PICP), pervious concrete, reinforced turf or gravel systems, concrete grid pavers, and pervious asphalt."

Section 3: DESIGN TABLE: Delete Table 3.2 and replace with the following:

Table 3.2. Permeable Pavement Design Criteria	
Level 1 Design	**Level 2 Design**
Tv [1]= (1)(Rv)(A) 3630	Tv = (1.1)(Rv)(A) 3630
Soil infiltration ≤ 0.5 in./hr.	Soil infiltration rate > 0.5 in./hr. to remove underdrain design, or a drawdown design in accordance with Section 6.
For PICP, the maximum contributing drainage area (CDA) is equal to the permeable surface area. Other types may only receive credit for the rainfall on its surface.	The permeable material handles only rainfall on its surface.
Underdrain required	1. Underdrain not required; ***OR*** 2. If an underdrain is used, a 12-inch stone sump must be provided below the underdrain invert; ***OR*** 3. The Tv stone reservoir volume has at least a 48-hour drain time, as regulated by a control structure

1. A = Area in acres

2. The CDA should be limited to paved surfaces in order to avoid sediment and debris wash-on. Where pervious areas are conveyed to permeable pavement, sediment sources controls and/or pre-treatment must be provided.

SECTION 5: PHYSICAL FEASIBILITY & DESIGN APPLICATIONS, External Drainage Area: Change "(for Level 1 Design)" to "(for PICP Level 1 Design)"

6.1 Sizing of Permeable Pavement, pg. 9: Replace paragraph beginning with "if the depth of the reservoir layer…" with "If the depth of the reservoir layer is too great (i.e. dp exceeds dp-max), or the verified soil infiltration rate is less than 0.5 inches per hour, then the design must include underdrains. An infiltration sump below the underdrain to achieve Level 2 performance credit can be implemented with soil infiltration rates as low as 0.1 inches per hour. However, for the volume of the infiltration sump to count for Tv storage, the field verified infiltration rate must be at least 0.5 inches per hour. If the field verified infiltration rate is less than 0.5 inches per hour, the sump will still qualify as a Level 2 design, however, any additional storage needed to hold the Tv must be added above the sump through additional stone. As an option, the entire Tv can be drained by the underdrain with a design 48-hour drain time using a control structure on the underdrain outlet."

6.1 Sizing of Permeable Pavement, pgs. 8 - 9: Delete Equations 3.3 through 3.5

6.1 Sizing of Permeable Pavement, pg. 9: Delete last paragraph and replace with:

"The permeability of the pavement surface and that of the gravel media is very high. However, the permeable pavement reservoir layer will drain increasingly slower as the storage volume decreases (i.e. the hydraulic head decreases). To account for this change, a conservative stage discharge relationship should be established for routing flow through the stone reservoir. The underdrains can serve as a hydraulic control for limiting flows, or an external control structure can be utilized at the outlet of the system.

Over-drain Relief. In all cases, the use of an over-drain (a perforated pipe drain near the top of the stone reservoir and below the pavement section) should be used to prevent the volume of runoff from backing up into the pavement surface. On pavement sections with a long grade, designers should utilize a stepped design with an over-drain in each cell in order to establish level reservoir storage areas and prevent flow from exiting the pavement through the surface at the low end."

6.4 Internal Geometry and Drawdowns: Add option for "Upturned Elbow" or Internal Water Storage (IWS) Layer.

6.5 Pretreatment: Add the following after the first sentence, "Additional pretreatment is required if the pavement receives run-on from an adjacent pervious or impervious area. For example, a gravel filter strip can be placed along the edge of the permeable pavement section to trap coarse sediment particles before reaching the permeable pavement surface."

6.7 Reservoir layer, pg. 11: Add the following to the last bullet, "Where underdrains are used in areas of marginal soils, a slight grade of 0.5% may be utilized to ensure the reservoir drains."

6.9 Maintenance Reduction Features, Pg. 11: Replace Protecting the Bottom of the Reservoir layer with the following:

- ***Protecting the Bottom of the Reservoir Layer***. There are two options to protect the bottom of the reservoir layer from intrusion by underlying soils. The first method involves covering the bottom with a barrier of choker stone and sand. In this case, underlying native soils should be separated from the reservoir base/subgrade layer by a thin 2 to 4 inch layer of clean, washed, choker stone (ASTM D 448 No. 8 stone) covered by a layer of 6 to 8 inches of course sand.

The second method is to place a layer of filter fabric on the native soils at the bottom of the reservoir. Some practitioners recommend avoiding the use of filter fabric since it may become a future plane of clogging within the system; however, designers should evaluate the paving application and refer to AASHTO M288-06 for an appropriate fabric specification. AASHTO M288-06 covers six geotextile applications: Subsurface Drainage, Separation, Stabilization, Permanent Erosion Control, Sediment Control and Paving Fabrics. However, AASHTO M288-06 is not a design guideline. It is the engineer's responsibility to choose a geotextile for the application that takes into consideration site-specific soil and water conditions. Fabrics for use under permeable pavement should at a minimum meet criterion for Survivability Classes (1) and (2). Permeable filter fabric is still recommended to protect the excavated sides of the reservoir layer, in order to prevent soil piping.

SECTION 7: Material Specifications, Table 3.4: Replace the Filter Fabric Specification with the following: "Use an appropriate filter fabric for the particular application based on AASHTO M288-06 Filter Fabric should have a Flow Rate greater than 125 gpm/sq. ft. (ASTM D4491), and an Apparent Opening Size

(AOS) equivalent to a US # 70 or # 80 sieve (ASTM D4751). The geotextile AOS selection is based on the percent passing the No. 200 sieve in "A" Soil subgrade, using FHWA or AASHTO selection criteria.

SECTION 8: SPECIAL CASE DESIGN ADAPTATIONS, Table 3.5: Add the following to the Porous Asphalt Notes: "Only for use in limited applications & requires MWS Staff approval."

SECTION 8: SPECIAL CASE DESIGN ADAPTATIONS: Insert the following:
8.2 Karst Terrain
Karst terrain is found in much of Middle Tennessee. Karst complicates both land development and stormwater design. A detailed geotechnical investigation may be required for any kind of stormwater design in karst terrain (see the Tennessee Permanent Stormwater Management and Design Guidance Manual, Appendix B Stormwater Design Guidelines for Karst Terrain for more information).

- The use of Level 2 (i.e. infiltration) permeable pavement designs at sites with known karst features may cause the formation of sinkholes (especially for large scale pavement applications) and are, therefore, not recommended. Designers should also avoid a Level 2 permeable pavement design if the site is designated as a severe stormwater hotspot.
- Micro-scale and small-scale permeable pavement installations are acceptable if they are designed according to the Level 1 criteria (i.e., they possess an impermeable bottom liner and an underdrain).
- The stone used in the reservoir layer should be carbonate in nature to provide extra chemical buffering capacity.

Volume 5, GIP-04 Infiltration Trenches:
SECTION 4: DESIGN CRITERIA, 4.1 Overview: Change, "Infiltration trenches should have a contributing drainage area of 5 or less" to "Infiltration trenches should have a contributing drainage area of 2 acres or less and be close to 100% impervious as possible."
SECTION 4: DESIGN CRITERIA, 4.1 Overview: Add new bullet, "Unless slope stability calculations demonstrate otherwise, infiltration practices should be located a minimum horizontal distance of 200 feet from down-gradient slopes greater than 20%. The average slope of the contributing drainage areas should be less than 15%."
SECTION 4: DESIGN CRITERIA: Insert new Section:
4.5 Infiltration Material Specifications
The basic material specifications for infiltration practices are outlined in Table 4.4 below:

Table 4.4. Infiltration Material Specifications

Material	Specification	Notes
Stone	Clean, aggregate with a maximum diameter of 3.5 inches and a minimum diameter of 1.5 inches (VDOT No. 1 Open-Graded Coarse Aggregate) or the equivalent.	
Observation Well	Install a vertical 6-inch Schedule 40 PVC perforated pipe, with a lockable screw cap and anchor plate.	Install one per 50 feet of length of infiltration the practice.
Trench Bottom	Install a 6- to 8-inch sand layer (VDOT Fine Aggregate, Grade A or B)	

Trench Surface Cover	Install a 3-inch layer of river stone or pea gravel. Turf is acceptable when there is subsurface inflow (e.g., a roof leader).	This provides an attractive surface cover that can suppress weed growth.
Buffer Vegetation	Keep adjacent vegetation from forming an overhead canopy above infiltration practices, in order to keep leaf litter, fruits and other vegetative material from clogging the stone.	
Filter Fabric (sides only)	Use non-woven polyprene geotextile with a flow rate of > 110 gallons/min./sq. ft. (e.g., Geotex 351 or equivalent).	
Choking Layer	Install a 2- to 4-inch layer of choker stone (typically #8 or # 89 washed gravel) over the underdrain stone.	
Overflow Collection Pipe (where needed)	Use 6-inch rigid schedule 40 PVC pipe, with 3/8" perforations at 6 inches on center, with each perforated underdrain, installed at a slope of 1% for the length of the infiltration practice.	Install non-perforated pipe with one or more caps, as needed.
Stone Jacket for Underdrain	The stone should be double-washed and clean and free of all soil fines.	Install a minimum of 3 inches of #57 stone above the underdrain and a minimum of 12 inches below it.

SECTION 4: DESIGN CRITERIA: Change 4.5 Other Design Criteria to 4.6 Other Design Criteria

Insert the following section:
SECTION 6: SPECIAL CASE DESIGN ADAPTATIONS
6.1. Karst Terrain
Conventional infiltration practices should not be used in karst regions due to concerns about sinkhole formation and groundwater contamination. Small-scale infiltration areas are permissible only if geotechnical studies indicate there is at least 4 feet of vertical separation between the bottom of the infiltration facilities and the underlying karst layer AND an impermeable liner and underdrain are used. In many cases, bioretention is a preferred stormwater management alternative to infiltration in karst areas.

Volume 5, GIP-05 Water Quality Swales:
SECTION 3: DESIGN TABLE, Table 5.2, pg. 3: Delete "or mixed onsite" from "Media" row
SECTION 6 DESIGN CRITERIA, 6.1 Sizing of Water Quality Conveyance and Water Quality Treatment Swales: Change "Water Quality Swale Soil Media" to "0.25"
6.9 Water Quality Swale Material Specifications, Table 5.4: In "Filter Fabric" row replace "Apply immediately above the choker stone" with "Apply immediately above the underdrain only. For hotspots and certain karst sites only, use an appropriate liner on the bottom"
SECTION 7: SPECIAL CASE DESIGN ADAPTATIONS: add the following section:
7.2. Karst Terrain
Shallow Water Quality Swales are an acceptable practice in karst areas. To prevent sinkhole formation and possible groundwater contamination, Water Quality Swales should use impermeable liners and

underdrains. Therefore, Level 2 Water Quality Swale designs that rely on infiltration are not recommended in any area with a moderate or high risk of sinkhole formation (Hyland, 2005).

If a dry swale facility is located in an area of sinkhole formation, standard setbacks to buildings should be increased.

Volume 5, GIP-09 Sheet Flow:

SECTION 3 DESIGN TABLE, Table 9.2: Add "6% to 8% Slope – Minimum 65 ft." to "Overall Slope and length" for "Vegetated Filter Strips"

5.2 Vegetated Filter Strips: Change "widths" to "lengths" in "Filter Slopes and Lengths"

6.3 Diaphragms, Berms and Level Spreaders: In Engineered Level Spreaders Section, change "A Forebay should have a maximum depth of 3 feet" to "A Forebay should have a minimum depth of 12 inches"