Stormwater Management: Ordinance & Design Manual
Key Updates / Site Plan Workshop

January 27, 2021
WORKSHOP AGENDA

- 1:00 p.m.  Welcome and Introduction: DWSD Stormwater Management Group
- 1:10 p.m.  Key Changes to the Stormwater Management Regulations and Design Manual
- 1:45 p.m.  Determining Applicability of the Regulations
- 1:50 p.m.  Understanding and Applying the Regulations to Site Plans
  - Key Performance Standards
  - Alternative Compliance
  - Example Site Plans
- 2:30 p.m.  10-minute BREAK
- 2:40 p.m.  Developing and Submitting a Post-Construction Stormwater Management Plan
- 3:10 p.m.  Site Plan Review and Approval Process
- 3:20 p.m.  Q&A

Watch the presentation via Zoom here.
Have a question for our team?

- Two options for asking questions:
  - Use the CHAT feature in Zoom to type a question, OR
  - Email Erin Washington at:

  Erin.Washington@ohm-advisors.com

- Questions will be collected, sorted, and read after each major topic and at the end of the seminar
Poll Questions
Welcome & Introduction
INTRODUCTIONS

DWSD
- Palencia Mobley, P.E., Deputy Director and Chief Engineer
- Lisa Wallick, P.E., SMG Manager
- Sarah Stoolmiller, SMG Engineer
- Barry Brown, SMG Engineer

OHM Advisors
- Greg Kacvinsky, P.E.
- Hannah Slabaugh, P.E.

Acknowledgements
- Don Carpenter, P.E. Drummond Carpenter
WORKSHOP GOALS

- **Summarize key updates** on the Stormwater Management Design Manual
- Assist **developers, planners, and designers** in understanding **how to comply** with Detroit’s Stormwater Management Regulations
- Provide understanding of **available technical resources**, including Detroit’s Stormwater Management Design Manual
- **Answer** participant questions and **document questions** to provide answers after workshop
Importance of Stormwater Rules

- Consistent standards across all properties
- Reduce the potential for flooding
- Increase the use of Green Stormwater Infrastructure (GSI)
  - Reduce flow to the combined sewer
  - Reduce CSO frequency & enhance water quality in the Rouge and Detroit Rivers
- Meet regulatory commitments (CSO Permit and MS4 Permit)
- Make Detroit’s infrastructure more resilient against the impacts of climate change

WHAT’S INSIDE THE DESIGN MANUAL?

• Regulatory Requirements
• Hydrologic Procedures
• Drainage Conveyance
• Soil & Aggregates
• Stormwater Control Measure (SCM) Design Specifications:
  ▪ Detention Practices
  ▪ Bioretention
  ▪ Infiltration Practices
  ▪ Permeable Pavement
  ▪ Rainwater Harvesting
  ▪ Living Roofs and Walls
  ▪ Stormwater Wetlands
  ▪ Manufactured Treatment Systems
  ▪ Trees for Stormwater Management

Key focus for today
Key Changes
Key Changes - ORDINANCE

- Amended Stormwater Ordinance effective December 9, 2020 with modifications to:
  - Definitions
  - Exemptions
  - Performance Standards
  - Stormwater Management Plan (Report)
  - O&M
  - Alternative Compliance (Retention Volume)
    - Sets minimum infiltration rate
    - On-site alternative compliance option
  - Ordinance leaves more specifics to the Design Manual
Key Changes – DESIGN MANUAL

- Updated Design Manual reflects changes to Ordinance
- Published in December 2020 (posted early January 2021)
- Focus on Chapters 2, 4, and 8
  - Major changes discussed today
  - Other minor changes throughout chapters; recommend reviewing Chapters 2, 4, and 8 before next site plan submittal
Key Changes to Chapter 2 – REGULATORY REQUIREMENTS

- Regulated Area equal to the Construction Area (CA) whenever CA < 50% of site
- Retention Volume requirement simplified to 1.0-inch storm event
- Clarified direct discharge requirements
- Specific in-situ infiltration criteria
- Changes to Alternative Compliance
  - Added *onsite* Alternative Compliance option

### Performance Standards for Direct Discharges*

<table>
<thead>
<tr>
<th>Performance Standard</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Quality</td>
<td>EGLE water quality criteria apply (applicant shall obtain a discharge permit from EGLE)</td>
</tr>
<tr>
<td>Channel Protection</td>
<td>EGLE channel protection criteria apply (applicant shall obtain a discharge permit from EGLE)</td>
</tr>
<tr>
<td>Flood Control</td>
<td>Applicant must demonstrate that there will be no potential cross-connections with any City-owned conveyance, including inlets, pipes, roadways, culverts, and bridges. No cross connection may occur for any storm event up to the 100-year / 24-hour event. Cross connections include any flow into a City-owned conveyance via overland flow, site flooding, detention pond overtopping, or any other hydraulic connection.</td>
</tr>
</tbody>
</table>

* Direct discharges are sites where 100% of the Regulated Area discharges stormwater directly to the Detroit River or Rouge River via a conveyance not owned by the City of Detroit. Surface discharges to City roads are not allowed. If any portion of the Regulated Area is connected to a City-owned conveyance, that portion of the property shall be subject to the performance standards outlined in Tables 2-1 to 2-4.
Key Changes to Chapter 2 – REGULATORY REQUIREMENTS

- Extended Detention added as onsite alternative compliance option
  - 48-hour detention of 2-yr/24-hr runoff volume equivalent
- Updated Alternative Compliance Request form and checklist to accommodate onsite options
- Added example site plans with guidance on use of equations (Appendix 2D)
  - Step-by-step process to calculate key design volumes and achieve compliance
  - Examples for sites with and without viable retention (infiltration) options
Key Modifications in Chapter 2 – REGULATORY REQUIREMENTS

- Specific criteria for Alternative Compliance to Retention Volume requirement:
  - Added existing soil infiltration capacity < 0.20 inches/hour
  - Defined minimum groundwater depth: less than 2 vertical feet from bottom of Stormwater Control Measure

*Additional Extraordinarily Difficult Site Conditions, including soil contamination, are listed in Chapter 2 of the Design Manual*
Key Changes to Chapter 4 – HYDROLOGIC PROCEDURES

- Water Quality Volume: 1.0 inch for all sites
  - ‘Natural Conditions’ language removed
- Computational methods updated
  - Simplified equations for Water Quality volume
  - New Alternative Compliance (Extended Detention volume)
- 20-acre cutoff for detention basin volume calculations:
  - ≤ 20 acres: simplified equations
  - > 20 acres: modeling/routing required

<table>
<thead>
<tr>
<th>Process Description</th>
<th>Approved Methodologies</th>
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</thead>
<tbody>
<tr>
<td>Stormwater conveyance system sizing, including routing flow offsite through the</td>
<td>Rational Method, EPA SWMM, HydroCAD, StormCAD, or other</td>
</tr>
<tr>
<td>municipal collection system</td>
<td>DWSD-approved model</td>
</tr>
<tr>
<td>Surface runoff volume for the water quality storm (a/k/a ‘retention volume’)</td>
<td>Simple Method for 1-inch storm:</td>
</tr>
<tr>
<td></td>
<td>$V_a = 3,630 \times C \times A$ (Eq. 4.11)</td>
</tr>
<tr>
<td>Surface runoff volume for Extended Detention (alternative compliance for retention)</td>
<td>Simple Method for 1.9-inch storm:</td>
</tr>
<tr>
<td></td>
<td>$V_{DE} = 6,897 \times C \times A$ (Eq. 4.12)</td>
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<tr>
<td>Surface runoff generation for discrete design storms (1- to 100-yr events)</td>
<td>Simple Method (1), NRCS Curve Number Approach, EPA SWMM,</td>
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<td></td>
<td>HEC-HMS, TR-55, TR-20, HydroCAD, StormCAD, or other DWSD-</td>
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<td></td>
<td>approved model</td>
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<tr>
<td>Detention basin volumetric sizing for large storms (10- to 100-yr events)</td>
<td>Modified Rational Method (1), NRCS Curve Number Approach,</td>
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<tr>
<td></td>
<td>EPA SWMM, HEC-HMS, TR-20, HydroCAD, StormCAD, or other</td>
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<td></td>
<td>DWSD-approved model</td>
</tr>
<tr>
<td>Routing flow on site through SCMs and stormwater controls</td>
<td>Hydrologic modeling packages, such as EPA SWMM, HEC-HMS,</td>
</tr>
<tr>
<td></td>
<td>TR-20, HydroCAD, StormCAD, or other DWSD-approved model</td>
</tr>
</tbody>
</table>

(1) Simple Method and/or Modified Rational Method are suitable for design calculations for sites up to 20 acres. For sites larger than 20 acres, use hydrologic calculations from the NRCS Curve Number Approach, EPA SWMM, or other DWSD-approved model.
Key Changes to Chapter 4 – HYDROLOGIC PROCEDURES

- **Clarifications** on Time of Concentration calculations
- **Additions and clarifications** for runoff coefficients
  - Lower Limit / Upper Limit explained
- **Added** references for common hydrologic/hydraulic modeling programs:
  - SWMM
  - HydroCAD / StormCAD
  - WinTR-55, WinTR-20
  - HEC-HMS
Key Changes to Chapter 8 - BIORETENTION

- **Additional guidance** on minimum in-situ infiltration requirements
  - 0.2 in/hr (measured)
- **Increased void ratio** for bioretention soil mix (0.20 to 0.30)
- **Updated requirements** for compliance with retention volume:
  - No distinction between infiltrated volume and discharge volume through an underdrain
  - Underdrains encouraged when measured in-situ infiltration is less than 1.0 inch/hour
- **Bioretention volume includes surface storage, subsurface storage, and active infiltration volume**
Applicability of Stormwater Regulations
Applicability Threshold

Any new or redevelopment project which creates or replaces 0.5 acres (21,780 square feet) or more of impervious surface will be considered a regulated construction activity and will be subject to the stormwater management requirements.
APPLICABILITY OF STORMWATER REGULATIONS

Direct Discharges

Direct discharge was removed from ‘exemptions’ for clarification purposes; applicant must demonstrate there will be no stormwater connections to the City-owned system up to and including the 100-year storm event.
Exemptions

• Construction of one Single Family detached dwelling as defined in the Zoning Ordinance (not part of a common plan of development)

• Emergency maintenance work performed for the protection of public health and safety

• Regulated construction activity done to protect public health as part of a Due Care Plan that is required and approved by a state or federal regulatory agency
Questions on Key Changes & Applicability

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Understanding & Applying the Regulations
Purpose of Stormwater Management
Performance Standards

- Improve water quality
- Provide more climate resiliency for Detroit’s infrastructure
- Protect channels of receiving waters
- Reduce the severity of flooding
- Reduce flow volumes the combined sewer system and reduce CSO frequency
Key Components of Stormwater Rules

- Intercept and control stormwater runoff before it enters a DWSD sewer
- For the 1-inch storm:
  - Control Total Suspended Solids (TSS)
    - 80% reduction or effluent concentration below 80 mg/L
  - Retain or infiltrate the entire runoff volume
  - When infiltration is not feasible, seek Alternative Compliance
- For the 2-year / 24-hour storm:
  - No peak flow increase
  - This will generally be automatically achieved through other compliance measures, including flood control
Key Components of Stormwater Rules

- **Flood Control (Regulated Area less than 5 acres)**
  - Provide storage volume and outlet control to limit the peak 10-yr/24-hr discharge to 0.15 cfs/acre

- **Flood Control (Regulated Area 5 acres or larger)**
  - Provide storage volume and outlet control to limit the peak 100-yr/24-hr discharge to 0.15 cfs/acre
Regulated Area

- For all stormwater performance measures, the Regulated Area will be:
  - Equal to the Construction Area if the Construction Area is less than 50% of the Development Site
  - Equal to the entire Development Site if the Construction Area is 50% or more of the Development Site
Standards Vary By Location

- Combined Sewer System (97% of Detroit)
- Separate Storm Sewer System (MS4)
  - Includes isolated areas along the Detroit and Rouge Rivers; very small percentage of Detroit
- Check with DWSD if uncertain whether your site is in an MS4 area
- Future sewer separation projects may increase the overall MS4 area
- Standards are very similar with lone exception being volume control (see figure)
TSS Control / Sediment Removal

- For the 1-inch storm:
  - Control Total Suspended Solids (TSS)
    - 80% reduction or effluent concentration below 80 mg/L
  - Automatically achieved if retention volume is provided through reuse or infiltration
  - Otherwise, generally achieved using:
    - Sediment forebay
    - Wet detention pond
    - Mechanical separator
- See Chapter 14 of the Design Manual for Manufactured Treatment Devices
Mechanical Separators – Advice and Lessons Learned

- Stick to the lists of approved manufacturers referenced in Chapter 14 (hyperlinks on Page 14-3)
  - NJCAT
  - TAPE
- Always locate mechanical separators upstream of detention storage

14.2.2 Independent Testing Protocols

Independently verified technologies have passed an established, independent testing protocol (such as the Water Environment Federation’s Stormwater Testing and Evaluation for Products and Practices or STEPP program) which includes an assessment of pollutant removal, volume reduction and/or peak flow reduction.

Independent testing protocols include, but are not limited to:

- New Jersey Department of Environmental Protection (NJDEP) certified and New Jersey Corporation for Advanced Technology (NJCAT) verified
- Water Environment Federation’s Stormwater Testing and Evaluation for Products and Practice (STEPP)

Note that many testing protocols have focused on total suspended solids (TSS) removal or similar pollutant removal performance evaluations. However, if the technology is claiming volume and/or peak flow reductions, then the technology’s volume and/or peak flow reduction performance must also be included in the testing protocol results.

The Department will be primarily using the NJDEP certification for manufactured treatment devices. Certification from other independent testing protocols may be
Pre-Approved Lists of Mechanical Separators

- Excerpt from the TAPE website
- Focus on “Pretreatment” and “Enhanced” tabs
- Pretreatment
  - 50% removal of TSS for an influent concentration range of 100 mg/L to 200 mg/L
  - Influent TSS concentration < 100 mg/L, effluent goal is < 50 mg/L
- Basic
  - 80% removal of TSS for an influent concentration range of 100 mg/L to 200 mg/L
  - Influent TSS concentration < 100 mg/L, effluent goal is < 20 mg/L
- ‘Pretreatment’ devices generally adequate for 80 mg/L requirement
Retention Volume

- For the 1-inch storm:
  - Retain all runoff volume on site using infiltration / evapotranspiration, water reuse, or a combination of the two
  - \( V_R = 3630 \times C \times A \)

- All site plans must comply with the Retention Volume unless it can be demonstrated that infiltration is not feasible (three most common conditions):
  - In-situ infiltration less than 0.20 in/hr (must be verified by direct infiltration testing and Professional Engineer certification of results)
  - Observed groundwater within 2 vertical feet of bottom of proposed infiltration measure (4 feet preferred)
  - Soil contamination (Environmental Site Assessment required)
APPLYING THE REGULATIONS

Retention Volume

- For sites where retention is deemed feasible (assuming infiltration is the selected stormwater management option):
  - Identify preliminary footprint for infiltration practice(s)
  - Calculate total storage
    - Surface storage (applicable for bioretention cells with surface storage, up to 12-inch depth)
    - Subsurface storage (void space within soil media and stone layers)
    - Active infiltration (applicable only when no underdrain is used); applied to the infiltration zone over a 6-hour period
  - Adjust footprint as necessary to achieve required retention volume
Retention Volume

- Tips and tricks for design (bioretention)
  - Start with a bioretention footprint approximately 10% of the contributing impervious area and adjust as necessary
  - Maximizing surface storage depth (up to 12 inches) reduces footprint
  - Use underdrain when measured infiltration rate is less than 1.0 inch/hour
  - When underdrain is used, assume dewatering rate is adequate for complete drawdown in the required timeframe
APPLYING THE REGULATIONS

Retention Volume

- Water Reuse (onsite storage and reuse)
  - Must demonstrate adequate site demand for stormwater reuse (Water Use Plan)
    - Irrigation
    - Gray water system in building(s)
    - Dewatering timeframe comparable to infiltration practices
  - May require special pre-treatment and maintenance schedule (more than typical stormwater systems)
  - May be subject to other City, State, and Federal code restrictions
  - See Chapter 11 (Rainwater Harvesting) for design guidance

![Cistern with informational signage, Raleigh, NC]
Retaining Volume

- For sites where infiltration/retention is not feasible:
  - Complete an Alternative Compliance Application (see Appendix 2B)
  - Select onsite, offsite, or Fee-in-Lieu Alternative Compliance
- Onsite Alternative Compliance
  - Extended Detention
  - Provide volume for 48-hour discharge of the 1.9-inch storm (roughly equivalent to 2-yr/24-hr excess runoff volume relative to pre-settlement conditions)
    - \[ V_{ED} = 6897 \times C \times A \]
  - Subset of flood control volume (results in two hydraulic controls: one for Extended Detention, and one for Flood Control)
Flood Control

- For sites greater than 20 acres, use a stormwater runoff / routing model to demonstrate compliance to the flood control standards.
- For sites smaller than 20 acres, applicants may use the Modified Rational Method to calculate storage volume:
  - Equations 4-1, 4-7, 4-8, and 4-9
- Sediment forebay (if used) can count toward flood control volume.
- Retention/infiltration stormwater control measures can count toward flood control volume.
Site Plan Example 1

- Development Site Area = 32.6 acres
- Construction Area = 22.9 acres
- Regulated Area = 32.6 acres
- New or replacement impervious area = 20.4 acres

Other site characteristics:
- No known soil contamination
- Measured infiltration rate: 1.0 in/hr
- Prevailing groundwater depth: 7 feet
  - Allows for BMP depth of 3-5 feet to achieve minimum 2-4 vertical feet of clearance
- Discharges to a combined sewer
Site Plan Example 1

- Development Site Area = 32.6 acres
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Site Plan Example 1 – Calculate Key Regulatory Volumes

- Retention Volume Requirement can be met due to existing soil characteristics:
  - Measured infiltration rate: 1.0 in/hr
  - Design infiltration rate: 0.50 in/hr

- Retention Volume calculated as the runoff resulting from 1.0 inch of rainfall:
  - \[ V_R = 3630 \times C \times A \]
  - \[ V_R = 3630 \times 0.56 \times 32.6 \text{ ac} = 66,269 \text{ CF} \]

- Proposed design: bioretention
  - 66,269 CF to be provided in surface storage and subsurface storage

Retention volume can be used to satisfy TSS requirements \textbf{and} count towards flood control volume.
Site Plan Example 1 – Calculate Key Regulatory Volumes

- Infrastructure Protection (2-yr / 24-hr storm)
  - \( V_{2\text{-yr}} = 6897 \times \Delta C \times A \)
    (\( \Delta C = \) change in runoff coefficient)
  - \( V_{2\text{-yr}} = 6897 \times (0.56 - 0.29) \times 32.6 \)
  - \( V_{2\text{-yr}} = 60,707 \) cubic feet

2-yr storage volume is less than the required Retention Volume (66,269 CF). Retention volume will satisfy Infrastructure Protection Requirement.
Site Plan Example 1 – Calculate Key Regulatory Volumes

- **Flood Control (100-yr / 24-hr storm)**
  - Site is larger than 5 acres; 100-yr storm applies
  - Site is larger than 20 acres:
    - Modified Rational Method may be used to estimate detention pond volume
    - Modeling/routing necessary to confirm detention pond design
  - Modified Rational Method (Chapter 4)

\[
D_{100} = 50 \cdot \left( \frac{Q_R}{C} \right)^{-0.984}
\]

\[
D_{100} = 50 \cdot \left( \frac{0.15}{0.56} \right)^{-0.984} = 183 \text{ min}
\]

\[
i = \frac{38.42 \cdot T^{0.208}}{(12.33 + D)^{0.841}}
\]

\[
i = \frac{38.42 \cdot 100^{0.208}}{(12.33 + 183)^{0.841}} = 1.19 \text{ in/hr}
\]

For sites smaller than 20 acres, the Modified Rational Method (Chapter 4 equations) are sufficient for sizing the detention pond
Site Plan Example 1 – Calculate Key Regulatory Volumes

- Flood Control (100-yr / 24-hr storm)
  - Required storage volume for detention pond:

\[
V_{100} = (60.5 \times D_{100} \times C \times A \times i) - (60 \times D_{100} \times Q_R \times A)
\]

\[
V_{100} = (60.5 \times 183 \times 0.56 \times 32.6 \times 1.19) - (60 \times 183 \times 0.15 \times 32.6) = 185,992 \text{ ft}^3
\]

Chapter 4 equations are useful to approximate pond size for preliminary design; using a stormwater routing model confirms sizing and outlet hydraulics.
Site Plan Example 1 – Calculate Key Regulatory Volumes

- Detention pond volume adjustment for retention volume:

\[ V_{n \text{-adjusted}} = V_n - V_R \]

\[ V_{100 \text{-adjusted}} = 185,992 - 66,269 = 119,723 \text{ ft}^3 \]

- Next step: determine where volume will be achieved:
  - Retention Volume (66,269 CF)
  - Detention Volume (119,723 CF)
Site Plan Example 1 – Bioretention

- Design infiltration rate = 0.50 in/hr
- Underdrain allowed, but not required
- Three components of bioretention volume:
  - Surface
    - Storage volume at design depth (12 inches maximum)
  - Subsurface
    - Void space in underlying soils (0.30)
  - Active infiltration (6 hours @ 0.50 in/hr)
    - Applied to bottom contour of bioretention cells

Don’t forget to roto-till (or scarify) the bottom of bioretention cell prior to placement of engineered fill.
Site Plan Example 1 – Bioretention

- Calculate volume:
  - Surface
    - Five (5) bioretention cells, each with a 9,000 square foot top contour and 7,000 square foot bottom contour
    - Maximum ponding depth: 12 inches
    - Surface storage: 40,000 CF
  - Subsurface
    - Engineered soils occupy bottom contour, depth of 2 feet, + 6 inches stone drainage layer:
      - $7,000 \text{ SF} \times 5 \text{ cells} \times 2.5 \text{ ft.} \times 0.30 = 26,250 \text{ CF}$
    - Active infiltration (6 hours @ 0.50 in/hr)
      - Applied to bottom contour of bioretention cells
      - $7,000 \text{ SF} \times 5 \text{ cells} \times 0.5/12 \times 6 \text{ hrs} = 8,750 \text{ CF}$
APPLYING THE REGULATIONS

Site Plan Example 1 – Bioretention

- Calculate volume:
  - Surface storage: 40,000 CF
  - Subsurface storage: 26,250 CF
  - Active infiltration: 8,750 CF
  - TOTAL VOLUME = 75,000 CF > 66,269 (required)

- Bioretention cells oversized by ~ 13%
- Adjust footprint as necessary to meet volume requirement

- Check loading ratio:
  - Total impervious area = 888,624 square feet
  - Total infiltration footprint: 45,000 square feet
  - LOADING RATIO: 19.7 (very high)
**LOADING RATIO**

- Ratio of tributary impervious area to the bioretention cell footprint
  - $A_i/X$
  - 19.7 in site plan example
- Appropriate ratios can vary depending on pollutant loading from drainage area:
  - Loading Ratio of 5 is considered ideal
  - Higher Loading Ratios (> 10) can result in pollutant overloading
  - Generally best to keep Loading Ratio < 10
  - Larger Loading Ratios are ok with upstream pretreatment (catch basin/sump or similar)
  - Usually limited by available space (many sites max out at 5%-10% area available for infiltration)

Source: Pennsylvania Dept. of Environmental Protection
BIORETENTION / RETENTION: LOADING RATIOS

LOADING RATIO

- How would this impact the design example?
  - Loading Ratio = 19.7
- Take the following design measures:
  - Reduce ponding depth and increase footprint of bioretention cells (especially those downstream of parking/drive areas)
    - 12-inch ponding depth to 6-inch or 9-inch
  - Design sump structures at each inlet point
  - Install flow spreaders / energy dissipators upstream of each infiltration area
  - Attempt to bring Loading Ratio closer to a value of 10

Source: Pennsylvania Dept. of Environmental Protection
INfiltration Stormwater Control Measures

- Design recommendations
  - Try to keep Loading Ratio < 10
    - Lower Loading Ratios for dirtier surfaces with higher pollutant buildup
    - Higher Loading Ratios may be ok for rooftop (cleaner) areas
  - Pre-treatment recommended (sump, sediment trap), especially when Loading Ratio approaches and exceeds 10
  - Loading ratio is at designer’s discretion, but remember:
    - Higher Loading Ratios = more pre-treatment necessary
    - Higher Loading Ratios = higher maintenance costs
INfiltration Stormwater Control Measures

- Design recommendations
  - Inlet design is very important
    - Must have enough capacity to receive flow from surrounding areas
    - Dissipate energy
    - Trap solids
  - Make it easier for long-term maintenance:
    - Install trap/sump at each inlet
    - Maintenance of infiltration practices is primarily solids removal; faster and cheaper to accumulate solids at a single point
EXAMPLE: Racquet Up Detroit

- Owner: Racquet Up Detroit
- Engineer: SmithGroup
  - Total impervious area: 1.09 acres
  - Measured infiltration rates:
    - 0.3 in/hr to 1.3 in/hr
  - Total infiltration BMP footprint: 0.12 acres
  - Loading Ratio ~ 9
    - Nearly half of the impervious area is rooftop (cleaner runoff)
    - Larger bioretention cell doubles as flood control (detention pond)
EXAMPLE: Racquet Up Detroit
- Owner: Racquet Up Detroit
- Engineer: SmithGroup
- Key design characteristics
  - Infiltration BMP depths: 6-11 inches
  - Roof leads discharge to riprap channel prior to bioretention cell
  - Surface water drawdown time:
    - 11-23 hours (< 24 hours)
  - Total drawdown time:
    - 15-38 hours (< 72 hours)
  - Bioretention soil depth: 12 inches
EXAMPLE: Racquet Up Detroit

- Simple design
- Native plant mix in infiltration/storage zone
- Turf grass upslope

Engineered fill: topsoil/sand mixture (DO NOT DRIVE ON OR COMPACT)

Roto-till (or scarify) the bottom of bioretention cell
WHEN INFILTRATION IS NOT FEASIBLE

- Fee-in-Lieu
- Offsite Alternative Compliance
- Onsite Alternative Compliance: Extended Detention
  - Simple equation: $V_{ED} = 6897 \times C \times A$
  - Targets 2-yr/24-hr storm (a/k/a ‘Bank Full’ event)
  - Subset of flood control volume (extended detention volume is usually part of the detention pond)

PLANNING/DESIGN STEPS

- Demonstrate infiltration is not feasible
  - Geotechnical analysis / environmental assessment
- Complete Alternative Compliance Form and receive approval from DWSD
- Upon approval from DWSD, perform the following calculations
  - $V_{ED} = 6897 \times C \times A$
  - Calculate average discharge rate (48-hour discharge)
    - $Q_{ED} = \frac{V_{ED}}{172,800}$ (cfs)
  - Calculate storage elevation at 50% of $V_{ED}$
  - Using the 50% storage head, size the orifice to achieve the average discharge rate ($Q_{ED}$) calculated above
  - If orifice size is < 0.75 inch, set orifice at 0.75 inch
Questions on Example Site Plan

Erin.Washington@ohm-advisors.com
10-Minute BREAK
Post-Construction Stormwater Management Plan
a/k/a “Stormwater Narrative” or “Stormwater Report”

- Required Components (see Chapter 2, page 2-14)
  - Map showing drainage boundary and discharge location(s)
  - Key metrics, including:
    - Total development site (total parcel area)
    - Total construction area (and as a % of development site)
    - Total new or replacement impervious area
    - Measured infiltration rate(s)
  - All calculations demonstrating retention volume and flood control volume (include model data if applicable)
  - Narrative describing stormwater design components and summary of key volumes, flow rates, and site information
  - Reference to Geotechnical/Environmental data impacting retention requirement
    - If applicable, include Alternative Compliance Application

In-Situ Infiltration Rates

The method of testing for infiltration rates is at the discretion of the applicant. DWSD staff do not need to witness infiltration testing.

However, infiltration testing must be performed by geotechnical professionals; the measured infiltration rate(s) must be certified by a Professional Engineer registered in Michigan.
POST-CONSTRUCTION STORMWATER MANAGEMENT PLAN

a/k/a “Stormwater Narrative” or “Stormwater Report”

- Required Components (see Chapter 2, page 2-14)
  - Preliminary calculations for drainage charge credits (flood control and volumetric credits, if applicable)
  - Hydraulic calculations for sewer pipe and outlet design
  - Operations & Maintenance Plan
    - Including Certification Statement (Appendix 2C)
  - Copies of all applicable state and federal permits related to erosion control and stormwater management

New requirement
a/k/a “Stormwater Narrative” or “Stormwater Report”

- Include Following Tables:

**Table 1: Site Conditions**

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>New of Replaced Impervious Area</td>
<td></td>
<td>Acres</td>
</tr>
<tr>
<td>Construction Activity Area</td>
<td></td>
<td>Acres</td>
</tr>
<tr>
<td>Measured Infiltration Rate</td>
<td></td>
<td>in/hr</td>
</tr>
<tr>
<td>Existing Site Runoff Coefficient, C</td>
<td></td>
<td>unitless</td>
</tr>
<tr>
<td>Proposed Site Runoff Coefficient, C</td>
<td></td>
<td>unitless</td>
</tr>
<tr>
<td>Regulated Area</td>
<td></td>
<td>Acres</td>
</tr>
</tbody>
</table>

**Table 2: Hydrologic Summary Table**

<table>
<thead>
<tr>
<th>Performance Standard</th>
<th>Design Storm</th>
<th>Volume (CF)</th>
<th>Peak Flow (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Quality (Retention Requirement)</td>
<td>1.0-Inch rainfall</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Infrastructure Protection (2-yr/24-hr storm)</td>
<td>Pre-Construction 2-yr, 24-Hr Storm</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Flood Control</td>
<td>Post Construction 100-yr (or 10-yr), 24-Hr Storm</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Example
Stormwater Model
Output/Summary
Example O&M Plan

- Plan should be part of Stormwater Report
- O&M Certification signed by owner and sealed by designer
- Recorded with Wayne County Register of Deeds

<table>
<thead>
<tr>
<th>MAINTENANCE ACTIVITIES</th>
<th>FREQENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitor plating/vegetation</td>
<td>3 times a year</td>
</tr>
<tr>
<td>Ensure means of access for maintenance remain clear/open</td>
<td>Annually</td>
</tr>
<tr>
<td>PREVENTIVE MAINTENANCE</td>
<td></td>
</tr>
<tr>
<td>Mowing</td>
<td>Up to 2 times/year</td>
</tr>
<tr>
<td>Remove accumulated sediment</td>
<td>As needed</td>
</tr>
<tr>
<td>Replace or wash/reuse stone filter</td>
<td>As needed</td>
</tr>
<tr>
<td>Structural repairs or replacement in kind</td>
<td>As needed</td>
</tr>
<tr>
<td>Make adjustments/repairs to ensure proper functioning</td>
<td>As needed</td>
</tr>
<tr>
<td>Oil and gasoline spills</td>
<td>Immediately</td>
</tr>
</tbody>
</table>

*NOT TO EXCEED THE LENGTH ALLOWED BY CITY ORDNANCE.*
**FORESTRY AND DETENTION BORDERS TO BE CLEANED WHENEVER SEDIMENT ACCUMULATES TO A DEPTH OF 6-12 INCHES OR IF SEDIMENT REMOVAL IS OBSERVED.***REPLACE STONE IF IT CANNOT BE ADEQUATELY CLEANED.
Example O&M Plan:

1. Monitoring / Inspection
2. Preventative Maintenance
3. Remedial Action and Repairs

<table>
<thead>
<tr>
<th>MAINTENANCE ACTIVITIES</th>
<th>SYSTEM COMPONENTS</th>
<th>FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mon. / Inspection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inspect for sediment accumulation**/clogging of stone filter</td>
<td>X X X X X X</td>
<td>Annually</td>
</tr>
<tr>
<td>Inspect for erosion and integrity of banks and berms</td>
<td>X X X X X X</td>
<td>Annually and after major events</td>
</tr>
<tr>
<td>Inspect for floatables, dead vegetation and debris</td>
<td>X X X X X X X X</td>
<td>Annually and after major events</td>
</tr>
<tr>
<td>Inspect all components during wet weather and compare to as-built plans</td>
<td>X X X X X X X</td>
<td>Annually</td>
</tr>
<tr>
<td>Monitor plantings/vegetation</td>
<td>X X X X X X X</td>
<td>2 times a year</td>
</tr>
<tr>
<td>Ensure means of access for maintenance remain clear/open</td>
<td>X X X X X X</td>
<td>Annually</td>
</tr>
<tr>
<td>Preventive Maintenance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mowing</td>
<td>X X X X</td>
<td>Up to 2 times/year*</td>
</tr>
<tr>
<td>Remove accumulated sediment</td>
<td>X X X X X X X</td>
<td>As needed**</td>
</tr>
<tr>
<td>Remove floatables, dead vegetation and debris</td>
<td>X X X X X X X</td>
<td>As needed</td>
</tr>
<tr>
<td>Replace or wash/reuse stone riser debris</td>
<td>X X</td>
<td>Every 3 years; more frequently if needed***</td>
</tr>
<tr>
<td>Remove invasive plant species</td>
<td>X X X X X X X</td>
<td>Annually</td>
</tr>
</tbody>
</table>
Site Plan Review and Approval Process
If Stormwater Management Regulations apply to a project, the site owner must:

- **Comply** with stormwater performance standards
- If applicable, demonstrate need for **Alternative Compliance** and include in the design documents
- **Perform** required **site investigations**, including **geotechnical** (infiltration testing) and, if applicable, an **environmental assessment**
- **Develop and submit** a compliant site plan and Post-Construction Stormwater Management Plan to DWSD for review and approval
- **Pay** required **fees**
- **Implement** (construct) approved components of the Stormwater Management Plan
- Record Restrictive Covenant and stormwater control **design plans** with the **Wayne County Register of Deeds**
- Request post-construction **inspection** (needed prior to **Certificate of Occupancy**)

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### SITE PLAN REVIEW & APPROVAL PROCESS

- **Comply** with stormwater performance standards
- If applicable, demonstrate need for **Alternative Compliance** and include in the design documents
- **Perform** required **site investigations**, including **geotechnical** (infiltration testing) and, if applicable, an **environmental assessment**
- **Develop and submit** a compliant site plan and Post-Construction Stormwater Management Plan to DWSD for review and approval
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- Record Restrictive Covenant and stormwater control **design plans** with the **Wayne County Register of Deeds**
- Request post-construction **inspection** (needed prior to **Certificate of Occupancy**)

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[Image of department logo]
Prior to receiving a Certificate of Occupancy, the applicant must:

- **Implement** (construct) approved components of the Stormwater Management Plan
- Record **Restrictive Covenant**, stormwater control **design plans**, and the **O&M Plan** for the regulated parcel(s) with the **Wayne County Register of Deeds**
- Request and schedule post-construction **inspection**
- **Receive letter** from the **inspector** stating that all stormwater control measures have been constructed per the Stormwater Management Plan
- **Certificate of Occupancy** granted after successful completion of above
SITE PLAN REVIEW AND APPROVAL PROCESS

- Plans are routed to DWSD stormwater management group when a project is submitted to BSEED for a special land use permit (SLU#), site plan review (SPR#), or a building permit (BLD#)

- Most reviews take 10 business days
  - Projects submitted for special land use do not require a full stormwater review
    - DWSD will simply comment that stormwater management will be required, if applicable
  - Projects needing site plan review must demonstrate that stormwater has been considered, the project team is aware of the amount of stormwater management required, and that it can “fit” on the site. These plans should be 30-50% complete. An alternative compliance application should be submitted if needed.
  - Projects seeking building permits must have their stormwater system 100% designed with all necessary documents and a stormwater narrative.
General Q&A Session

Erin.Washington@ohm-advisors.com
Final Poll Question
THANK YOU!

Sarah Stoolmiller, Engineer

Detroit Water & Sewerage Department

Email: sarah.stoolmiller@detroitmi.gov

Phone: 313.209.1095

For more information visit: www.detroitmi.gov/dwsd

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