TOOL 1

Post-Construction Guidance Manual

Stormwater Program Self-Assessment

This is one of several tools designed to assist local stormwater managers with the development of their post-construction stormwater program. The tools are a companion to the Post-Construction Guidance Manual (www.cwp.org/postconstruction). The following tools are available:

Tool 1: Post-Construction Stormwater Program Self-Assessment

Tool 2: Program & Budget Planning Tool

Tool 3: Post-Construction Stormwater Model Ordinance

Tool 4: Codes & Ordinance Worksheet (COW)

Tool 5: Stormwater Manual Builder

Tool 6: Plan Review, BMP Construction, and Maintenance Checklists

Tool 7: Performance Bonds

Tool 8: BMP Evaluation Tool

For more information on the Post-Construction Guidance Manual, contact the Center for Watershed Protection, 8390 Main Street, 2nd floor, Ellicott City, MD 21046, 410-461-8323

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www.cwp.org.

Post-Construction Program Self-Assessment
Center for Watershed Protection, Inc.
July 31, 2008

Purpose:
One of the main challenges for a post-construction program is to assess the program's existing status and map out a future course and program direction. This assessment is designed to assist stormwater program managers with this task. The desired outcome for conducting this self-assessment is to generate short-term and long-term action items to build a more effective program.

How the Program Assessment is Structured
The structure of the assessment follows the sections in *Managing Stormwater in Your Community: A Guide for Building Effective Post-Construction Programs* (www.cwp.org/postconstruction).

Program Development (Ch. 2)
Land Use Planning as the First BMP: Linking Stormwater to Land Use (Ch. 3)
Developing a Stormwater Management Approach and Criteria (Ch. 4)
Developing a Post-Construction Stormwater Ordinance (Ch. 5)
Stormwater Guidance Manuals (Ch. 6)
Plan Review Process (Ch. 7)
Inspection of Permanent Stormwater BMPs During Construction (Ch. 8)
Maintenance (Ch. 9)
Tracking, Monitoring & Evaluation (Ch. 10)

The assessment recognizes that each program is in a different stage of development and will evolve and become more sophisticated through time. The questions in each section of the assessment are divided into three subgroups, as follows:

- **Group A (Initiating the Program):** These assessment questions are most relevant for relatively new programs that are just putting program elements in place. It is strongly recommended that each program strive to accomplish the program elements in Group A by the end of the first NPDES MS4 permit cycle. If your program accomplishes all of the objectives in Group A -- Congratulations. . .and keep going!
- **Group B (Enhancing the Program):** These assessment questions represent important program enhancements that are necessary for an effective program. All existing programs should evaluate these carefully to determine which are most relevant for local conditions, and strive to incorporate selected elements within the second permit cycles.
- **Group C (Advancing the Program):** These questions refer to program elements that can be added as a program develops its funding, staffing, and planning capabilities. The timing for implementation of selected elements varies for each program.

Completing the assessment involves answering the questions for Groups A, B, and C, and identifying specific action items, as appropriate, from each group. Action items from Group A will be priorities for the short-term since these elements are recommended to be established by the end of the first permit cycle. The three groups are not meant to be

static. Each program has unique opportunities and conditions, and accordingly, each program will be able to check off items in each of the three groups. For instance, programs operated by a city public works department will look very different than a county program consisting of multiple townships.

How to Complete the Assessment

For many programs, completing the assessment will require involving several staff from different departments. Ideally, the assessment can be completed by a stormwater manager with overall program responsibilities. However, the assessment can also be used by city or town managers, planning or public works directors and staff, and consultants working on behalf of local programs.

For each section, the assessment involves the following steps:

1. For Groups A, B, and C, go through each statement and check off the appropriate box according to whether the element is part of your existing post-construction stormwater program.
2. Review the items for which you have checked the "NO" box. Consider which of these you would recommend for short-term and long-term actions. For items checked as "NO" in Group A, develop short-term action items and list these under the "Action Items for Next 1 – 5 Years" at the end of each section. For items checked as "NO" in Groups B and C, evaluate their relevance to your program, and create short or long term action items for the selected elements. Long-term action items should be listed in the "Action Items for Next 5 – 10 Years" section.
3. For any item that is checked as "Don't Know," make identifying the status of that program element a priority action item for Year 1.
4. This exercise may best be done with the help of a small internal staff committee. Please note that you are not committing to these actions, but only developing a draft list to inform your program planning and budgeting. For this reason, you may want to list your action items in priority order.
5. Since permitted post-construction programs must report on "measurable goals," it is also important to develop or clarify your measurable goals for each section. Measurable goals should be related to the short and long-term action items that you have identified. Additional guidance of measurable goals can be found in Chapter 10 of *Managing Stormwater in Your Community.* In the self-assessment, a table is provided below the Action Items in each section with some suggestions for measurable goals. The intention is that you will modify these and add others to suit your program.
6. Once you have developed action items and measurable goals, you can use this information to communicate with other departments or decision-makers, help develop your post-construction funding and budgeting plan, and develop goals for your permit renewal documents.

Ch. 2 Program Development

GROUP A – Initiating the Program

Place a check in the appropriate box based on whether a component is part of your existing program

2.A.1. Post-construction program has at least one staff person assigned to oversee program development and implementation	☐Yes	☐No	☐Don't know
2.A.2. A department or point of contact is identified to administer and coordinate the stormwater program	☐Yes	☐No	☐Don't know
2.A.3. Post-construction program has access to necessary engineering and administrative support	☐Yes	☐No	☐Don't know
2.A.4. Annual budget for post-construction stormwater program defined and funds are available to support the program	☐Yes	☐No	☐Don't know
2.A.5. Public involvement provided for each program component	☐Yes	☐No	☐Don't know
2.A.6. Local geographic characteristics have been assessed to inform the development of the post-construction program	☐Yes	☐No	☐Don't know
2.A.7. Local water quality characteristics have been assessed to inform the development of the post-construction program	☐Yes	☐No	☐Don't know
2.A.8. Local demographic & community characteristics have been assessed to inform the development of the post-construction program	☐Yes	☐No	☐Don't know
2.A.9. Maps show existing and future land use conditions overlaid with streams and watersheds	☐Yes	☐No	☐Don't know
2.A.10. Measurable goals established for post-construction based on regulatory requirements and local priorities	☐Yes	☐No	☐Don't know
2.A.11. Annual reports and permit renewals are complete and submitted on time	☐Yes	☐No	☐Don't know

GROUP B – Enhancing the Program

Place a check for every component that the program currently has in place

2.B.1. Phased implementation plan utilized to phase in staff, resources, and budgets over time	☐Yes	☐No	☐Don't know
2.B.2. Mix of revenue sources is utilized with at least one dedicated revenue source	☐Yes	☐No	☐Don't know
2.B.3. Diverse skill-set available amongst staff involved in post-construction program, including at least 3 of the following:	☐ construction, inspections, & facilities maintenance ☐ hydrologic engineering/hydrology ☐ water quality & biology ☐ GIS ☐ land use & planning ☐ budget planning & mgmt ☐ capital project management ☐ law & regulations expertise		

2.B.4. If different departments are involved in the stormwater program, cross-training and coordination sessions are held at least twice/year	☐Yes ☐No ☐Don't know
2.B.5. Public involvement goes beyond minimum notification to include stakeholder committees, workshops, and/or outreach to neighborhoods & target audiences (e.g., hotspots)	☐Yes ☐No ☐Don't know
2.B.6. A hotline and/or website is available for citizen alerts and complaints	☐Yes ☐No ☐Don't know
2.B.7. Program information is available on website to download:	☐ Application forms ☐ Manuals ☐ Checklists ☐ Other ☐ No ☐ Don't know
2.B.8. Water resources databases and maps are incorporated into GIS and include:	☐ impaired waters ☐ high priority local resources ☐ areas subject to flooding ☐ utilities ☐ current and future impervious cover
2.B.9. Stream assessment and outfall inventory conducted to assess current conditions and locations of all outfalls	☐Yes ☐No ☐Don't know
2.B.10. Pollutants of concern (based on local, regional, and state priorities) have been identified for local stormwater program	☐Yes ☐No ☐Don't know

GROUP C – Advancing the Program

Place a check for every component that the program currently has in place

2.C.1. Post-construction program elements incorporated in a master stormwater plan and/or watershed plan(s)	☐ master swm plan ☐ watershed plan ☐ subwatershed plan(s)
2.C.2. Stormwater utility instituted, including dedicated funding for maintenance program	☐Yes ☐No ☐Don't know
2.C.3. Diverse skill-set available amongst staff involved in post-construction program, including at least 4 of the following:	☐ construction, inspections, & facilities maintenance ☐ hydrologic engineering/hydrology ☐ water quality & biology ☐ GIS ☐ land use & planning ☐ budget planning & management ☐ capital project management ☐ law & regulations expertise
2.C.4. At least two education & outreach events are conducted each year for staff and target audiences: plan reviewers, applicants, inspectors, property owners & managers, etc.	☐Yes ☐No ☐Don't know

Action Item Development

Review the list above. For items checked as "No" in Group A, develop short-term action items based on that component and enter it into the list of action items for the next 1 – 5 years.. For items checked as "No" in Groups B & C, evaluate their relevance to your program and create short or long-term action items for selected elements. For any item that is checked as "Don't Know" make identifying the status of that program element an action item for the following year.

Program Development Action Items for Next 1 – 5 Years

1. _____

2. _____

3. _____

4. _____

5. _____

Program Development Action Items for Next 5 – 10 Years:

1. _____

2. _____

3. _____

4. _____

5. _____

Program Development Measurable Goals

Measurable Goal Examples	Date of Completion
Assign a lead department to coordinate post-construction stormwater program	Year 1
Develop maps with relevant geographic, demographic, and water resources information	Year 2
Conduct a Program Self-Assessment	Year 2
Secure a dedicated funding mechanism	Year 5

Ch. 3 Land Use Planning as the First BMP: Linking Stormwater to Land Use

GROUP A – Initiating The Program

Place a check in the appropriate box based on whether a component is part of your existing program

3.A.1. Stormwater managers included in comprehensive plan process so that overall watershed and stormwater goals can be incorporated	☐ Yes	☐ No	☐ Don't know
3.A.2. Comprehensive or General Plan amended to include post-construction stormwater program goals, objectives, and strategies	☐ Yes	☐ No	☐ Don't know
3.A.3. Both land use planners and stormwater managers involved in pre-concept and/or pre-application meetings for potential development projects	☐ Yes	☐ No	☐ Don't know

GROUP B – Enhancing the Program

Place a check for every component that the program currently has in place.

3.B.1. Comprehensive review of local policies and regulations (zoning, subdivision, etc.) has been conducted, identifying potential obstacles to meeting stormwater goals	☐ Yes	☐ No	☐ Don't know
3.B.2. Both land use planners and stormwater managers are involved in utility and transportation master planning	☐ Yes	☐ No	☐ Don't know
3.B.3. Multidisciplinary team -- including engineers, planners, local decision-makers, and key stakeholders – are involved in program development	☐ Yes	☐ No	☐ Don't know

3.B.4. Land use planning approach allows for minimizing water quality impacts of development at various scales, utilizing at least 3 of the following:

- ☐ infill, redevelopment, & compact development incentives
- ☐ natural area protection
- ☐ direct development to designated growth areas
- ☐ low-impact development
- ☐ stream buffering
- ☐ overlay zoning & performance standards
- ☐ special stormwater criteria for sensitive receiving waters
- ☐ purchase and/or transfer of development rights
- ☐ alternative street & parking design (less impervious cover)
- ☐ fee-in-lieu program for watershed projects

GROUP C – Advancing the Program

Place a check for every component that the program currently has in place.

3.C.1. Stormwater managers are involved in economic development planning, especially for enterprise zones, Main Street projects, and other projects that involve infill and redevelopment	☐ Yes	☐ No	☐ Don't know

3.C.2. Land use planning approach allows for minimizing water quality impacts of development at various scales, utilizing at least 5 of the following:	☐ infill, redevelopment, & compact development incentives ☐ natural area protection ☐ development in growth areas ☐ low-impact development ☐ stream buffering ☐ overlay zoning & performance standards ☐ special stormwater criteria ☐ purchase and/or transfer of development rights ☐ alternative street & parking design ☐ fee-in-lieu program for watershed projects
3.C.3. Site-level stormwater management integrated with watershed plans to use a watershed approach (for instance, priority retrofits, stream repairs, and/or stream buffer enhancements are used in lieu of or in addition to on-site measures through a fee-in-lieu or mitigation system)	☐Yes ☐No ☐Don't know
3.C.4. Cross-training and joint activities allow land use planners, stormwater managers, and transportation, utility, and capital project planners to explore how various land use/stormwater processes can be better integrated	☐Yes ☐No ☐Don't know
3.C.5. Post-construction program and land use planners are capable of adaptive management when/if climate change poses challenges to current stormwater management strategies	☐Yes ☐No ☐Don't know

Action Item Development

Review the list above. For items checked as "No" in Group A, develop short-term action items based on that component and enter it into the list of action items for the next 1 – 5 years. For items checked as "No" in Groups B & C, evaluate their relevance to your program and create short or long-term action items for selected elements. For any item that is checked as "Don't Know," make identifying the status of that program element an action item for the following year.

Land Use Planning Action Items for Next 1 – 5 Years:

1. _____

2. _____

3. _____

4. _____

5. _____

Land Use Planning Action Items for Next 5 – 10 Years:

1. _____

2. _____

3. _____

4. _____

5. _____

Land Use Planning Measurable Goals

Measurable Goal Examples	Date of Completion
Remove unnecessary barriers to infill and redevelopment	Year 3
Revise zoning and subdivision codes to remove barriers to LID, conservation design, and other site designs that protect water quality	Year 4
Restrict development or adopt stricter performance standards in sensitive watersheds	Year 5

Ch. 4 Developing a Stormwater Management Approach and Criteria

GROUP A – Initiating the Program

Place a check in the appropriate box based on whether a component is part of your existing program

4.A.1. Overlay maps identifying sensitive waters and other sensitive natural areas are used to influence local stormwater criteria	☐Yes ☐No ☐Don't know
4.A.2. Local/regional rainfall analysis has been conducted and used to develop stormwater management criteria and appropriate treatment volumes based on local/regional precipitation trends	☐Yes ☐No ☐Don't know
4.A.3. Site designers encouraged to use design techniques that minimize impervious cover and preserve natural areas	☐Yes ☐No ☐Don't know

GROUP B – Enhancing the Program

Place a check for every component that the program currently has in place

4.B.1. Site-by-site stormwater management approach is enhanced by a master plan or watershed-based plan	☐Yes ☐No ☐Don't know
4.B.2. Stormwater program provides flexibility to meet criteria for redevelopment conditions	☐Yes ☐No ☐Don't know
4.B.3. Post-construction stormwater criteria developed, as applicable, for:	☐ Natural resources inventory prior to site development ☐ Groundwater recharge; runoff reduction ☐ Water quality treatment ☐ Channel protection ☐ Flood control
4.B.4. Special stormwater criteria applied to, as applicable:	☐ Exceptional waters (e.g., cold water fisheries) ☐ Impaired waters ☐ Drinking water supplies ☐ Wetlands ☐ Coastal resources ☐ Stormwater hotspots ☐ Other locally-important resources List: _____
4.B.5. Potential pollution hotspots are identified during plan review and source control methods applied to design, when appropriate	☐Yes ☐No ☐Don't know
4.B.6. Source control and pollution prevention practices are incorporated into a stormwater public education program	☐Yes ☐No ☐Don't know

GROUP C – Advancing the Program

Place a check for every component that the program currently has in place

4.C.1. Site-based load limits or special performance standards for pollutants identified in a TMDL study are applied to development and redevelopment sites	☐Yes ☐No ☐Don't know

4.C.2. Local government sites (e.g., schools, regional parks, office buildings, public works yards) used as demonstration sites for both Smart Growth and innovative stormwater management ☐Yes ☐No ☐Don't know

Action Item Development

Review the list above. For items checked as "No" in Group A, develop short-term action items based on that component and enter it into the list of action items for the next 1 – 5 years. For items checked as "No" in Groups B & C, evaluate their relevance to your program and create short or long-term action items for selected elements. For any item that is checked as "Don't Know," make identifying the status of that program element an action item for the following year.

Stormwater Approach & Criteria Action Items for Next 1 – 5 Years:

1. _____

2. _____

3. _____

4. _____

5. _____

Stormwater Approach & Criteria Action Items for Next 5 – 10 Years:

1. _____

2. _____

3. _____

4. _____

5. _____

Stormwater Approach & Criteria Measurable Goals

Measurable Goal Examples	Date of Completion
Develop a stormwater approach that includes improved site design, source controls, and stormwater treatment	Year 2
Develop specific stormwater management criteria for inclusion in ordinances and design standards that address water quality treatment	Year 3
Develop specific stormwater management criteria for inclusion in ordinances and design standards that address: natural resources inventory, runoff reduction, and channel protection	Year 5

Ch. 5 Developing a Post-Construction Stormwater Ordinance

GROUP A – Initiating the Program

Place a check in the appropriate box based on whether a component is part of your existing program

5.A.1. Post-construction stormwater requirements are codified in a stand-alone ordinance or other code (e.g., zoning)	☐Yes ☐No ☐Don't know
5.A.2. Inconsistencies with existing codes and standards (e.g., zoning, subdivision codes) identified and remedied	☐Yes ☐No ☐Don't know
5.A.3. Basic elements included in stormwater ordinance:	☐ Legal authority & purpose statements ☐ Definitions ☐ Applicability of requirements (parcel size, disturbed area, or impervious cover created) ☐ Exemptions & waivers ☐ Performance criteria: water quantity and quality. ☐ Plan submission & review procedures ☐ Plan review fees ☐ Approval of stormwater plans prior to other plan/permit approvals (e.g., grading permit) ☐ Inspection reporting and frequency ☐ Requirement for maintenance agreements ☐ Penalties & remedies
5.A.4. Basic public involvement procedures exist for ordinance development & adoption – public meetings, comment period, public hearings	☐Yes ☐No ☐Don't know

GROUP B – Enhancing the Program

Place a check for every component that the program currently has in place

5.B.1. Post-construction stormwater ordinance integrated with ordinance(s) for construction site stormwater and illicit discharge detection & elimination (IDDE), as follows:	☐ Enforcement procedures integrated ☐ Plan review integrated ☐ Inspections integrated ☐ Don't know
5.B.2. Technical and procedure details included in design and/or policy manual referenced in ordinance	☐Yes ☐No ☐Don't know
5.B.3. Concept plan and/or pre-submittal meeting required for development projects	☐Yes ☐No ☐Don't know
5.B.4. Provides for coordination with State/Federal/Other Local permits and plans (e.g., local grading permit not issued until applicable State & Federal permits obtained)	☐Yes ☐No ☐Don't know

5.B.5. Low-impact development and/or non-structural measures permitted/encouraged through credits or other approval process.	☐Yes	☐No	☐Don't know
5.B.6. Easements for access, drainage, and stormwater BMPs required	☐Yes	☐No	☐Don't know
5.B.7. Bonding or other surety required for post-construction stormwater practices up through final stabilization and test period (e.g., 2 years after final stabilization)	☐Yes	☐No	☐Don't know
5.B.8. As-built plans with certification required	☐Yes	☐No	☐Don't know
5.B.9. Civil penalties included in penalties section, including for maintenance non-compliance	☐Yes	☐No	☐Don't know
5.B.10. Substantial public involvement (focus groups, workshops, public meetings, etc.) is part of ordinance development and adoption	☐Yes	☐No	☐Don't know

GROUP C – Advancing the Program

Place a check for every component that the program currently has in place

5.C.1. BMP-specific maintenance plans required on plans and/or as part of maintenance agreements	☐Yes	☐No	☐Don't know
5.C.2. Fee-in-lieu provisions allow for off-site or watershed projects (e.g., stream restoration, stormwater retrofits) identified in watershed plan	☐Yes	☐No	☐Don't know
5.C.3. Low-impact development required to the greatest practical extent, at least within certain districts (e.g., all "Greenfield" development)	☐Yes	☐No	☐Don't know
5.C.4. Advisory Committee or Codes Roundtable involved in developing and/or revising stormwater ordinance	☐Yes	☐No	☐Don't know

Action Item Development

Review the list above. For items checked as "No" in Group A, develop short-term action items based on that component and enter it into the list of action items for the next 1 – 5 years. For items checked as "No" in Groups B & C, evaluate their relevance to your program and create short or long-term action items for selected elements. For any item that is checked as "Don't Know," make identifying the status of that program element an action item for the following year.

Stormwater Ordinance Action Items for Next 1 – 5 Years:

1. _____

2. _____

3. _____

4. _____

5. _____

Stormwater Ordinance Action Items for Next 5 – 10 Years:

1. _____
2. _____
3. _____
4. _____
5. _____

Stormwater Ordinance Measurable Goals

Measurable Goal Examples	Date of Completion
Adopt stormwater ordinance that addresses post-construction	Year 2
Stormwater ordinance developed or amended to allow and provide incentives for site design that protects water quality and low-impact development	Year 3

Ch. 6 Stormwater Guidance Manuals

GROUP A – Initiating the Program

Place a check in the appropriate box based on whether a component is part of your existing program

6.A.1. Stormwater manual referenced in ordinance has following basic components:

- ☐ Background information on need for stormwater management
- ☐ BMP Standards referenced to an appropriate State or other technical manual
- ☐ Acceptable computation and BMP sizing methods
- ☐ Standard maintenance agreement
- ☐ Stormwater plan review checklist (Tool 6)
- ☐ Construction checklist(s) (Tool 6)
- ☐ Maintenance checklist(s) (Tool 6)

6.A.2. Manual reviewed and updated on regular basis (every 5 years) ☐ Yes ☐ No ☐ Don't know

GROUP B – Enhancing the Program

Place a check for every component that the program currently has in place

6.B.1. Policy/Procedure Manual referenced in ordinance has additional components:

- ☐ Plan submission & review procedures
- ☐ Performance measures that can be used to provide incentives for better site design and low-impact development
- ☐ Information on Federal/State/Local permits for activities in wetlands, streams, and floodplains
- ☐ Standards for easements – where & when required, dimensions, maintenance access, recordation procedures
- ☐ Standard deed(s) of easement
- ☐ Standard performance bond form and bond release procedure (Tool 7)
- ☐ Inspections schedules, during and after construction

6.B.2. Design Manual referenced in ordinance has additional components:	☐ List of recommended BMPs ☐ Specific standards or criteria for long-term maintenance reduction ☐ Standards/guidance on proprietary BMPs, including standard maintenance contract ☐ Landscaping and pondscaping guidance provided and coordinated with other landscaping standards ☐ Guidance for single-family lot plans, if applicable ☐ Design examples ☐ List of acceptable hydrologic models
6.B.3. Periodic system exists for reviewing and updating manual, such as review committee and structured feedback from field experiences (annual basis)	☐ Yes ☐ No ☐ Don't know

GROUP C – Advancing the Program

Place a check for every component that the program currently has in place

6.C.1. Design Manual has following additional components:	☐ Formal system of credits or incentives for low-impact development, non-structural measures, and/or source controls to be used in lieu of structural measures ☐ Standards, design procedures, and/or examples for low-impact development, non-structural measures, and source controls. ☐ System for contributions to watershed projects such as details for calculating fee-in-lieu ☐ Boilerplate BMP-specific maintenance plans as attachments to maintenance agreement ☐ Guidelines for monitoring and reporting on BMP performance and compliance

Action Item Development

Review the list above. For items checked as "No" in Group A, develop short-term action items based on that component and enter it into the list of action items for the next 1 – 5 years. For items checked as "No" in Groups B & C, evaluate their relevance to your program and create short or long-term action items for selected elements. For any item that is checked as "Don't Know," make identifying the status of that program element an action item for the following year.

Stormwater Guidance Manuals Action Items for Next 1 – 5 Years:

1. _____

2. _____

3. _____

4. _____

5. _____

Stormwater Guidance Manuals Action Items for Next 5 – 10 Years:

1. _____

2. _____

3. _____

4. _____

5. _____

Stormwater Guidance Manuals Measurable Goals

Measurable Goal Examples	Date of Completion
Compile list of applicable technical resources	Year 1
Develop policy/procedures manual as guidance for compliance	Year 4
Develop technical manual for selecting and sizing recommended BMPs for the community	Year 5

Ch. 7 Plan Review Process

GROUP A – Initiating the Program

Place a check in the appropriate box based on whether a component is part of your existing program

7.A.1. Plan submittal requirements are outlined in a checklist with clear expectations and instructions (Tool 6)	☐Yes ☐No ☐Don't know
7.A.2. Submissions, reviews, and approvals have specific schedule and are tracked in database or other system	☐Yes ☐No ☐Don't know
7.A.3. Access to basic information (submitted plans, review comments, and approval procedures) is available to:	☐ applicants ☐ internal departments ☐ public
7.A.4. Computations detail the existing and proposed hydrologic conditions.	☐Yes ☐No ☐Don't know
7.A.5. Documentation must be? prepared for transfer of project to construction and maintenance phase	☐Yes ☐No ☐Don't know
7.A.6. Public projects treated equally to private projects in terms of submittal and review	☐Yes ☐No ☐Don't know

GROUP B – Enhancing the Program

Place a check for every component that the program currently has in place

7.B.1. Development review process map/flowchart provided to act as communication tool and lend predictability to review process	☐Yes ☐No ☐Don't know
7.B.2. Proactive notification and plan tracking provided to applicants and public (allows fair opportunity to learn about plans and review details)	☐Yes ☐No ☐Don't know
7.B.3. Concept/preliminary plan stage used to encourage early consideration of post-construction stormwater in development process	☐Yes ☐No ☐Don't know
7.B.4. Pre-submittal meetings (mandatory or voluntary) held to review plan content and site issues and as vehicle to promote low-impact development and innovative practices	☐Yes ☐No ☐Don't know
7.B.5. Inspections staff notified/involved during plan review	☐Yes ☐No ☐Don't know
7.B.6. Field-delineated natural resources information included and confirmed as part of review process	☐Yes ☐No ☐Don't know

7.B.7. Review coordinated with Federal, State, and other local permit reviews. For instance, site plans are not approved until applicable permits have been obtained	☐ Construction stormwater permit ☐ Fed/State stream & wetland permit ☐ Dam safety permit ☐ Flood plain permit ☐ Other ☐ Reviews not coordinated with other permits ☐ Don't know
7.B.8. Each reviewer reviews no more than 70-100 plans on an annual basis	☐Yes ☐No ☐Don't know
7.B.9. Joint site visits conducted with applicant	☐Yes ☐No ☐Don't know
7.B.10. Plan preparer certifies final plan package (construction drawings, computations, easement plats, and maintenance agreement)	☐Yes ☐No ☐Don't know

GROUP C – Advancing the Program

Place a check for every component that the program currently has in place

7.C.1. Computation package has standardized content and modeling based on local or regional hydrologic and/or water quality model	☐Yes ☐No ☐Don't know
7.C.2. Incentives in place to enable expedited review process for plans that use innovative stormwater practices, while still ensuring thorough review by staff	☐Yes ☐No ☐Don't know
7.C.3. Ongoing training sessions held between review staff and design consultants and developers (encourages two-way communication on review process)	☐Yes ☐No ☐Don't know

Action Item Development

Review the list above. For items checked as "No" in Group A, develop short-term action items based on that component and enter it into the list of action items for the next 1 – 5 years. For items checked as "No" in Groups B & C, evaluate their relevance to your program and create short or long-term action items for selected elements. For any item that is checked as "Don't Know," make identifying the status of that program element an action item for the following year.

Plan Review Action Items for Next 1 – 5 Years:

1. _____

2. _____

3. _____

4. _____

5. _____

Plan Review Action Items for Next 5 – 10 Years:

1. _____
2. _____
3. _____
4. _____
5. _____

Plan Review Measurable Goals

Measurable Goal Examples	Date of Completion
Develop plan review and plan submittal checklist(s)	Year 1
Train staff and design consultants on the plan review process	Year 2
By the end of the permit cycle, XX% of new plans are consistent with design criteria by the second submittal	Year 5

Ch. 8 Inspection of Permanent Stormwater BMPs During Construction

GROUP A – Initiating the Program

Place a check in the appropriate box based on whether a component is part of your existing program

8.A.1. Construction checklists available to inspectors and contractors (Tool 6)	☐Yes	☐No	☐Don't know
8.A.2. Inspections for permanent controls coordinated with construction-phase (erosion control) and long-term maintenance inspections	☐Yes	☐No	☐Don't know
8.A.3. Each post-construction stormwater BMP inspected to ensure timely and correct installation – nominal # of inspections = 3 per facility at key construction milestones	☐Yes	☐No	☐Don't know
8.A.4. Proper records kept of inspections and critical milestones for program documentation and to transfer project to long-term maintenance	☐Yes	☐No	☐Don't know
8.A.5. Enforcement tools available to remedy problems in the field	☐Yes	☐No	☐Don't know

GROUP B – Enhancing the Program

Place a check for every component that the program currently has in place

8.B.1. Pre-construction meeting held with plan reviewer, inspector, owner, and contractor prior to any land disturbance to review construction sequence, critical areas, sign-off points, and issues with post-construction stormwater BMPs	☐Yes	☐No	☐Don't know
8.B.2. Performance Bonds posted for post-construction stormwater BMPs and released after stabilization or set "test" period (e.g., 2 years)	☐Yes	☐No	☐Don't know
8.B.3. Complaints during construction responded to in timely fashion (within 1 week for routine issues; within 24 hours for potential threats to public health and safety)	☐Yes	☐No	☐Don't know
8.B.4. Certified as-built plans reviewed and signed off by inspectors and review staff	☐Yes	☐No	☐Don't know
8.B.5. Public has access to inspection and complaint response records	☐Yes	☐No	☐Don't know
8.B.6. Ongoing training and cross-training is provided for inspections staff	☐Yes	☐No	☐Don't know

GROUP C – Advancing the Program

Place a check for every component that the program currently has in place

8.C.1. Inspections staff size adequate to inspect each site at the desired frequency (e.g., every 2 weeks and after each runoff-producing storm event)	☐Yes	☐No	☐Don't know
8.C.2. Comprehensive inspections conducted that include structural and non-structural measures, source controls, low-impact development measures	☐Yes	☐No	☐Don't know
8.C.3. Inspection reports, performance bond data, and as-built approvals tied to post-construction GPS/GIS and database	☐Yes	☐No	☐Don't know
8.C.4. Inspection certification program provides for private, certified on-site inspectors for certain sites	☐Yes	☐No	☐Don't know

Action Item Development

Review the list above. For items checked as "No" in Group A, develop short-term action items based on that component and enter it into the list of action items for the next 1 – 5 years. For items checked as "No" in Groups B & C, evaluate their relevance to your program and create short or long-term action items for selected elements. For any item that is checked as "Don't Know," make identifying the status of that program element an action item for the following year.

Inspection During Construction Action Items for Next 1 – 5 Years:

1. _____

2. _____

3. _____

4. _____

5. _____

Inspection During Construction Action Items for Next 5 – 10 Years:

1. _____

2. _____

3. _____

4. _____

5. _____

Inspection During Construction Measurable Goals

Measurable Goal Examples	# and/or Date of Completion
Develop checklists for staff inspectors	Year 1
Inspect all sites at least 3 times during construction	Year 3
Train contractors on key construction requirements for stormwater BMPs	Year 4
Number of post-construction BMPs installed correctly (as per standards and approved plan)	#

Ch. 9 Maintenance

GROUP A – Initiating the Program

Place a check in the appropriate box based on whether a component is part of your existing program

9.A.1. Policies developed about Extent & Level of Service and long-term maintenance responsibility	☐Yes	☐No	☐Don't know
9.A.2. Inspectors have legal authority to gain access to and inspect post-construction facilities	☐Yes	☐No	☐Don't know
9.A.3. Inspections for public stormwater BMPs take place in response to complaints and at least on an annual basis	☐Yes	☐No	☐Don't know
9.A.4. Inspections for private stormwater BMPs take place in response to complaints and/or at least once every 3 years	☐Yes	☐No	☐Don't know
9.A.5. Basic maintenance checklist used (Tool 6)	☐Yes	☐No	☐Don't know
9.A.6. "Chain of custody" documentation used to transfer projects from plan review to inspection to maintenance functions	☐Yes	☐No	☐Don't know
9.A.7. Remedies exist to take care of immediate threats to public health, safety, and the environment	☐Yes	☐No	☐Don't know
9.A.8. Post-construction stormwater BMPs mapped and tracked using GIS or other tool	☐Yes	☐No	☐Don't know

GROUP B – Enhancing the Program

Place a check for every component that the program currently has in place

9.B.1. Thorough inventory conducted of newly-approved plus pre-existing stormwater BMPs	☐Yes	☐No	☐Don't know
9.B.2. GIS used to map and track all stormwater BMPs	☐Yes	☐No	☐Don't know
9.B.3. BMP-specific maintenance checklists used to identify routine maintenance needs as well as more serious repairs (Tool 6)	☐Yes	☐No	☐Don't know
9.B.4. Maintenance policies and standards defined for proprietary devices, including maintenance plans and contracts	☐Yes	☐No	☐Don't know
9.B.5. Inspections for *all* stormwater BMPs take place at least once a year and in response to complaints	☐Yes	☐No	☐Don't know
9.B.6. GIS/GPS used to track and keep records of maintenance activities	☐Yes	☐No	☐Don't know
9.B.7. Prioritization system used to allocate program resource to most important maintenance tasks	☐Yes	☐No	☐Don't know
9.B.8. Ongoing education and outreach programs assist private entities with maintenance (e.g., Adopt-A-Pond, co-inspections with local staff)	☐Yes	☐No	☐Don't know

9.B.9. Program uses a combination of legal authority and outreach to correct serious maintenance conditions as well as provide preventative maintenance	☐Yes	☐No	☐Don't know

GROUP C – Advancing the Program

Place a check for every component that the program currently has in place

9.C.1. System in place to secure easements and access to older stormwater BMPs that should be included in maintenance program	☐Yes	☐No	☐Don't know
9.C.2. Comprehensive inspections and maintenance include non-structural measures, source controls, low-impact development measures, and retrofits. Maintenance standards exist for non-structural measures (Tool 6)	☐Yes	☐No	☐Don't know
9.C.3. Maintenance escrow or cash reserve requirement ensures financial capability for responsible parties	☐Yes	☐No	☐Don't know
9.C.4. Program integrated with watershed or master plan; projects are ongoing to include maintenance, retrofits, restoration projects, repairs, and outreach	☐Yes	☐No	☐Don't know

Action Item Development

Review the list above. For items checked as "No" in Group A, develop short-term action items based on that component and enter it into the list of action items for the next 1 – 5 years. For items checked as "No" in Groups B & C, evaluate their relevance to your program and create short or long-term action items for selected elements. For any item that is checked as "Don't Know," make identifying the status of that program element an action item for the following year.

Maintenance Action Items for Next 1 – 5 Years:

1. _____

2. _____

3. _____

4. _____

5. _____

Maintenance Action Items for Next 5 – 10 Years:

1. _____

2. _____

3. _____

4. _____

5. _____

Maintenance Measurable Goals

Measurable Goal Examples	# and/or Date of Completion
Address critical maintenance deficiencies within 3 months of initial inspection	Year 2
Inspect high priority stormwater BMPs at least annually	Year 3
Inspect all stormwater BMPs at least every three years (or according to program schedule)	Year 4
# of routine maintenance tasks performed for publicly-maintained facilities (annual)	#
# of repairs performed for publicly-maintained facilities (annual)	#
# maintenance inspection reports received from responsible parties (privately-maintained) (annual)	#

Ch. 10 Tracking, Monitoring, and Evaluation

GROUP A – Initiating the Program

Place a check in the appropriate box based on whether a component is part of your existing program

10.A.1. Basic measurable goals and performance indicators have been outlined to guide program	☐Yes ☐No ☐Don't know
10.A.2. New stormwater BMPs added to system for tracking and reporting	☐Yes ☐No ☐Don't know
10.A.3. All NPDES evaluation and reporting requirements are met	☐Yes ☐No ☐Don't know

GROUP B – Enhancing the Program

Place a check for every component that the program currently has in place

10.B.1. Baseline data has been gathered in order to measure progress (e.g., water quality data, # of BMPs already implemented)	☐Yes ☐No ☐Don't know
10.B.2. Strategic plan with specific goals and objectives guides overall tracking & monitoring program	☐Yes ☐No ☐Don't know
10.B.3. Water resources information is used to guide stormwater program approaches and assess progress, using at least one of the following:	☐ Watershed assessment monitoring ☐ Targeted monitoring for water quality problems ☐ BMP performance monitoring ☐ Modeling ☐ Stream assessments
10.B.4. Various stormwater infrastructure is mapped in GIS, including:	*System components:* ☐ BMPs ☐ Outfalls ☐ Conveyances *Information:* ☐ Date of installation ☐ Location ☐ Condition ☐ Photo ☐ Maintenance needs
10.B.5. Tracking of plan reviews, inspections, and maintenance linked in GIS (expedites coordination and reporting)	☐Yes ☐No ☐Don't know
10.B.6. Field remedies (landscaping changes, soil mix, types of acceptable facilities, etc.) communicated back to plan review staff for design manual updates	☐Yes ☐No ☐Don't know
10.B.7. NPDES-mandated reports and audits are used internally to evaluate and address deficiencies and improve local stormwater program	☐Yes ☐No ☐Don't know

10.B.8. Program goals are periodically revisited to promote innovation and incorporation of current research, technologies, and design approaches	☐ Yes ☐ No ☐ Don't know

GROUP C – Advancing the Program

Place a check for every component that the program currently has in place

10.C.1. Implementation of long-term monitoring and evaluation of measurable goals and performance indicators is conducted to improve program through time. Methods include some or all of the following:	☐ Tracking program indicators ☐ Tracking stormwater infrastructure ☐ Tracking land use/land cover ☐ Water quality monitoring ☐ BMP performance monitoring ☐ BMP maintenance surveys ☐ Stream assessments ☐ Water quality modeling ☐ Citizen/stakeholder attitude surveys
10.C.2. Water resources information is used to guide stormwater program approaches and assess progress, using at least 2 of the following:	☐ Watershed assessment monitoring ☐ Targeted monitoring for water quality problems ☐ BMP performance monitoring ☐ Modeling ☐ Stream assessments
10.C.3. Land use and land cover changes are assessed to guide stormwater program approaches and assess progress, including:	☐ Impervious cover ☐ Land use ☐ Land cover ☐ Future land use ☐ High value resources

Action Item Development

Review the list above. For items checked as "No" in Group A, develop short-term action items based on that component and enter it into the list of action items for Years 1--5 Action Item list. For items checked as "No" in Groups B & C, evaluate their relevance to your program and create short or long-term action items for selected elements. For any item that is checked as "Don't Know," make identifying the status of that program element an action item for the following year.

Tracking, Monitoring & Evaluation Action Items for Next 1 – 5 Years:

1. _____

2. _____

3. _____

4. _____

5. _____

Tracking, Monitoring & Evaluation Action Items for Next 5 – 10 Years:

1. _____
2. _____
3. _____
4. _____
5. _____

Tracking, Monitoring & Evaluation Measurable Goals

Measurable Goal Examples	**# and/or Date of Completion**
Outline stormwater program goals and performance indicators in a strategic plan	Year 4
Create tracking system for plan reviews, stormwater inspections, and maintenance activities linked with GIS	Year 4

TOOL 2

Post-Construction Guidance Manual

Program & Budget Planning

This is one of several tools designed to assist local stormwater managers with the development of their post-construction stormwater program. The tools are a companion to the Post-Construction Guidance Manual (www.cwp.org/postconstruction). The following tools are available:

Tool 1: Post-Construction Stormwater Program Self-Assessment

Tool 2: Program & Budget Planning Tool

Tool 3: Post-Construction Stormwater Model Ordinance

Tool 4: Codes & Ordinance Worksheet (COW)

Tool 5: Stormwater Manual Builder

Tool 6: Plan Review, BMP Construction, and Maintenance Checklists

Tool 7: Performance Bonds

Tool 8: BMP Evaluation Tool

For more information on the Post-Construction Guidance Manual, contact the Center for Watershed Protection, 8390 Main Street, 2nd floor, Ellicott City, MD 21046, 410-461-8323

center@cwp.org

www.cwp.org.

USER'S GUIDE TO THE PROGRAM & BUDGET PLANNING TOOL

For many municipalities, the Public Works, Engineering or Planning department is responsible for developing a stormwater post-construction program. Depending on the size of the municipality, it will likely require staff participation from multiple departments. The task of developing a stormwater post-construction program can be difficult and questions may arise such as:

- Where should we start?
- What regulatory requirements are applicable?
- What should we include in our program?
- What is it going to cost?

The program & budget planning tool is a spreadsheet tool that is meant to assist stormwater managers with program planning, goal setting, and phasing. It is not meant to be a detailed budgeting tool but rather an overview of planning milestones. The spreadsheet enables the user to fill in the staffing needs and expenses, other program expenses, and potential revenue sources for each task and subtask. This tool should be modified by stormwater managers to fit the needs and characteristics of their individual programs.

The spreadsheet is modeled after Tables 1.6 through 1.9 which provides a template for the development and operation of a comprehensive post-construction program plan. The four tables represent four different phases of program development:

- Phase 1: Program Development, Linking to Land Use, and Adopting An Ordinance
- Phase 2: Developing Stormwater Guidance Manuals and the Stormwater Plan Review Process
- Phase 3: Inspecting Permanent Stormwater BMPs During Construction, Developing a Maintenance Program, and Tracking and Evaluating the Program
- Program operation: Putting the comprehensive program plan into practice

Table 1.6. Phase 1 of a Comprehensive Program Plan

Phase 1 Task	Relevant Guide Section or Tool
1. Program Development	
1.a. Assess Watershed & Community	1.6
1.b. Conduct Program Self-Audit	1.7, Tool #1
1.c. Develop Program Goals, Plan & Budget	1.8, Tool #2
1.d. Develop & Implement Public Involvement Strategy	each chapter

1.e. Hire Core Program Staff	Ch. 1
2. Link Stormwater to Land Use	
2.a. Establish Links to Planning Department	2.5
2.b. Evaluate Existing Land Use Codes	2.6, Tool #4
2.c. Assess Integrated Stormwater/Land Use Tools	2.7
2.d. Adopt Smart Growth Policies	Ch. 2, EPA docs
3. Adopt or Amend Stormwater Ordinance	
3.a. Scope Out Ordinance Task	3.2
3.b. Identify MS4 Permit Requirements & Commitments	3.2
3.c. Identify State, Regional, or National Model Ordinance	3.2, Tool #3
3.d. Decide Whether to Integrate Ordinance with Construction Stormwater & IDDE	3.2
3.e. Develop & Implement Stakeholder Participation Plan	3.5
3.f. Develop Draft Ordinance	Ch. 3, Tool #3
3.g. Project Plan Review, Inspection & Maintenance Loads	Ch. 3, 5, 6, 7
3.h. Adopt Ordinance Through Public Process	Ch. 3

Table 1.7. Phase 2 of a Comprehensive Program Plan

Phase 2 Task	Relevant Guide Section or Tool
4. Develop Stormwater Guidance Manual(s)	
4.a. Scope Out Design Guidance Task	4.3
4.b. Identify Local, State, or Regional Manual to use as Model or By Reference	Ch. 4, Tool #5
4.c. Decide Whether to Integrate Manual with Construction Stormwater (erosion & sediment control manual)	Ch. 4
4.d. Develop & Implement Stakeholder Participation Plan	4.15
4.e. Develop Policy & Procedures Manual	4.4, Tool #5
4.f. Develop Technical Design Manual	4.5 -- 4.13, Tool #5
4.g. Adopt the Manuals Through Public Process	Ch. 4
4.h. Provide Training on Use of Manuals	4.14 -- 4.15
5. Create or Enhance Stormwater Plan Review Process	
5.a. Scope Out Plan Review Process	5.3
5.b. Decide Whether to do Review In-House or Contract to Consultant	5.3 -- 5.5
5.c. Create Flowchart or Map Out Review Process	5.4
5.d. Create Forms, Applications, Instruction Materials & Checklists for Applicants & Review Staff	Ch. 5, Tool #6
5.e. Forecast Staff Needs & Acquire Staff	5.3 -- 5.5
5.f. Provide Training for Review Staff and Design Consultants	5.5 -- 5.6
5.g. Develop Web-based on Other Tracking System to Track Plans and Approvals	Ch. 8

5.h. Set up Performance Bond Process, Forms, and Tracking System	Tool #7

Table 1.8. Phase 3 of a Comprehensive Program Plan

Phase 3 Task	Relevant Guide Section or Tool
6. Inspect Permanent Stormwater BMPs During Construction	
6.a. Scope Out Inspection Process	6.2
6.b. Decide Whether to use In-House Inspectors or Contractors	6.5
6.c. Create Checklists, As-Built Certification Forms, and Other Forms Needed for Inspection	6.4, Tool #6
6.d. Forecast Staff Needs & Acquire Inspection Staff or Utilize Existing Staff	Ch. 6
6.e. Provide Training for Inspectors & Contractors	6.5
6.f. Develop Web-based or Other Tracking System to Track Inspections & Enforcement Actions	Ch. 8
7. Develop Maintenance Program	
7.a. Scope Out Maintenance Program	7.3
7.b. Decide on Maintenance Approach & Make Level of Service Policy Decisions	7.4
7.c. Decide Whether to use In-House Inspectors, Contractors, or Rely on Responsible Parties for Maintenance Inspections	Ch. 7
7.d. Decide Whether to use In-House Resources, Contractors, or Responsible Parties for Routine & Structural Maintenance Tasks & Repairs	Ch. 7
7.e. Create Checklists, Inspection Forms, and Enforcement Tools	7.4, Tool #6
7.f. Forecast Staff and Equipment Needs and Acquire Resources	Ch. 7
7.g. Create & Disseminate Outreach Materials for Responsible Parties	7.4 -- 7.6
7.h. Develop Web-based or Other Tracking System to Track Inspections & Enforcement Actions	Ch. 8
8. Track, Evaluate & Monitor Your Program	
8.a. Scope Out Evaluation & Monitoring Tasks	Ch. 8
8.b. Decide on Monitoring Protocols	Ch. 8
8.c. Develop Tracking & Reporting Tools to Track Key Program Elements	Ch. 8

Table 1.9. Program Operation

Program Operation Task	Relevant Guide Section or Tool
4. Stormwater Guidance Manual(s)	

4.o.1. Update the Manuals At Least Every 5 Years	4.14
5. Stormwater Plan Review Process	
5.o.1 Review Stormwater Plans	Ch. 5, Tool #6
6. Inspect Permanent Stormwater BMPs During Construction	
6.o.1. Inspect BMPs During Construction	Ch. 8
7. Maintenance Program	
7.o.1. Inspect BMPs for Maintenance	Ch. 9
7.o.2. Conduct Maintenance Tasks	Ch. 10
8. Track, Evaluate & Monitor Your Program	
8.o.1. Write Annual Reports for Program Compliance & Other Program Reports & Documents	Ch. 8
8.o.2. Maintain the Tracking System	Ch. 8

In order to use this tool effectively, the following steps will be necessary:

1. Gather all existing or proposed expense and revenue data for the stormwater post-construction program. This includes labor costs for the personnel expected to be involved with the program's development or implementation, as well as non-labor costs like computers, vehicles, GIS, GPS, phones, printing, and other items or services.

2. Enter the estimated labor that will be necessary for each subtask. This tool uses the Full Time Equivalent (FTE) as the time unit for measuring labor. One FTE equals one year of labor for a given employee. Note that the subtasks in Phases 1-3 are one-time costs, while the subtasks in Program Operation are annual costs.

3. Enter the cost per FTE based on personnel salary and benefits. This value will not be the same for each subtask, as different personnel (with different salaries and benefits) will likely be assigned to different subtasks.

4. Enter non-labor costs for each subtask in the "Other Program Expenses" column. Again, the subtasks in Phases 1-3 are one-time costs, while the subtasks in Program Operation are annual costs.

5. Use the Potential Revenue Sources column to note where funding for the program may come from.

Once the budget items have been completed for each subtask, the total program development costs (the sum of costs from Phases 1-3) and the annual program operation cost (sum of costs from Program Operation page) will be displayed.

This tool is designed to assist in development of a stormwater post-construction program, but will be an equally effective resource for quantification of existing program costs or developing a wish list of program improvements.

Post-Construction Guidance Manual

TOOL 3

Post-Construction Stormwater Model Ordinance

This is one of several tools designed to assist local stormwater managers with the development of their post-construction stormwater program. The tools are a companion to the Post-Construction Guidance Manual (www.cwp.org/postconstruction). The following tools are available:

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Tool 5: Stormwater Manual Builder

Tool 6: Plan Review, BMP Construction, and Maintenance Checklists

Tool 7: Performance Bonds

Tool 8: BMP Evaluation Tool

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center@cwp.org

www.cwp.org.

Post-Construction Stormwater Model Ordinance

Introduction

This Post-Construction Model Ordinance provides a MENU of code language for local, regional, and/or state stormwater programs to use to craft or update their ordinances. The ordinance is written so that individual sections can be lifted out and modified to suit individual program needs.

Guidance for using the Model Ordinance is provided below:

1. The Ordinance is designed to complement the Post-Construction Program Self-Assessment. Completing the Self-Assessment will assist a stormwater manager in determining which sections of the Model Ordinance to include in his or her new or revised post-construction code.
2. The text in the Model Ordinance has different styles applied to it based on each section's relevance to programs that are at different stages or levels of sophistication. This system parallels the Post-Construction Program Self-Assessment, where the columns represent actions taken by local programs as they evolve and develop. The text styles in the Model Ordinance reflect the following:
    a. Standard text represents fundamental language that all programs should strive to include in some form as part of a "basic" program (generally corresponding to "Group A" in the Self-Assessment). Programs that creating an ordinance from scratch (e.g., no pre-existing stormwater code) should begin with this language. Other programs should confirm that, at a minimum, these elements are addressed in the existing code.
    b. Text in *italics* represents program enhancements that most programs should strive to incorporate within the near future (for example, by the second permit cycle for programs subject to MS4 requirements). These program elements allow for more flexibility in compliance and also incorporate enhanced criteria to protect water resources.
    c. Text that is <u>underlined</u> represents advanced or alternative program elements that either require a fairly high degree of program sophistication and watershed information OR support alternative program elements that can save time and money for local programs (such as the use of certified private inspectors). In general, these elements also provide more flexibility for both applicants and reviewers and promote a watershed-based approach to stormwater, rather than relying solely on site-by-site compliance.
3. While these text styles provide some guidance, it should be considered fluid. Each program is unique, and may incorporate elements from all three types of text.
4. The Model Ordinance contains language in brackets to indicate where a local program should insert its particular information. An example is the [STORMWATER AUTHORITY], which, at the local level, is the department charged with operating the stormwater program. Other terms, such as

Stormwater Design Manual, are in bold because a locality may wish to substitute another term or reference.

5. Many model ordinances are currently available from local, regional, and state agencies and organizations. A local program should consult any models that are "close to home" and then compare sections with this Model Ordinance to see if other elements should be added.
6. Text boxes are provided throughout the ordinance to provide clarification or to present various options for developing code language. **These boxes should be removed when developing an actual code document.**

Table 1 lists some critical decisions to make while developing a post-construction ordinance. Chapter 5 of the Post-Construction Guidance provides more information on many of the topics to consider when crafting an ordinance.

TABLE 1: POST-CONSTRUCTION ORDINANCE DECISIONS

Decision	Rationale	More Guidance
Should post-construction ordinance be combined with erosion and sediment control (construction stormwater) and/or illicit discharge detection and elimination ordinances	Creates a comprehensive code, but can end up being a massive overwhelming document	Chapter 5
Develop a separate Stormwater Design Manual to keep technical details and specifications out of the ordinance	Having a separate manual is the recommended approach, and there are likely state and local manuals to reference	Chapter 6 Tool 5: Manual Builder
Include credits for Low-Impact Development, non-structural measures, and Smart Growth techniques	These are recommended program tools. The program should develop the technical and program capabilities to include these as the program matures.	Chapters 3, 4, 6 Tool 6: Checklists
Include special stormwater criteria for important resources, such as drinking water supplies, coastal areas, wetlands, cold-water fisheries, impaired streams	Special criteria can provide extra protection for locally-important resources. The technical criteria for meeting the standards should be in the Design Manual.	Chapter 4
Determine the number and types of sites that will be subject to stormwater requirements, plan review, and site inspections	The ordinance can apply to nearly all development and redevelopment sites, or only those of a certain size, disturbed area, or impervious threshold. Applicability is a critical program decision	Chapter 5

Contents

Section 1. General Provisions

1.1. Findings of Fact

It is hereby determined that:

(1) Land development activities and associated increases in site impervious cover often alter the hydrologic response of local watersheds and increase stormwater runoff rates and volumes, flooding, stream channel erosion, or sediment transport and deposition;

(2) This stormwater runoff contributes to increased quantities of water-borne pollutants, including siltation of aquatic habitat for fish and other desirable species;

(3) Improper design and construction of stormwater best management practices (BMPs) can increase the velocity of stormwater runoff thereby increasing stream bank erosion and sedimentation;

(4) Impervious surfaces allow less water to percolate into the soil, thereby decreasing groundwater recharge and stream baseflow;

(5) Substantial economic losses can result from these adverse impacts on the waters of the municipality;

(6) Stormwater runoff, soil erosion and nonpoint source pollution can be controlled and minimized through the regulation of stormwater runoff from land development activities;

(7) The regulation of stormwater runoff discharges from land development activities in order to control and minimize increases in stormwater runoff rates and volumes, stream channel erosion, and nonpoint source pollution associated with stormwater runoff is in the public interest and will minimize threats to public health and safety.

(8) Regulation of land development activities by means of performance standards governing stormwater management and site design will produce development compatible with the natural functions of a particular site or an entire watershed and thereby mitigate the adverse effects of stormwater runoff from development.

(9) Clearing and grading during construction tends to increase soil erosion and add to the loss of native vegetation necessary for terrestrial and aquatic habitat;

(10) Illicit and non-stormwater discharges to the storm drain system can contribute a wide variety of pollutants to waterways, and the control of these discharges is necessary to protect public health and safety and water quality.

1.2. Purpose

Purpose

- Most local codes do have a purposes section that establishes the reasons that the locality is regulating stormwater.
- The Purpose section is usually tied to protection of public health and safety and may also refer to regulatory requirements (e.g., MS4 requirements).
- If the ordinance addresses construction stormwater and/or illicit discharge detection & elimination, then the "Purpose" section should include references to these activities.
- Optional "add-ons" to the section are indicated in italics at the end of the section.

The purpose of this ordinance is to establish minimum stormwater management requirements and controls to protect and safeguard the general health, safety, and welfare of the public residing in watersheds within the [**JURISDICTION**]. This ordinance seeks to meet that purpose through the following objectives:

(1) To inhibit the deterioration of water resources resulting from development.
(2) To protect the safety and welfare of citizens, property owners, and businesses by minimizing the negative impacts of increased stormwater discharges from new land development and redevelopment.
(3) To control the rate, quality and volume of stormwater originating from development and redevelopment sites so that surface water and groundwater are protected and flooding and erosion potential are not increased.
(4) To control nonpoint source pollution and stream channel erosion.
(5) To maintain the integrity of stream channels and networks for their biological functions, drainage, and natural recharge of groundwater.
(6) To protect the condition of state (and U.S.) waters for all reasonable public uses and ecological functions.
(7) To provide long-term responsibility for and maintenance of stormwater BMPs.
(8) To facilitate the integration of stormwater management and pollution control with other ordinances, programs, policies, and the comprehensive plan of [**JURISDICTION**].
(9) To establish legal authority to carry out all the inspection and monitoring procedures necessary to ensure compliance with this ordinance.

Specific to the MS4

(1) To regulate the contribution of pollutants to the MS4 by stormwater discharges from development, redevelopment.
*(2) To enable [**JURISDICTION**] to comply with the National Pollution Discharge Elimination System permit and applicable federal and state regulations.*
*(3) To facilitate compliance with state and federal standards and permits by owners of construction sites, developments, and permanent stormwater BMPs with [**JURISDICTION**].*

Other Special Resources

- *To preserve the natural infiltration of groundwater to maintain the quantity and quality of groundwater resources.*
- *To protect against and minimize the pollution of public drinking water supplies resulting from development and redevelopment.*
- *Impaired Waters*
- *Lakes*
- *Cold-Water Fisheries*
- *Coastal Areas*
- *Wetlands*

1.3. Applicability

Applicability

- The Applicability section establishes the "mesh size" for the post-construction ordinance; that is, the site size or site characteristics that trigger application of the post-construction standards.
- Applicability can be based on site impervious cover, a land disturbance threshold, overall site size, number of lots, and/or the type of development (e.g., hotspots).
- The most common threshold is 1-acre disturbed. The advantage of this threshold is that it is consistent with the NPDES threshold for construction sites. However, impervious cover may be a more precise trigger for a post-construction ordinance.
- The following table outlines choices for the applicability section based on program sophistication. **Choices should be substituted for the area size in brackets in the ordinance language.**

Table 1. Applicability Choices Based on Program Sophistication

Increasing Program Sophistication →		
1 acre or more of land disturbance	• 5,000 square feet or more of new impervious cover • 5,000 square feet or more of impervious cover created, added or replaced for redevelopment AND • Any new development or redevelopment, regardless of size, that is identified by the **[STORMWATER AUTHORITY]** to be an area where the land use has the potential to generate highly contaminated runoff	• 2,500 square feet of new impervious cover • Any redevelopment OR • All land development and redevelopment activities

- Some local ordinances will have a variable trigger for new development versus redevelopment, especially if redevelopment is a critical component to an overall land use policy that encourages infill.
- The "Applicability" section must be clear in its terminology. It is important to define and be consistent with terms such as "land disturbing activity," "development," "land development," or "agricultural land uses." These terms should be provided in the definitions section and should also be used consistently with applicable state regulations.

This ordinance shall be applicable to all land development, including, but not limited to, site plan applications, subdivision applications, and grading applications, unless exempt pursuant to Section 1.4. These provisions apply to any new development or redevelopment site within [**JURISDICTION**] that meets one or more of the following criteria:

(1) Land development that creates [**FIVE-THOUSAND (5,000) SQUARE FEET OR MORE**] of impervious cover.

(2) Redevelopment that creates, adds, or replaces **[FIVE-THOUSAND (5,000) SQUARE FEET OR MORE]** of impervious cover.

(3) Land development activities that are smaller than the minimum applicability criteria set forth above if such activities are part of a larger common plan of development, even though multiple, separate and distinct land development activities may take place at different times on different schedules.

1.4. Exemptions

Exemptions

- The most important consideration in the Exemptions section is to catch land uses activities that should be regulated. Exemptions can easily turn into loopholes if the ordinance language is not precise.
- There is some debate about some exemptions, such as state and federal projects (that may also be subject to other regulatory requirements) and temporary projects, such as road and utility maintenance.
- Exemption 3b is provided as an incentive for conservation plans.

The following activities are exempt from this ordinance:

(1) Individual single-family or duplex residential lots that are not part of a subdivision or phased development project that is otherwise subject to this ordinance.

(2) Additions or modifications to existing single-family or duplex residential structures.

(3a) Projects that are exclusively for agricultural and silvicultural uses. Agricultural or silvicultural roads that are used to access other land uses subject to this ordinance are not exempt. Agricultural structures that are also used for other uses subject to this ordinance are not exempt.
OR
*(3b) Any agricultural or silvicultural activity that is conducted according to an approved farm conservation plan or timber management plan prepared or approved by [**APPROPRIATE STATE AGENCIES**].*

(4) Maintenance and repair to any stormwater BMP deemed necessary by the [**STORMWATER AUTHORITY**].

(5) Any emergency project that is immediately necessary for the protection of life, property, or natural resources.

(6) Linear construction projects, such as pipeline or utility line installation, that do not result in the installation of any impervious cover, as determined by the

[STORMWATER AUTHORITY]. Such projects must be designed to minimize the number of stream crossings and width of disturbance, and are subject to **[APPLICABLE CONSTRUCTION STORMWATER OR EROSION & SEDIMENT CONTROL ORDINANCE].**

(7) Any part of a land development that was approved by **[JURISDICTION'S PLAN APPROVING AUTHORITY]** prior to the effective date of this ordinance.

Legal Authority, Compatibility, Severability, Liability, Designation of Stormwater Authority Sections

- These Administrative sections appear in some, but not all, ordinances for various legal reasons.
- Check with legal staff to determine the applicability of these sections to your situation.

1.5. Legal Authority

This ordinance is adopted pursuant to authority conferred by and in accordance with **[APPLICABLE STATE AND/OR FEDERAL REGULATIONS].**

1.6. Compatibility with Other Permit and Ordinance Requirements

This ordinance is not intended to interfere with, abrogate, or annul any other ordinance, rule or regulation, stature, or other provision of law. The requirements of this ordinance should be considered minimum requirements, and where any provision of this ordinance imposes restrictions different from those imposed by any other ordinance, rule or regulation, or other provision of law, whichever provisions are more restrictive or impose higher protective standards for human health or the environment shall be considered to take precedence.

1.7. Severability

If the provisions of any article, section, subsection, paragraph, subdivision or clause of this ordinance shall be judged invalid by a court of competent jurisdiction, such order of judgment shall not affect or invalidate the remainder of any article, section, subsection, paragraph, subdivision or clause of this ordinance.

1.8. Liability

Any person who undertakes or causes to be undertaken any land development shall ensure that soil erosion, sedimentation, increased pollutant loads and changed water flow characteristics resulting from the activity are controlled so as to minimize pollution of receiving waters. The requirements of this ordinance are minimum standards and a person's compliance with the same shall not relieve such person from the duty of enacting all measures necessary to minimize pollution of receiving waters.

By approving a plan under this regulation, [**JURISDICTION**] does not accept responsibility for the design, installation, and operation and maintenance of stormwater BMPs.

1.9. Designation of Stormwater Authority: Powers and Duties

*The [**STORMWATER AUTHORITY**] shall administer and enforce this ordinance, and may furnish additional policy, criteria and information including specifications and standards, for the proper implementation of the requirements of this ordinance and may provide such information in the form of a Stormwater Design Manual.*

*The Stormwater Design Manual may be updated and expanded from time to time, at the discretion of the [**STORMWATER AUTHORITY**], based on improvements in engineering, science, monitoring and local maintenance experience.*

Representatives of the [**STORMWATER AUTHORITY**] shall have the right to enter upon any land for the purposes of making an inspection or acquiring information to determine whether or not the property conforms to the requirements of this ordinance.

Section 2. Definitions

Definitions
Ensure that terms are defined consistently across other related guidance and regulatory documents.

"Applicant" means a property owner or agent of a property owner who has filed an application for a stormwater management permit.

"Building" means any structure, either temporary or permanent, having walls and a roof, designed for the shelter of any person, animal, or property, and occupying more than 100 square feet of area.

"Channel" means a natural or artificial watercourse with a definite bed and banks that conducts continuously or periodically flowing water.

"Dedication" means the deliberate appropriation of property by its owner for general public use.

"Detention" means the temporary storage of storm runoff in a stormwater BMP with the goals of controlling peak discharge rates and providing gravity settling of pollutants.

"Easement" means a legal right granted by a landowner to a grantee allowing the use of private land for conveyance or treatment of stormwater runoff and access to stormwater practices.

"Erosion and Sediment Control Plan" means a plan that is designed to minimize the accelerated erosion and sediment runoff at a site during construction activities.

"Fee in Lieu Contribution" means a payment of money in place of meeting all or part of the stormwater performance standards required by this ordinance.

"Groundwater Management Area" means a geographically defined area that may be particularly sensitive in terms of groundwater quantity and/or quality by nature of the use or movement of groundwater, or the relationship between groundwater and surface water, and where special management measures are deemed necessary to protect groundwater and surface water resources.

"Groundwater Recharge Volume (Rev)" – The portion of the water quality volume (WQv) used to maintain groundwater recharge rates at development sites.

"Impaired Waters" means those streams, rivers and lakes that currently do not meet their designated use classification and associated water quality standards under the Clean Water Act.

"Impervious Cover" means those surfaces that cannot effectively infiltrate rainfall (e.g., building rooftops, pavement, sidewalks, driveways, etc).

"Industrial Stormwater Permit" means a National Pollutant Discharge Elimination System permit issued to a commercial industry or group of industries that regulates the pollutant levels associated with industrial stormwater discharges or specifies on-site pollution control strategies.

"Infill Development" means land development that occurs within designated areas based on local land use, watershed, and/or utility plans where the surrounding area is generally developed, and where the site or area is either vacant or has previously been used for another purpose.

"Infiltration" means the process of percolating stormwater into the subsoil.

"Infiltration Facility" means any structure or device designed to infiltrate retained water to the subsurface. These facilities may be above grade or below grade.

"Jurisdictional Wetland" means an area that is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation.

"Land Development" means a human-made change to, or construction on, the land surface that changes its runoff characteristics.

"Land Disturbing Activity" means any activity that changes the volume or peak flow discharge rate of rainfall runoff from the land surface. This may include the grading, digging, cutting, scraping, or excavating of soil, placement of fill materials, paving, construction, substantial removal of vegetation, or any activity that bares soil or rock or involves the diversion or piping of any natural or man-made watercourse.

"Landowner" means the legal or beneficial owner of land, including those holding the right to purchase or lease the land, or any other person holding proprietary rights in the land.

"Maintenance Agreement" means a legally recorded document that acts as a property deed restriction, and that provides for long-term maintenance of stormwater BMPs. "Municipal Separate Storm Sewer System (MS4)" means publicly-owned facilities by which stormwater is collected and/or conveyed, including but not limited to any roads with drainage systems, municipal streets, gutters, curbs, catch basins, inlets, piped storm drains, pumping facilities, retention and detention basins, natural and human-made or altered drainage ditches/channels, reservoirs, and other drainage structures.

"National Pollutant Discharge Elimination System (NPDES) Stormwater Discharge Permit" means a permit issued by the EPA, or by a State under authority delegated pursuant to 33 USC § 1342(b), that authorizes the discharge of pollutants to waters of the State, whether the permit is applicable on an individual, group, or general area-wide basis.

"Non-Stormwater Discharge" means any discharge to the storm drain system that is not composed entirely of stormwater.

"Non-Structural Measure" means a stormwater control and treatment technique that uses natural processes, restoration or enhancement of natural systems, or design approaches to control runoff and/or reduce pollutant levels. Such measures are used in lieu of or to supplement structural practices on a land development site. Non-structural measures include, but are not limited to: minimization and/or disconnection of impervious surfaces; development design that reduces the rate and volume of runoff; restoration or enhancement of natural areas such as riparian areas, wetlands, and forests; and on-lot practices such as rain barrels, cisterns, and vegetated areas that intercept roof and driveway runoff.

"Nonpoint Source Pollution" means pollution from any source other than from any discernible, confined, and discrete conveyances, and shall include, but not be limited to, pollutants from agricultural, silvicultural, mining, construction, subsurface disposal and urban runoff sources.

"Off-Site Facility" means a stormwater BMP located outside the subject property boundary described in the permit application for land development activity.

"On-Site Facility" means a stormwater BMP located within the subject property boundary described in the permit application for land development activity.

"Owner" means the owner or owners of the freehold of the premises or lesser estate therein, a mortgagee or vendee in possession, assignee of rents, receiver, executor, trustee, lessee or other person, firm or corporation in control of a piece of land. As used herein, owner also refers to, in the appropriate context: (i) any other person authorized to act as the agent for the owner; (ii) any person who submits a stormwater management concept or design plan for approval or requests issuance of a permit, when required, authorizing land development to commence; and (iii) any person responsible for complying with an approved stormwater management design plan.

"Permanent Stormwater BMP" means a stormwater best management practice (BMP) that will be operational after the construction phase of a project and that is designed to become a permanent part of the site for the purposes of managing stormwater runoff. "Private Inspector" means an independent agency or private entity that is retained by the applicant to conduct inspections and submit documentation to the [**STORMWATER AUTHORITY**] in accordance with this ordinance, and that is certified by the [**STORMWATER AUTHORITY**] to conduct such inspections.

"Pro-Rata Share" means the proportional amount to be paid by an applicant to contribute to the construction of a regional stormwater BMP, as determined by the [**STORMWATER AUTHORITY**].

"Receiving Stream or Channel" means the body of water or conveyance into which stormwater runoff is discharged.

"Recharge" means the replenishment of underground water reserves.

"Redevelopment" means a change to previously existing, improved property, including but not limited to the demolition or building of structures, filling, grading, paving, or excavating, but excluding ordinary maintenance activities, remodeling of buildings on the existing footprint, resurfacing of paved areas, and exterior changes or improvements that do not materially increase or concentrate stormwater runoff or cause additional nonpoint source pollution.

"Regional Stormwater" means stormwater BMPs designed to control stormwater runoff from multiple properties or a particular land use district, and where the owners or developers of the individual properties may participate in the provision of land, financing, design, construction, and/or maintenance of the facility.

"Responsible Party" means any individual, partnership, co-partnership, firm, company, corporation, association, joint stock company, trust, estate, governmental entity, or any other legal entity; or their legal representatives, agents, or assigns that is named on a stormwater maintenance agreement as responsible for long-term operation and maintenance of one or more stormwater BMPs.

"Stop Work Order" means an order issued that requires that all construction activity on a site be stopped.

"Stormwater Authority" means the department or agency, and its authorized agents, which is responsible for coordinating the review, approval, and permit process as defined by this ordinance.

"Stormwater Design Manual" means an engineering and/or project review document maintained by the **[STORMWATER AUTHORITY**] containing technical standards and specifications, policies, procedures, and other materials deemed appropriate by [**STORMWATER AUTHORITY**] to assist with compliance with the provisions of this ordinance.

"Stormwater Hotspot" means an area where land use or activities generate highly contaminated runoff, with concentrations of pollutants in excess of those typically found in stormwater.

"Stormwater Management" means the use of structural or non-structural practices that are designed to reduce stormwater runoff pollutant loads, discharge volumes, peak flow discharge rates and detrimental changes in stream temperature that affect water quality and habitat.

"Stormwater Pollution Prevention Plan" means a plan, usually required by a permit, to manage stormwater associated with industrial, commercial, institutional, or other land use activities, including construction. The Plan commonly describes and ensures the implementation of practices that are to be used to reduce pollutants in stormwater and non-stormwater discharges.

"Stormwater Best Management Practice (BMP)" means a measure, either structural or nonstructural, that is determined to be the most effective, practical means of preventing or reducing point source or nonpoint source pollution inputs to stormwater runoff and water bodies.

"Stormwater Retrofit" means a stormwater BMP designed for an existing development site that previously had either no stormwater BMP in place or a practice inadequate to meet the stormwater management requirements of the site.

"Stormwater Runoff" means flow on the surface of the ground, resulting from precipitation.

"Stream Buffer" means an area of land at or near a streambank, wetland, or waterbody that has intrinsic water quality value due to the ecological and biological processes it performs or is otherwise sensitive to changes which may result in significant degradation to water quality.

"Water Quality Volume (WQv)" means the storage needed to capture and treat 90% of the average annual stormwater runoff volume. Numerically (WQv) will vary as a function of long term rainfall statistical data.

"Watercourse" means a permanent or intermittent stream or other body of water, either natural or man-made, which gathers or carries surface water.

"Watershed or Subwatershed Management Plan" means a document, usually developed cooperatively by government agencies and other stakeholders, to protect, restore, and/or otherwise manage the water resources within a particular watershed or subwatershed. The plan commonly identifies threats, sources of impairment, institutional issues, and technical and programmatic solutions or projects to protect and/or restore water resources.

"Wetland Hydroperiod" means the pattern of fluctuating water levels within a wetland caused by the complex interaction of flow, topography, soils, geology, and groundwater conditions in the wetland.

Section 3. Permit Procedures and Requirements

Permit Procedures & Requirements

- This section outlines the requirements for plans to be submitted, the schedule for review, and general conditions for approval.
- Plan approval can be a locality's last chance to influence several important issues, such as ensuring long-term access to stormwater BMPs and assigning maintenance responsibility.
- The ordinance should establish the plan approval process as a mechanism to secure needed documents for the long-term viability of a site's stormwater BMPs.

3.1. Stormwater Management Concept Plan and Consultation Meeting

*Each owner subject to this ordinance shall submit to the [**STORMWATER AUTHORITY**] for review and approval a stormwater management concept plan as provided herein:*

*(1) **Stormwater Management Concept Plan:** All preliminary plans of subdivision and site plans shall provide a stormwater management concept plan describing, in general, how stormwater runoff through and from the development will be treated and conveyed. The concept plan shall also identify important natural features identified though a Natural Resources Inventory conducted in accordance with Section 4.1(17). All other land development projects subject to this ordinance shall submit a stormwater management concept plan prior to preparation of the stormwater management design plan.*

*(2) **Application Requirements:** The stormwater management concept plan submittal shall contain a completed application form provided by the [STORMWATER AUTHORITY], the fee required by Section 3.10, and a stormwater management concept plan that satisfies the requirements of this section and the Stormwater Design Manual.*

*(3) **Concept Plan Prior to Design Plan**: The stormwater management concept plan must be approved prior to submission of a stormwater management design plan (as part of the construction or final site plan) for the entire development, or portions thereof.*

*(4) **Meetings with [STORMWATER AUTHORITY]:** All applicants are encouraged to hold a pre-submittal consultation meeting with the [**STORMWATER AUTHORITY**] to discuss potential approaches for stormwater design and opportunities to use design techniques to reduce runoff rates, volumes, and pollutant loads. In addition, the applicant or his representative shall meet on-site with a designee of the [**STORMWATER AUTHORITY**] prior to approval of the stormwater management concept plan for the purposes of verifying the conditions of the site and all receiving channels.*

(5) ***Maximize Use of Techniques to Reduce Runoff by Design:*** *The stormwater management concept plan shall utilize to the maximum extent practicable site planning and design technique that reduce runoff rates, volumes, and pollutant loads. Such techniques include, but are not limited to, minimization and/or disconnection of impervious surfaces; development design that reduces the rate and volume of runoff; restoration or enhancement of natural areas such as riparian areas, wetlands, and forests; and distributed practices that intercept and treat runoff from developed areas.*

3.2. Stormwater Management Design Plan

Each owner subject to this ordinance shall submit to the [**STORMWATER AUTHORITY**] for review and approval a stormwater management design plan as provided herein:

Stormwater Management Design Plan: A stormwater management design plan containing all appropriate information as specified in this Ordinance shall be submitted to the [**STORMWATER AUTHORITY**] in conjunction with the final subdivision plat, final site plan, construction plan, or any other land development plan subject to this ordinance.

Application Requirements: The stormwater management design plan submittal shall contain a completed application form provided by the [**STORMWATER AUTHORITY**], the fee required by Section 3.10, a stormwater management design plan that satisfies the requirements of this section and the Stormwater Design Manual, a stormwater maintenance plan, and a certification stating that all requirements of the approved plan will be complied with. Failure of the owner to demonstrate that the project meets these requirements, as determined by the [**STORMWATER AUTHORITY**], shall be reason to deny approval of the plan.

Consistency between Concept & Design Plans: A copy of the approved stormwater management concept plan shall be submitted with the stormwater management design plan. The [**STORMWATER AUTHORITY**] shall check the design plan for consistency with the concept plan and may require a revised stormwater management concept plan if changes in the site development proposal have been made.

Stormwater Management Design Plan Content: The stormwater management design plan shall contain maps, charts, graphs, tables, photographs, narrative descriptions, explanations, citations to supporting references, a record of all major permit decisions, and other information as may be necessary for a complete review of the plan, and as specified in the latest version of the Stormwater Design Manual.

3.3. Stormwater Management Design Plan: Review Procedures

Preliminary Review for Completeness of Plan: The [**STORMWATER AUTHORITY**] shall have a maximum of ten (10) calendar days from the receipt of an application for preliminary review to determine if the application is complete. During this period, the application will be accepted for review, which will begin the thirty (30) day review period, or rejected for incompleteness. The applicant will be informed in writing of the information necessary to complete the application.

Review Period: The thirty (30) day review period begins on the day the complete stormwater management design plan is accepted for review by the [**STORMWATER AUTHORITY**]. During the thirty (30) day review period, the [**STORMWATER AUTHORITY**] shall either approve or disapprove the plan and communicate the decision to the applicant in writing. Approval or denial shall be based on the plan's compliance with this Ordinance and the Stormwater Design Manual.

Modifications Needed for Approval: In cases where modifications are required to approve the plan, the [**STORMWATER AUTHORITY**] shall have an additional thirty (30) days to review the revised plan from the initial and any subsequent resubmission dates. If the plan is approved, one copy bearing certification of such approval shall be returned to the applicant. If the plan is disapproved, the applicant shall be notified in writing of the reasons.

Appeal Decisions of [STORMWATER AUTHORITY]: The applicant or any aggrieved party authorized by law may appeal the [**STORMWATER AUTHORITY'S**] decision of approval or disapproval of a stormwater management design plan. The appeal shall be made to the [**GOVERNING BOARD OF JURISDICTION**], must be in writing, and must be submitted within thirty (30) days after the [**STORMWATER AUTHORITY**] renders its decision to approve or disapprove the plan.

Substantive Changes to Plan: No substantive changes shall be made to an approved plan without review and written approval by the [**STORMWATER AUTHORITY**]. The [**STORMWATER AUTHORITY**] may request additional data with a plan amendment as may be necessary for a complete review of the plan and to ensure that changes to the plan will comply with the requirements of this ordinance.

Expiration of Plan Approval: The stormwater management design plan's approval expires in one year from the date of approval unless a final plat is recorded or unless work has actually begun on the site. The recordation of a final plat for a section of a subdivision (or initiation of construction in a section) does not vest the approval of the stormwater management design plan for the remainder of the subdivision. If the stormwater management design plan expires, the applicant shall file with the [**STORMWATER AUTHORITY**] for reapproval of the stormwater management design plan.

3.4. Plan Preparation and Certification

(1) **Certification by Plan Preparer:** The stormwater management design plan shall be prepared by a licensed landscape architect, certified professional surveyor, or professional engineer and must be signed by the professional preparing the plan, who shall certify that the design of all stormwater BMPs meet the requirements in this local law.

(2) **Certification by Owner:** The owner shall certify that all land clearing, construction, land development and drainage will be done according to the approved plan.

3.5. Coordination with Other Approvals and Permits

*(1) **Approval of Other Permits:** No grading or building permit shall be issued for land development without approval of a stormwater management design plan.*

*(2) **Coordination with Other Plans:** Approval of the stormwater management design plan shall be coordinated by the [**STORMWATER AUTHORITY**] with approval of an erosion and sediment control or construction stormwater plan with regard to the location, schedule, and/or phasing for temporary and permanent stormwater management measures. If natural drainage features or other natural areas are to be preserved, then these areas must be shown and measures provided for their protection on both the erosion and sediment control plan and the stormwater management design plan. If other elements of the stormwater management design plan utilize soils, vegetation, or other natural features for infiltration or treatment, then these areas must be shown on the erosion and sediment control plan and measures provided for their protection during construction*

*(3) **Other Permits or Approvals May Be Needed:** Approvals issued in accordance with this ordinance do not relieve the applicant of responsibility for obtaining all other necessary permits and/or approvals from other federal, state, and/or local agencies. If requirements vary, the most restrictive shall prevail. These permits may include, but are not limited to: construction stormwater discharge permits, applicable state and federal permits for stream and wetland impacts, and applicable dam safety permits. Applicants are required to show proof of compliance with these regulations before the [**JURISDICTION'S PLAN APPROVING AUTHORITY**] will issue a grading, building, or zoning permit.*

*(4) **Stormwater Measures within Flood Plain:** Construction of stormwater measures or facilities within a Federal Emergency Management Agency (FEMA) designated floodplain shall be avoided to the extent possible. When this is unavoidable, all stormwater BMP construction shall be in compliance with all applicable requirements of the [**JURISDICTION'S FLOOD PLAIN CODE**].*

3.6. Maintenance Agreement and Plan

Maintenance Agreement and Plan
This section is intended to ensure long-term maintenance. The approval and review procedures should include the following:

- Ensure maintenance agreements are recorded.
- Ensure the easements for maintenance and access are platted.
- Establish maintenance inspection and reporting requirements.

Prior to approval by the [**STORMWATER AUTHORITY**] of a stormwater management design plan, each owner shall submit a maintenance agreement and maintenance plan in accordance with the following:

(1) **Responsible Party:** The owner shall be responsible for the operation and maintenance of such measures and shall pass such responsibility to any successor owner, unless such responsibility is transferred to [**JURISDICTION**] or to another governmental entity in accordance with Section 3.12.

(2) **Requirement for Maintenance Agreement & Plan:** If a stormwater management design plan requires structural or nonstructural measures, the owner shall execute a stormwater maintenance agreement prior to the [**STORMWATER AUTHORITY**] granting final approval for the plan, or any plan of development or other development for which a permit is required under this Ordinance. The agreement shall be recorded in the office of the clerk of the circuit court for [**JURISDICTION**] and shall run with the land.

(3) **Required Elements for Maintenance Agreement & Plan:** The stormwater maintenance agreement shall be in a form approved by [**JURISDICTION**], and shall, at a minimum:

(a) **Designate Responsible Party:** Designate for the land development the owner, governmental agency, or other legally established entity (responsible party) which shall be permanently responsible for maintenance of the structural or non-structural measures required by the plan.

(b) **Pass Responsibility to Successors:** Pass the responsibility for such maintenance to successors in title.

(c) **Right of Entry for Stormwater Authority**: Grant the [**STORMWATER AUTHORITY**] and its representatives the right of entry for the purposes of inspecting all stormwater BMPs at reasonable times and in a reasonable manner. This includes the right to enter a property when the [**STORMWATER AUTHORITY**] has a reasonable basis to believe that a violation of this Ordinance is occurring or has occurred and to enter when necessary for abatement of a public nuisance or correction of a violation of this Ordinance.

(d) ***Maintenance Plan:*** *Ensure the continued performance of the maintenance obligations required by the plan and this ordinance through a maintenance plan (which may be an attachment to the actual maintenance agreement). The plan shall include a list of inspection and maintenance tasks, a schedule for routine inspection and maintenance, actions to be taken when maintenance is required, and other items listed in the Stormwater Design Manual.*

3.7. Easements

Storm drainage easements shall be required where the conveyance, storage, or treatment of stormwater is identified on the stormwater management design plan, or where access is needed to structural or non-structural stormwater measures.

The following conditions shall apply to all easements:

(1) Dimensions: Easements shall be of a width and location specified in the Stormwater Design Manual.

(2) Easements Approved Before Plat Approval: Easements shall be approved by the [JURISDICTION'S PLAN APPROVING AUTHORITY] prior to approval of a final plat and shall be recorded with the [JURISDICTION] and on all property deeds.

(3) Deeds of Easement: A deed of easement shall be recorded along with the final plat specifying the rights and responsibilities of each party to the easement.

3.8. Performance Bond or Guarantee

(1) ***Performance Bond or Guarantee Required:*** *No permits shall be issued unless the applicant furnishes a performance bond or guarantee. This is to ensure that action can be taken by [**JURISDICTION**], at the applicant's expense, should the applicant fail to initiate or maintain those measures identified in the approved stormwater management design plan (after being given proper notice and within the time specified by the [**STORMWATER AUTHORITY**]). If [**JURISDICTION**] takes such action upon such failure by the applicant, [**JURISDICTION**] shall collect from the applicant the difference should the amount of reasonable cost of such action exceed the amount of the security held.*

(2) ***Term of Performance Bond or Guarantee:*** *The performance bond or guarantee furnished pursuant to this section, or the unexpended or unobligated portion thereof, shall be returned to the applicant within sixty (60) days of issuance by the [**STORMWATER AUTHORITY**] of a Stormwater Certificate of Completion in accordance with Section 5, OR the final acceptance of the permanent stormwater BMP by the [**STORMWATER AUTHORITY**].*

(3) ***Term Extended for Initial Maintenance****: At the discretion of the [**STORMWATER AUTHORITY**], the performance bond or guarantee may be extended beyond the time period specified above to cover a reasonable period of time for testing the practices during storm events and for initial maintenance activities. For the purposes of this section, the time shall not exceed 2 years.*

(4) ***Partial Release of Bond:*** *The [**STORMWATER AUTHORITY**] shall have the discretion to adopt provisions for a partial pro-rata release of the performance bond or guarantee on the completion of various stages or phases of development.*

3.9. As-Built Plans

*All applicants are required to submit as-built plans for any permanent stormwater management facilities located on-site after final construction is completed. The plan must show the final design specifications for all stormwater management facilities, meet the criteria for as-built plans in the Stormwater Design Manual, and be sealed by a registered professional engineer. A final inspection by the [**STORMWATER AUTHORITY**] is required before any performance bond or guarantee will be released.*

3.10. Fees

Fees

- The jurisdiction should insert the applicable fee schedule in **Section 3.10**.
- If a local program does not currently charge fees for plan review, waivers, and inspections, then it should consider fees as a possible revenue source for the program.

The [**STORMWATER AUTHORITY**] has the ability to require a fee to support local plan review, inspection and program administration. Each owner seeking approval of a stormwater management concept plan or stormwater management design plan shall pay a fee upon submittal of such plan, and shall pay a fee for each inspection, in amounts according to the schedule set forth below.

(1) Stormwater Management Concept Plan: $
(2) Stormwater Management Design Plan: $
(3) Amendment to a Stormwater Management Concept or Design Plan: $
(4) Request for a Waiver: $
(5) Each Inspection: $

3.11. Fee-In-Lieu Payment

The [**STORMWATER AUTHORITY**] may maintain a Fee-In-Lieu and/or Pro-Rata Share program in accordance with an approved watershed or subwatershed plan or

stormwater master plan. Such a program shall follow the general conditions of **Section 4.9.**

3.12. Dedication of Stormwater BMPs

The owner of a stormwater practice required by this Ordinance may offer for dedication any such stormwater practice, together with such easements and appurtenances as may be reasonably necessary, as provided herein:

(1) **Preliminary Determination by [STORMWATER AUTHORITY]**: Upon receipt of such offer of dedication by [**JURISDICTION**], the [**STORMWATER AUTHORITY**] shall make a preliminary determination that the dedication of the practice is appropriate to protect the public health, safety and general welfare, and furthers the goals of [**JURISDICTION'S**] stormwater management program and/or associated watershed plans. The [**STORMWATER AUTHORITY**] shall forward its determination to [**GOVERNING BOARD OF JURISDICTION**]. Prior to making its determination, the [**STORMWATER AUTHORITY**] shall inspect the practice to determine whether it has been properly maintained and is in good repair.

(2) **Acceptance by [GOVERNING BOARD]:** [**GOVERNING BOARD OF JURISDICTION**] may accept the offer of dedication by adoption of a resolution. The document dedicating the stormwater BMP shall be recorded in the office of the clerk of the circuit court for the [**JURISDICTION**].

(3) **Owner to Provide Documentation**: The owner, at his sole expense, shall provide any document or information requested by the [**STORMWATER AUTHORITY**] or the [**GOVERNING BOARD OF JURISDICTION**] in order for a decision to be reached on accepting the practice.

Section 4. Post-Construction Performance Criteria for Stormwater Management

Post-Construction Criteria

- Criteria are the core of the stormwater ordinance. They establish the design objectives for stormwater BMPs, and will influence the types and sizes of these practices.
- Criteria in the ordinance should remain fairly simple, with technical detail relegated to the design manual.

4.1. General Post-Construction Stormwater Management Criteria

(1) **Stormwater BMP Maintenance:** All stormwater BMPs shall be maintained in accordance with the approved and deeded stormwater maintenance agreement and stormwater maintenance plan. The design of stormwater facilities shall incorporate maintenance accommodation and long-term maintenance reduction features in accordance with the latest version of the Stormwater Design Manual.

(2) **Overland Flood Routes:** Overland flood routing paths shall be used to convey stormwater runoff from the 100-year, 24-hour storm event to an adequate receiving water resource or stormwater BMP such that the runoff is contained within the drainage easement for the flood routing path and does not cause flooding of buildings or related structures. The peak 100-year water surface elevation along flood routing paths shall be at least one foot below the finished grade elevation at the structure. When designing the flood routing paths, the conveyance capacity of the site's storm sewers shall be taken into consideration.

(3) **Velocity Dissipation:** Velocity dissipation devices shall be placed at discharge locations and along the length of any outfall to provide non-erosive flow velocity from the structure to an adequate receiving stream or channel so that the natural physical and biological characteristics and functions of the receiving stream are maintained and protected.

(4) **Discharges to Adjacent Property:** Concentrated discharges from land development, including from stormwater practices, shall not be discharged onto adjacent developed property without adequate conveyance in a natural stream or storm sewer system. The [STORMWATER AUTHORITY] may require drainage easements where stormwater discharges must cross an adjacent or off-site property before reaching an adequate conveyance.

(5) **Individual Lots Not Separate Land Development:** Residential, commercial or industrial developments shall apply these stormwater management criteria to land development as a whole. Individual residential lots in new subdivisions shall not be

considered separate land development projects, but rather the entire subdivision shall be considered a single land development project.

(6) **Location of Stormwater Facilities on Lots:** Stormwater facilities within residential subdivisions that serve multiple lots and/or a combination of lots and roadways shall be on a lot owned and maintained by an entity of common ownership, unless an alternative arrangement is approved by the [STORMWATER AUTHORITY]. Stormwater practices located on individual lots shall be maintained by the lot owner, or, at the discretion of the [STORMWATER AUTHORITY], be placed within an easement and maintained by an entity of common ownership.

(7) **Hydrologic Computation Assumptions:** Hydrologic parameters shall reflect the ultimate land development and shall be used in all engineering calculations. All pre-development calculations shall consider woods and fields to be in good condition, regardless of actual conditions at the time of application.

(8) **Authorization to Discharge to MS4:** If runoff from a land development will flow to a municipal separate storm sewer system (MS4) or other publicly-owned storm sewer system, then the applicant shall obtain authorization from the system's owner to discharge into the system. The [**STORMWATER AUTHORITY**] may require the applicant to demonstrate that the system has adequate capacity for any increases in peak flow rates and volumes.

(9) **Compliance with Federal & State Regulations:** All stormwater facilities and conveyance systems shall be designed in compliance with all applicable state and federal laws and regulations, including the Federal Clean Water Act and all applicable erosion and sediment control and flood plain regulations. To the extent practical, stormwater facilities shall not be located in areas determined to be jurisdictional waters through Section 404 of the Federal Clean Water Act and/or applicable state regulations.

(10) **Protect Public Health, Safety & General Welfare:** The design of stormwater BMPs shall consider public health, safety, and general welfare. These considerations include, but are not limited to: preventing flooding of structures and travelways; preventing standing water in facilities, manholes, inlets, and other structures in a manner that promotes breeding of mosquitoes; preventing attractive nuisance conditions and dangerous conditions due to velocity or depth of water and/or access to orifices and drops; and preventing aesthetic nuisances due to excessive slopes, cuts and fills, and other conditions.

*(11) **Adherence to Stormwater Design Manual:** All stormwater BMPs shall be designed to the standards of the most current version of the Stormwater Design Manual, unless the [**STORMWATER AUTHORITY**] grants the applicant a waiver or the applicant is exempt from such requirements.*

(12) ***Treat Entire Land Development:*** *The stormwater design shall provide for treatment of runoff from the entire land development, to the extent practical.*

(13) ***Landscape Plan:*** *The design of stormwater BMPs shall include a landscape plan detailing both the vegetation to be in the practice and how and who will manage and maintain the vegetation. The landscape plan shall be prepared in accordance with the Stormwater Design Manual.*

(14) ***Pretreatment:*** *Each stormwater BMP shall have an acceptable form of water quality pretreatment, in accordance with the pretreatment requirements found in the current Stormwater Design Manual.*

(15) ***Stormwater Authority Discretion:*** *If hydrologic, geologic, topographic, or land use conditions warrant greater control than that provided by the minimum control requirements, the [**STORMWATER AUTHORITY**] may impose additional requirements deemed reasonable and necessary to control the volume, timing, rate and/or quality of runoff. The [**STORMWATER AUTHORITY**] may restrict the use of certain stormwater BMPs, require pretreatment above the minimum standards in the Stormwater Design Manual, and/or require a stormwater pollution prevention plan in certain circumstances. These include, but are not limited to: stormwater generated from stormwater hotspots, stormwater discharges that are conveyed with non-stormwater discharges, and stormwater discharged in important groundwater management areas or areas where geologic conditions are conducive to groundwater contamination (e.g., karst).*

(16) ***Replicating Pre-Development Hydrology:*** *Stormwater management designs shall preserve the natural hydrologic functions, stream channel characteristics, and groundwater recharge of the pre-developed site, to the extent practical. This shall be accomplished by treating runoff at the source, disconnecting impervious surfaces, preserving or enhancing natural flow paths and vegetative cover, preserving or enhancing natural open spaces and riparian areas, and other measures that replicate pre-development hydrologic conditions. The [**STORMWATER AUTHORITY**] shall exercise discretion in the application of this standard, especially in cases of infill development, redevelopment, or other unique circumstances.*

(17) ***Natural Resources Inventory:*** *Stormwater management designs shall include an inventory of important natural resources features on the site, and these features shall be shown on the Stormwater Management Concept Plan that may be prepared in accordance with Section 3.1. Protection and/or conservation of the site's natural features may, at the discretion of the [**STORMWATER AUTHORITY**], be used and given credit as "Non-Structural Measures" in accordance with Section 4.8. The natural resources inventory shall include, but not be limited to the following: natural drainage features, riparian buffers, wetlands, steep slopes, soils with high infiltration capacity, significant forest or prairie patches, and significant trees and natural communities.*

(18) ***Treatment of Off-Site Stormwater:*** *Off-site stormwater conveyed through a land development shall be placed within an easement and conveyed in a manner that does not increase upstream or downstream flooding. Off-site stormwater shall be conveyed around on-site stormwater BMPs, unless the facilities are designed to manage the off-site stormwater. The [**STORMWATER AUTHORIT**Y] may allow credits for treating off-site stormwater.*

(19) ***Stream & Wetland Crossings:*** *All stream and wetland crossings subject to Section 404 and/or state stream and wetland regulations shall minimize impacts on streams and wetlands, to the extent practical and achievable, by crossing streams and wetlands at a right-angle, reducing the footprint of grading and fill, and utilizing bridges, open bottom arches, spans, or other structures that do not restrict or alter stream or wetland hydrology. If culverts are placed within stream and wetlands, at least one culvert shall be countersunk or otherwise placed to allow the formation of a natural channel or wetland bottom to allow movement of aquatic organisms.*

4.2 Runoff Reduction Criteria

Runoff Reduction Criteria

- Runoff Reduction is a relatively recent criterion that seeks to tailor stormwater treatment to meet more specific resource objectives, such as promoting groundwater recharge, enhancing protection for locally-important resources, or providing better overall protection for water quality and downstream channel impacts.
- These criteria can apply jurisdiction-wide or to specifically-designated zones where stormwater management is more critical, such as drinking water source areas, wetlands, cold-water fisheries, impaired waters, and others.
- When using these criteria, programs should stress the use of non-structural measures (see **Section 4.8**) to complement structural practices.
- The Runoff Reduction criteria in the model ordinance give three basic options. The first focuses on groundwater recharge, and is a good choice for programs where recharge is an important objective. The second and third options are for the more generalized goal of reducing post-development runoff volumes. While these three options are provided in the model ordinance, the local program should select the one that best meets local objectives. This will simplify the application of this criterion.

In order to replicate pre-development hydrologic conditions, and to promote baseflow to streams and wetlands, some portion of the post-development runoff shall be permanently reduced by disconnecting impervious areas, maintaining sheetflow to areas of natural vegetation, infiltration practices, and/or collection and reuse of runoff. The applicant shall use either (1) (2) or (3) below to comply with these criteria:

(1) <u>Groundwater Recharge/Infiltration</u>

Replicate the pre-development recharge volume, based on regional average recharge rates for hydrologic soil groups

- *Residential Sites: Post-development recharge = 90% of pre-development recharge*
- *Non-Residential Sites: Post-development recharge = 60% of pre-development recharge*

(2) *Overall Runoff Reduction (Option 1)*
No increase in the overall runoff volume compared to the pre-development condition for all storms less than or equal to the 2-year, 24-hour storm.

(3) *Overall Runoff Reduction (Option 2)*
Capture and remove from the site hydrograph the volume of water associated with the 80th percentile storm event (or other storm event deemed appropriate by the STORMWATER AUTHORITY).

(4) *This criterion shall be met using practices outlined in the **Stormwater Design Manual** that provide for the infiltration, evapotranspiration, and/or storage and reuse of runoff.*

(5) *The volume of water needed for Runoff Reduction shall be considered part of the overall Water Quality Volume (WQv) required in Section 4.3, and shall not be in addition to the Water Quality Volume.*

*The [**STORMWATER AUTHORITY**] may waive some or all of the requirements of this section as specified in (6) and (7) below:*

(6) ***Risk of Groundwater Contamination:** Stormwater hotspots, contaminated soils, and sites in close proximity to karst or drinking water supply wells may not be subject to groundwater recharge/infiltration requirements, as determined by the [STORMWATER AUTHORITY]. The [STORMWATER AUTHORITY] may impose reasonable conditions in granting such a waiver.*

(7) ***Site Constraints:** Areas characterized by high water table, shallow bedrock, clay soils, contaminated soils, and other constraints may be subject to reduced volume control requirements, as determined by the [STORMWATER AUTHORITY]. The [STORMWATER AUTHORITY] may impose reasonable conditions in granting such a waiver.*

(8) ***Documentation for Waiver:** When seeking a waiver in accordance with either (6) or (7) above, the applicant shall demonstrate that no reasonable alternatives for compliance exist through site and stormwater management design, and that stormwater discharges will not unreasonably increase the extent, frequency, or duration of flooding at downstream properties and structures or have an unreasonable adverse effect on streams, aquatic habitats, and channel stability.*

*In making its determination to allow full or partial waivers, the [**STORMWATER AUTHORITY**] shall consider cumulative impacts and also the land development's adherence to the land use plans and policies of [**JURISDICTION**], including the promotion of infill and redevelopment in particular areas.*

4.3. Water Quality Criteria

Post-development runoff that is not permanently removed through the application of the runoff reduction criterion shall be captured and treated in a water quality BMP to prevent or minimize water quality impacts from land development. The applicant shall use (1) below to comply with this criterion:

(1) **Water Quality Volume Standard:** Structural and non-structural practices shall be designed to capture and treat the Water Quality Volume (WQv). The WQv shall be computed as follows, unless another volume is specified in the **Stormwater Design Manual**.

WQv = [P x Rv x A]/12, where:

P = rainfall depth generated by the 90% storm event (inches)

Rv = Site Runoff Coefficient = Rv_I x %I + Rv_T x %T + Rv_F x %F

Where:

Rv_I = runoff coefficient for impervious cover

%I = percent of site with impervious cover (fraction)

Rv_T = runoff coefficient for turf cover and disturbed soils

%T = percent of site with turf cover or disturbed soils (fraction)

Rv_F = runoff coefficient for forest cover or natural open space

%F = percent of site with forest cover or natural open space (fraction)

A = Area draining to stormwater BMP (acres)

Value for Rv_I, Rv_T, and, Rv_F shall be determined from the following table based on hydrologic soil groups present on the site.

Rv Coefficients				
	A soils	**B Soils**	**C Soils**	**D Soils**
Forest Cover & Natural Open Space	0.02	0.03	0.04	0.05
Turf Cover & Disturbed Soils	0.15	0.20	0.22	0.25
Impervious Cover	0.95	0.95	0.95	0.95

(2) This criterion shall be met using practices from the Stormwater Technology Table in the **Stormwater Design Manual**. BMPs or combinations of BMPs should be selected that achieve the highest pollutant load reduction for the pollutants of concern.

(3) All runoff removed through the runoff reduction criterion counts towards treating the WQv.

(4) ***Additional Criteria for Stormwater Hotspots:*** *In addition, stormwater discharges from stormwater hotspots may require the use of specific structural, non-structural, and/or pollution prevention practices, including enhanced pre-treatment. Discharges from a stormwater hotspot shall not be infiltrated without enhanced pre-treatment, as approved by the [**STORMWATER AUTHORITY**].*

4.4. Channel Protection Criteria

The stormwater system shall be designed so that post-development discharges will not erode natural channels or steep slopes. This will protect in-stream habitats and reduce in-channel erosion. The applicant shall use Tier 1 or Tier 2 performance standards, as applicable, to meet this criterion.

*(1) At each discharge point from the site, if the on-site drainage area is **less** than 10% of the total contributing drainage area to the receiving channel or waterbody, the following Tier 1 performance standards shall apply:*

Tier 1 Performance Standards

(a) Wherever practical, maintain sheetflow to riparian buffers or vegetated filter strips. Vegetation in buffers or filter strips must be preserved or restored where existing conditions do not include dense vegetation (or adequately sized rock in arid climates).
(b) Energy dissipaters and level spreaders must be used to spread flow at outfalls.
(c) On-site conveyances must be designed to reduce velocity through a combination of sizing, vegetation, check dams, and filtering media (e.g., sand) in the channel bottom and sides.
(d) If flows cannot be converted to sheetflow, they must be discharged at an elevation that will not cause erosion or require discharge across any constructed slope or natural steep slopes.
(e) Outfall velocities must be non-erosive from the point of discharge to the receiving channel or waterbody where the discharge point is calculated.

*(2) At each discharge point from the site, if the on-site drainage area is **greater** than 10% of the total contributing drainage area to the receiving channel or waterbody, then the Tier 1 performance standards in subsection (1) shall apply in addition to the following Tier 2 performance standards:*

Tier 2 Performance Standards

*(a) Sites greater than 10 acres (or a site size deemed appropriate by the [**STORMWATER AUTHORITY**]) must perform a detailed downstream (hydrologic and hydraulic) analysis based on post-development discharges. The downstream analysis shall extend to the point where post-development discharges have no significant impact, and do not create erosive conditions, on receiving channels, waterbodies, or storm sewer systems.*

(b) If the downstream analysis confirms that post-development discharges will have an impact on receiving channels, waterbodies, or storm sewer systems, then the site must incorporate some or all of the following to mitigate downstream impacts:

- *Site design techniques that decrease runoff volumes and peak flows.*
- *Downstream stream restoration or channel stabilization techniques, as permitted through local, state, and federal agencies.*
- *24-hour detention of the volume from the post-development 1-year, 24-hour storm. The [**STORMWATER AUTHORITY**] may give credit for the application of Runoff Reduction (Section 4.2) and WQv measures (Section 4.3) toward meeting storage requirements. Discharges to cold water fisheries should be limited to 12-hour detention.*

*(c) Sites less than 10 acres (or a site size deemed appropriate by the [**STORMWATER AUTHORITY**] shall verify that stormwater measures provide 12- to 24-hour detention of the volume from post-development 1-year, 24-hour storm. The [**STORMWATER AUTHORITY**] may give credit for the application of Runoff Reduction (Section 4.2) and WQv measures (Section 4.3) toward meeting storage requirements. A detailed downstream analysis is not required unless the local program identifies existing downstream conditions that warrant such an analysis.*

4.5. Flood Control Criteria

Flood Control Criteria
The Flood Control criterion depends on where a property is situated within a watershed and the design storms that typically cause flooding in the community. This criterion can address one or both of the following, depending on community priorities:

- Overbank Flood Protection: Prevent nuisance flooding that damages downstream property and infrastructure.
- Extreme Flood Control: Maintain boundaries of the pre-development 100-year flood plain and reduce risk to life and property from infrequent but extreme storms

Most local reviewing authorities establish an overbank design storm that is matched with the same design storm used for open channels, culverts, bridges, and storm drain systems. Therefore, most localities require that post-development peak discharge rates from the 10-year and/or 25-year, 24-hour design storm event be controlled to pre-development rates.

The choice of what design storm(s) to target for overbank flood protection is a local decision, unless these design storms are specified in state regulations or handbooks. In making this determination, a local program should investigate which storm frequencies lead to nuisance or more serious flooding problems for properties, roads, bridges, culverts, and other infrastructure elements.

Some flood-prone communities require a more rigorous standard to detain the 100-year storm. Even if this standard is not applied, local programs should require that all stormwater structures that impound water can safely pass the 100-year storm without overtopping or creating damaging downstream conditions, as stated in **Section 4.5**.

Downstream overbank flood and property protection shall be provided by controlling the post-development peak discharge rate to the pre-development rate. This criterion shall be met for the 10-year, 24-hour storm event, or other design storm(s) listed in the **Stormwater Design Manual.**

Stormwater BMPs that impound water shall demonstrate that the 100-year storm can safely pass through the structure without overtopping or creating damaging conditions downstream.

The [**STORMWATER AUTHORITY**] may waive some or all of the requirements of this section as specified in (1), (2), (3) and (4) below:

(1) **Discharge to Large Waterbody:** The land development discharges directly to a flood plain, ocean, or major river or waterbody, and the [STORMWATER AUTHORITY] determines that waiving the flooding criteria will not harm public health and safety. The applicant shall secure drainage easements from any downstream property owners across whose property the runoff must flow to reach the

flood plain, ocean, or major river or waterbody. The applicant shall also demonstrate that any piped or open-channel system in which the runoff will flow has adequate capacity and stability to receive the project's runoff plus any off-site runoff also passing through the system.

(2) **Insignificant Increases in Peak Flow:** The land development results in insignificant increases in peak flow rates, as determined by the [**STORMWATER AUTHORITY**].

(3) **Alternative Criteria Provided:** The land development is subject to a floodplain study that recommends alternative criteria for flood control.

(4) **Increases in Downstream Peak Flows or Flood Elevations:** The [**STORMWATER AUTHORITY**] determines that complying with the requirements of this section will result increases in peak flows or downstream flooding conditions due to coincident peaks from the site and the contributing watershed or another factor.

(5) **Documentation for Waiver:** When seeking a waiver in accordance with either (1), (2), (3) or (4) above, the applicant shall demonstrate that stormwater discharges will not unreasonably increase the extent, frequency, or duration of flooding at downstream properties and structures or have an unreasonable adverse effect on streams, aquatic habitats, and channel stability. In making its determination to allow full or partial waivers, the [**STORMWATER AUTHORITY**] shall consider cumulative impacts and also the land development's adherence to the land use plans and policies of [**JURISDICTION**], including the promotion of infill and redevelopment in particular areas.

4.6. Redevelopment Criteria

Redevelopment Criteria
Redevelopment projects can present unique stormwater challenges due to existing hydrologic impacts, compacted soils, generally small size and intensive use, and other factors.

Local programs should examine flexible standards for redevelopment, so that stormwater requirements do not act as a disincentive for desirable redevelopment projects. This is especially important within designated redevelopment zones, downtown revitalization zones, enterprise zones, brownfield sites, and other areas where infill and redevelopment is promoted through local policies and incentive programs. At the same time, redevelopment offers a unique opportunity to achieve incremental water quality and/or drainage improvements in previously developed areas where stormwater controls might be few or nonexistent. Redevelopment is one of the few chances to address existing impairments.

Land development that qualifies as redevelopment shall meet one of the following criteria:

(1) ***Reduce Impervious Cover:*** *Reduce existing site impervious cover by at least 20%.*

(2) ***Provide Treatment:*** *Provide Runoff Reduction and water quality treatment for at least 30% of the site's pre-development impervious cover and any new impervious cover through stormwater BMPs designed in accordance with the criteria in* ***Sections 4.2 through 4.3*** *and the* ***Stormwater Design Manual****.*

(3) ***Apply Innovative Approaches:*** *Utilize innovative approaches to reduce stormwater impacts across the site. Examples include green roofs and pervious parking materials. The local program can exercise flexibility with regard to sizing and design standards for sites that are fitting practices into existing drainage infrastructure.*

(4) ***Provide Off-Site Treatment:*** *Provide equivalent stormwater treatment at an off-site facility*

(5) ***Address Downstream Issues:*** *Address downstream channel and flooding issues through channel restoration and/or off-site remedies*

(6) Contribute to Watershed Project: *Contribute to a watershed project in accordance with* ***Section 4.9.***

(7) ***Combination of Measures:*** *Any combination of (1) through (6) above that is acceptable to the [****STORMWATER AUTHORITY****].*

4.7. Sensitive Waters and Wetlands: Enhanced Criteria

Land development that discharges to sensitive waters and wetlands, as designated in the ***Stormwater Design Manual****, shall meet enhanced criteria. These may include, but are not limited to:*

(1) ***Nutrient-Sensitive Waters:*** *Enhanced control of nutrients and sediment for discharges to drinking water reservoirs, lakes, estuaries, and/or coastal waters.*

(2) ***Cold-Water Fisheries:*** *Control of temperature increases for discharges to designated cold-water fisheries.*

(3) ***Groundwater:*** *Enhanced recharge and pre-treatment requirements to protect groundwater supply.*

(4) ***Wetlands****: The control of impacts to wetland hydrology, including limiting fluctuations to the natural or pre-development wetland hydrology.*

(5) ***Impaired Waters:*** *Enhanced bacteriological or pollutant controls for discharges to impaired waters, as designated in the most recent 303(d) list produced by EPA or the appropriate State agency.*

*In these cases, the [**STORMWATER AUTHORITY**] may require additional storage, treatment, filtering, infiltration, or other techniques. The use of non-structural practices shall be used to the maximum extent practical to meet enhanced criteria.*

*In making its determination to apply enhanced criteria, the [**STORMWATER AUTHORITY**] shall consider cumulative impacts and also the land development's adherence to the land use plans and policies of [**JURISDICTION**], including the promotion of infill and redevelopment in particular areas.*

4.8. Non-Structural Measures

*The use of nonstructural measures is encouraged to reduce sole reliance on structural stormwater management measures. The applicant may, if approved by the [**STORMWATER AUTHORITY**], take credit for the use of nonstructural measures as a means to comply with the criteria in **Sections 4.2 through 4.7**. For each potential credit, there is a minimum set of design criteria that identify the conditions or circumstances under which the credit may be applied. The site design practices that qualify for this credit and the criteria and procedures for applying and calculating the credits shall be included in the **Stormwater Design Manual**.*

4.9. Contribution to a Watershed Project: Fee-in-Lieu & Pro-Rata Share

Compliance Through Off-Site or Watershed Projects
A local program may want to dictate the conditions under which an off-site or watershed project can be used to comply with stormwater criteria. Such conditions may include:

- **Site Size**: Small sites (less than ½ acre impervious cover) may not be able to provide as effective or comprehensive on-site treatment compared to larger sites. Off-site or watershed solutions may make sense for small sites, especially in areas designated for infill and redevelopment.
- **Condition of Receiving Stream or Watershed**: If a site discharges to a degraded or impaired stream, even effective on-site treatment will not correct past problems. In these cases, contribution to restoration project may be suitable for partial compliance. The Stormwater Authority must assure, however, that the site development does not make conditions in the receiving stream even worse. In this regard, adherence to on-site channel protection criteria may be advisable.
- **Watershed or Subwatershed Management Plan**: As noted in **Section 4.9**, projects identified in an adopted watershed or stormwater management plan can be implemented through the site development process – either through on-site implementation or contribution to or implementation of off-site projects.

If a jurisdiction opts to collect offset fees, specific provisions relating to the collection and expenditure of the fees should be included in the ordinance. Jurisdictions should verify that the fees collected can fully recover the cost of stormwater management. For example, the Maryland Critical Areas Commission set the offset fee to recover the cost to remove phosphorus from one acre of impervious cover (CWP, 2003).

The [**STORMWATER AUTHORITY**] shall establish the criteria and conditions by which a project is eligible for a fee-in-lieu payment for off-site and watershed enhancements. The [**STORMWATER AUTHORITY**] may allow a fee-in-lieu payment, according to the established criteria and conditions, in lieu of partial or full on-site compliance with the requirements of this Ordinance.

Provided that the [**STORMWATER AUTHORITY**] implements a program in accordance with **Section 3.11**, land development projects that are within the target or drainage area of a watershed or subwatershed management plan adopted by the **[STORMWATER AUTHORITY**], [**JURISDICTION**], and/or another appropriate local, regional, or state agency or program, shall comply with the following:

(1) **On-Site Projects**: If the watershed or subwatershed management plan identifies specific projects on the applicant's property, the [**STORMWATER AUTHORITY**] may allow implementation of some or all of these projects as part of the stormwater management design plan to satisfy, in part or in whole, the criteria in Sections 4.2 through 4.7.

(2) **Fee-in-Lieu Contribution for Off-Site Projects:** The [**STORMWATER AUTHORITY**] may allow a fee-in-lieu contribution to off-site watershed project(s) identified in the management plan to satisfy, in part or in whole, the criteria in Sections 4.2 through 4.7. The fee-in-lieu contribution shall be in accordance with the fee schedule adopted by [**JURISDICTION**] and maintained by the [**STORMWATER AUTHORITY**].

(3) **Regional Stormwater Management:** If the land development is within the drainage area of an existing or planned regional stormwater BMP identified in the management plan, the applicant shall pay a pro-rata share of the cost of implementing the practice. The pro-rata share contribution shall be in accordance with the fee schedule adopted by [**JURISDICTION**] and maintained by the [**STORMWATER AUTHORITY**]. If a project is eligible for a fee-in-lieu and pro-rata share contribution, then the [**STORMWATER AUTHORITY**] shall determine one or the other fee or contribution for the project to pay.

(4) **Other Off-Site Projects:** In certain circumstances dictated by the [**STORMWATER AUTHORITY**], the applicant may propose an off-site watershed solution as a means to comply, in part or in whole, with the criteria in **Sections 4.2 through 4.7**. In these cases, the [**STORMWATER AUTHORITY**] shall require submission of a comprehensive watershed study that includes sufficient information to evaluate impacts of the proposed solution on runoff rates, water quality, volumes and velocities, and environmental characteristics of the affected areas. The [**STORMWATER AUTHORITY**] may approve the watershed solution as a means to comply with **Sections 4.2 through 4.7**, in part or in whole, if the watershed solution provides better overall protection for water resources than strict application of the on-site criteria. In all cases, land rights, access agreements or easements, and a maintenance agreement and plan shall be provided to ensure long-term maintenance of any off-site watershed project.

Nothing in the subsection shall compel the [**STORMWATER AUTHORITY**] to approve a plan that, in its determination, may pose a threat to public health, safety, or the environment. In approving a contribution to a watershed project, the [**STORMWATER AUTHORITY**] may apply conditions necessary to protect downstream property and environmental resources.

4.10. Waivers

Every applicant shall provide for stormwater management as required by this Ordinance, unless a written request for a waiver is filed and approved by the [STORMWATER AUTHORITY]. Prior to applying for a waiver request, the applicant must demonstrate that all reasonable options to comply with Ordinance have been exhausted, including the use of non-structural measures (**Section 4.8**) and/or construction or contribution to a watershed project (**Section 4.9**).

The request for a waiver must be in writing and must include waiver fee specified in **Section 3.10**. The [**STORMWATER AUTHORITY**] shall respond in writing by granting or denying the waiver in full, or granting the waiver with any necessary conditions or mitigation measures to protect public health, safety, and the environment. The applicant shall note any full or partial waivers, and conditions imposed by the [**STORMWATER AUTHORITY**], on the stormwater management design plan.

Section 5. Construction Inspection for Permanent Stormwater BMPs

Construction Inspection for Permanent BMPs

- The inspection section of the ordinance outlines the regulatory requirements for inspecting and reporting on permanent stormwater controls.
- The ordinance should be clear about who is responsible for conduction inspections (the responsible party, a local government department or a combination), and the type and frequency of reporting that must be submitted.

5.1. Notice of Construction Commencement

The applicant must notify the [**STORMWATER AUTHORITY**] before the commencement of construction. In addition, the applicant must notify the [**STORMWATER AUTHORITY**] in advance of construction of critical components of the stormwater practices on the approved stormwater management design plan. The [**STORMWATER AUTHORITY**] may, at its discretion, issue verbal or written authorization to proceed with critical construction steps, such as installation of permanent stormwater practices based on stabilization of the drainage area and other factors.

5.2. Construction Inspections by [STORMWATER AUTHORITY] or its Representatives

The [**STORMWATER AUTHORITY**] or its representatives shall conduct periodic inspections of the stormwater practices shown on the approved stormwater management design plan, and especially during critical installation and stabilization steps. All inspections shall be documented in writing. The inspection shall document any variations or discrepancies from the approved plan, and the resolution of such issues. Additional information regarding inspections can be found in the **Stormwater Design Manual**. A final inspection by the Stormwater Authority is required before any performance bond or guarantee, or portion thereof, shall be released.

5.3. Inspection by Certified Inspector

At its discretion, the [**STORMWATER AUTHORITY**] may authorize the use of private inspectors to conduct and document inspections during construction. Such private inspectors shall submit all inspection documentation in writing to the **[STORMWATER AUTHORITY**]. All costs and fees associated with the use of private inspectors shall be the responsibility of the applicant.

If the use of private inspectors in authorized, the [**STORMWATER AUTHORITY**] shall maintain a training and certification program, or authorize another entity to maintain

such a program. All private inspectors shall be certified prior to conducting any inspections or submitting any inspection documentation to the [**STORMWATER AUTHORITY**].

If private inspectors are utilized, then inspections by the [**STORMWATER AUTHORITY**] or its representatives, as provided in **Section 6.2**, may be reduced in frequency. However, the [**STORMWATER AUTHORITY**] shall remain the responsible entity for ultimate inspection, approval, and acceptance of all stormwater BMPs, and for issuance of the Certificate of Completion in accordance with **Section 5.5**.

5.4. Stormwater Certificate of Completion

Subsequent to final installation and stabilization of all stormwater BMPs shown on the stormwater management design plan, submission of all necessary as-built plans, and final inspection and approval by the [**STORMWATER AUTHORITY**], the [**STORMWATER AUTHORITY**] shall issue a Stormwater Certificate of Completion for the project. In issuing such a certificate, the [**STORMWATER AUTHORITY**] shall determine that all work has been satisfactorily completed in conformance with this Ordinance.

Section 6. Ongoing Maintenance for Stormwater BMPs

6.1. Maintenance Responsibility

The responsible party named in the recorded stormwater maintenance agreement (**Section 3.6**) shall maintain in good condition and promptly repair and restore all structural and non-structural stormwater BMPs and all necessary access routes and appurtenances (grade surfaces, walls, drains, dams and structures, vegetation, erosion and sedimentation controls, and other protective devices). Such repairs or restoration and maintenance shall be in accordance with the approved stormwater management design plan, the stormwater maintenance agreement, and the stormwater maintenance plan.

6.2. Maintenance Inspection by [STORMWATER AUTHORITY] or its Representatives

The [**STORMWATER AUTHORITY**] or its representatives shall conduct periodic inspections for all stormwater practices for which a Stormwater Certificate of Completion has been issued in accordance with Section 5.5. All inspections shall be documented in writing. The inspection shall document any maintenance and repair needs and any discrepancies from the stormwater maintenance agreement and stormwater maintenance plans.

6.3. Maintenance Inspection by Certified Inspector

At its discretion, the [**STORMWATER AUTHORITY**] may authorize the use of private inspectors to conduct and document ongoing maintenance inspections. Such private inspectors shall submit all inspection documentation in writing to the [**STORMWATER AUTHORITY**]. All costs and fees associated with the use of private inspectors shall be the responsibility of the responsible party.

If the use of private inspectors is authorized, the [**STORMWATER AUTHORITY**] shall maintain a training and certification program, or authorize another entity to maintain such a program. All private inspectors shall be certified prior to conducting any inspections or submitting any inspection documentation to the [**STORMWATER AUTHORITY**].

If private inspectors are utilized, then inspections by the [**STORMWATER AUTHORITY**] or its representatives, as provided in **Section 6.2**, may be reduced in frequency. However, the [**STORMWATER AUTHORITY**] shall remain the responsible entity for ultimate inspection of stormwater practices and any enforcement actions necessary under **Section 7 of this Ordinance**.

6.4. Records of Maintenance Activities

The responsible party shall make records of the installation and of all maintenance and repairs, and shall retain the records for at least five (5) years. These records shall be made available to the [**STORMWATER AUTHORITY**] during inspection of the practice and at other reasonable times upon request.

6.5. Failure to Provide Adequate Maintenance

In the event that the stormwater BMP has not been maintained and/or becomes a danger to public safety or public health, the [**STORMWATER AUTHORITY**] shall notify the responsible party by registered or certified mail. The notice shall specify the measures needed to comply with the maintenance agreement and the maintenance plan and shall specify that the responsible party has thirty (30) days or other time frame mutually agreed to between the [**STORMWATER AUTHORITY**] and the responsible party, within which such measures shall be completed. If such measures are not completed, then the [**STORMWATER AUTHORITY**] shall pursue enforcement procedures pursuant to Section 7 of this Ordinance.

If a responsible person fails or refuses to meet the requirements of an inspection report, maintenance agreement, or maintenance plan the [**STORMWATER AUTHORITY**], after thirty (30) days written notice (except, that in the event the violation constitutes an immediate danger to public health or public safety, 24 hours notice shall be sufficient), may correct a violation of the design standards or maintenance requirements by performing the necessary work to place the practice in proper working condition. The [**STORMWATER AUTHORITY**] may assess the responsible party of the practice for the cost of repair work which shall be a lien on the property, or prorated against the beneficial users of the property, and may be placed on the tax bill and collected as ordinary taxes by [**JURISDICTION**].

Section 7. Violations, Enforcement and Penalties

7.1. Violations

Any action or inaction which violates the provisions of this Ordinance, the requirements of an approved stormwater management design plan or permit, and/or the requirements of a recorded stormwater maintenance agreement may be subject to the enforcement actions outlined in this Section. Any such action or inaction is deemed to be a public nuisance and may be abated by injunctive or other equitable relief. The imposition of any of the penalties described below shall not prevent such equitable relief.

7.2. Notice of Violation

If the [**STORMWATER AUTHORITY**] or [**JURISDICTION**] determines that an applicant or other responsible person has failed to comply with the terms and conditions of a permit, an approved stormwater management design plan, a recorded stormwater management maintenance agreement, or the provisions of this ordinance, it shall issue a written notice of violation to such applicant or other responsible person. Where a person is engaged in activity covered by this ordinance without having first secured a permit therefore, the notice of violation shall be served on the owner or the responsible person in charge of the activity being conducted on the site.

The notice of violation shall contain:

(1) The name and address of the owner or the applicant or the responsible person;

(2) The address or other description of the site upon which the violation is occurring;

(3) A statement specifying the nature of the violation;

(4) A description of the remedial measures necessary to bring the action or inaction into compliance with the permit, the stormwater management design plan, the stormwater maintenance agreement, or this ordinance and the date for the completion of such remedial action;

(5) A statement of the penalty or penalties that may be assessed against the person to whom the notice of violation is directed; and,

(6) A statement that the determination of violation may be appealed to **[GOVERNING BOARD OF JURISDICTION]** by filing a written notice of appeal within thirty (30) days after the notice of violation (except, that in the event the violation constitutes an immediate danger to public health or public safety, 24 hours notice shall be sufficient).

7.3. Penalties

Penalties (Civil)

- Most post-construction ordinances do not have a schedule of civil penalties as laid out in **Section 7.3(4).** The advantage of having such a schedule is that it makes administering the civil penalties more predictable and easier for the jurisdiction to apply. For a particular jurisdiction, the specific violations tied to civil penalties and the penalty amounts can be modified.
- Check with legal staff before including a schedule of civil penalties. State or local codes may specify how these can apply.

In the event the remedial measures described in the notice of violation have not been completed by the date set forth for such completion in the notice of violation, any one or more of the following actions or penalties may be taken or assessed against the person to whom the notice of violation was directed.

(1) **Stop Work Order:** The **[STORMWATER AUTHORITY]** or **[JURISDICTION]** may issue a stop work order which shall be served on the applicant or other responsible person. The stop work order shall remain in effect until the applicant or other responsible person has taken the remedial measures set forth in the notice of violation or has otherwise cured the violation or violations described therein, provided the stop work order may be withdrawn or modified to enable the applicant or other responsible person to take the necessary remedial measures to cure such violation or violations.

(2) **Withhold Certificate of Occupancy:** The **[STORMWATER AUTHORITY], [JURISDICTION'S PERMIT ISSUING AUTHORITY]**, or **[JURISDICTION]** may refuse to issue a certificate of occupancy for the building or other improvements constructed or being constructed on the site until the applicant or other responsible person has taken the remedial measures set forth in the notice of violation or has otherwise cured the violations described therein.

(3) **Suspension, Revocation or Modification of Permit:** The **[STORMWATER AUTHORITY]** or **[JURISDICTION]** may suspend, revoke or modify the permit authorizing the land development project. A suspended, revoked or modified permit may be reinstated after the applicant or other responsible person has taken the remedial measures set forth in the notice of violation or has otherwise cured the violations described therein, provided such permit may be reinstated upon such conditions as the **[STORMWATER AUTHORITY]** or **[JURISDICTION]** may deem necessary to enable the applicant or other responsible person to take the necessary remedial measures to cure such violations.

(4) ***Civil Penalties:*** *In the event the applicant or other responsible person fails to take the remedial measures set forth in the notice of violation, the* ***[STORMWATER AUTHORITY]*** *or* ***[JURISDICTION]*** *may impose a penalty not to exceed $1,000 (depending on the severity of the violation) for each day the violation remains*

unremedied after receipt of the notice of violation. A schedule of civic penalties is outlined in the table below.

Violation	Penalty
Failure to submit and receive approval of a stormwater management design plan prior to construction	**[$ 1,000]**
Failure to submit and receive approval of a stormwater maintenance agreement and plan prior to construction	**[$ 500]**
Failure to install stormwater BMP(s) as indicated on the approved stormwater management design plan	**[$ 750]**
Failure to notify Stormwater Authority before commencement of construction	**[$ 500]**
Failure to maintain stormwater BMP within 30 days of notification (See Section 6.5 for more detail)	**[$ 750]**

(5) **Criminal Penalties**: For intentional and flagrant violations of this ordinance, the **[STORMWATER AUTHORITY]** or **[JURISDICTION]** may issue a citation to the applicant or other responsible person, requiring such person to appear in **[APPROPRIATE MUNICIPAL, MAGRISTRATE, OR RECORDERS]** court to answer charges for such violation. Upon conviction, such person shall be punished by a fine not to exceed $1,000 or imprisonment for 60 days or both. Each act of violation and each day upon which any violation shall occur shall constitute a separate offense.

7.4. Appeals

The decisions or orders of the **[STORMWATER AUTHORITY]** or [**JURISDICTION]** shall be final. Further relief shall be to a court of competent jurisdiction.

7.5. Remedies Not Exclusive

The remedies listed in this Ordinance are not exclusive of any other remedies available under any applicable federal, state or local law.

Approved by: _____ Date _____

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TOOL 4

Post-Construction Guidance Manual

Codes & Ordinance Worksheet (COW)

This is one of several tools designed to assist local stormwater managers with the development of their post-construction stormwater program. The tools are a companion to the Post-Construction Guidance Manual (www.cwp.org/postconstruction). The following tools are available:

Tool #1: Post-Construction Stormwater Program Self-Audit

Tool #2: Program & Budget Planning Tool

Tool #3: Post-Construction Stormwater Model Ordinance

Tool #4: Codes & Ordinance Worksheet (COW)

Tool #5: Stormwater Manual Builder

Tool #6: Plan Review, BMP Construction, and Maintenance Checklists

Tool #7: Performance Bonds

Tool #8: BMP Evaluation Tool

For more information on the Post-Construction Guidance Manual, contact the Center for Watershed Protection, 8390 Main Street, 2nd floor, Ellicott City, MD 21046, 410-461-8323

center@cwp.org

www.cwp.org.

CODE AND ORDINANCE WORKSHEET

The Code and Ordinance Worksheet allows an in-depth review of the standards, ordinances, and codes (i.e., the development rules) that shape how development occurs in your community. You are guided through a systematic comparison of your local development rules against the model development principles. Institutional frameworks, regulatory structures and incentive programs are included in this review. The worksheet consists of a series of questions that correspond to each of the model development principles. Points are assigned based on how well the current development rules agree with the site planning benchmarks derived from the model development principles.

The worksheet is intended to guide you through the first two steps of a local site planning roundtable.

Step 1: Find out what the Development Rules are in your community.

Step 2: See how your rules stack up to the Model Development Principles.

The homework done in these first two steps helps to identify which development rules are potential candidates for change.

PREPARING TO COMPLETE THE CODE AND ORDINANCE WORKSHEET

Two tasks need to be performed before you begin in the worksheet. First, you must identify all the development rules that apply in your community. Second, you must identify the local, state, and federal authorities that actually administer or enforce the development rules within your community. Both tasks require a large investment of time. The development process is usually shaped by a complex labyrinth of regulations, criteria, and authorities. A team approach may be helpful. You may wish to enlist the help of a local plan reviewer, land planner, land use attorney, or civil engineer. Their real-world experience with the development process is often very useful in completing the worksheet.

Identify the Development Rules

Gather the key documents that contain the development rules in your community. A list of potential documents to look for is provided in Table 1. Keep in mind that the information you may want on a particular development rule is not always found in code or regulation, and maybe hidden in supporting design manuals, review checklists, guidance document or construction specifications. In most cases, this will require an extensive search. Few communities include all of their rules in a single document. Be prepared to contact state and federal, as well as local agencies to obtain copies of the needed documents.

Table 1: Key Local Documents that will be Needed to Complete the COW
Zoning Ordinance
Subdivision Codes
Street Standards or Road Design Manual
Parking Requirements
Building and Fire Regulations/Standards
Stormwater Management or Drainage Criteria
Buffer or Floodplain Regulations
Environmental Regulations
Tree Protection or Landscaping Ordinance
Erosion and Sediment Control Ordinances
Public Fire Defense Masterplans
Grading Ordinance

Identify Development Authorities

Once the development rules are located, it is relatively easy to determine which local agencies or authorities are actually responsible for administering and enforcing the rules. Completing this step will provide you with a better understanding of the intricacies of the development review process and helps identify key members of a future local roundtable. Table 2 provides a simple framework for identifying the agencies that influence development in your community. As you will see, space is provided not only for local agencies, but for state and federal agencies as well. In some cases, state and federal agencies may also exercise some authority over the local development process (e.g., wetlands, some road design, and stormwater).

USING THE WORKSHEET: HOW DO YOUR RULES STACK UP TO THE MODEL DEVELOPMENT PRINCIPLES?

Completing the Worksheet

Once you have located the documents that outline your development rules and identified the authorities responsible for development in your community, you are ready for the next step. You can now use the worksheet to compare your development rules to the model development principles. The worksheet is presented at the end of this chapter. The worksheet presents seventy-seven site planning benchmarks. The benchmarks are posed as questions. Each benchmark focuses on a specific site design practice, such as the minimum diameter of cul-de-sacs, the minimum width of streets, or the minimum parking ratio for a certain land use. You should refer to the codes, ordinances, and plans identified in the first step to determine the appropriate development rule. The questions require either a yes or no response or specific numeric criteria. If your development rule agrees with the site planning benchmark, you are awarded points.

Calculating Your Score

A place is provided on each page of the worksheet to keep track of your running score. In addition, the worksheet is subdivided into three categories:

- Residential Streets and Parking Lots (Principles No. 1 - 10)
- Lot Development (Principles No. 11 - 16)
- Conservation of Natural Areas (Principles No. 17 - 22).

For each category, you are asked to subtotal your score. This "**Time to Assess**" allows you to consider which development rules are most in line with the site planning benchmarks and what rules are potential candidates for change.

The total number of points possible for all of the site planning benchmarks is 100. Your overall score provides a general indication of your community's ability to support environmentally sensitive development. As a general rule, if your overall score is lower than 80, then it may be advisable to systematically reform your local development rules. A score sheet is provided at end of the Code and Ordinance Worksheet to assist you in determining where your community's score places in respect to the Model Development Principles. Once you have completed the worksheet, go back and review your responses. Determine if there are specific areas that need improvement (e.g., development rules that govern road design) or if your development rules are generally pretty good. This review is key to implementation of better development: assessment of your current development rules and identification of impediments to innovative site design. This review also directly leads into the next step: a site planning roundtable process conducted at the local government level. The primary tasks of a local roundtable are to systematically review existing development rules and then determine if changes can or should be made. By providing a much-needed framework for overcoming barriers to better development, the site planning roundtable can serve as an important tool for local change.

Table 2: Local, State, and Federal Authorities Responsible for Development in Your Community			
Development Responsibility	**State/Federal**	**County**	**Town**
Sets road standards	Agency: Contact Name: Phone No.:		
Review/approves subdivision plans	Agency: Contact Name: Phone No.:		
Establishes zoning ordinances	Agency: Contact Name: Phone No.:		
Establishes subdivision ordinances	Agency: Contact Name: Phone No.:		
Reviews/establishes stormwater management or drainage criteria	Agency: Contact Name: Phone No.:		
Provides fire protection and fire protection code enforcement	Agency: Contact Name: Phone No.:		
Oversees buffer ordinance	Agency: Contact Name: Phone No.:		
Oversees wetland protection	Agency: Contact Name: Phone No.:		
Establishes grading requirements or oversees erosion and sediment control program	Agency: Contact Name: Phone No.:		
Reviews/approves septic systems	Agency: Contact Name: Phone No.:		
Review/approves utility plans (e.g., water and sewer)	Agency: Contact Name: Phone No.:		
Reviews/approves forest conservation/ tree protection plans	Agency: Contact Name: Phone No.:		

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Development Feature	*Your Local Criteria*

1. Street Width

What is the minimum pavement width allowed for streets in low density residential developments that have less than 500 daily trips (ADT)? _____ feet

*If your answer is between **18-22 feet**, give yourself **4** points* ☞ [ ]

At higher densities are parking lanes allowed to also serve as traffic lanes (i.e., queuing streets)? YES/ NO

*If your answer is **YES**, give yourself **3** points* ☞ [ ]

Notes on Street Width (include source documentation such as name of document, section and page #):

2. Street Length

Do street standards promote the most efficient street layouts that reduce overall street length? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ [ ]

Notes on Street Length (include source documentation such as name of document, section and page #):

3. Right-of-Way Width

What is the minimum right of way (ROW) width for a residential street? _____ feet

*If your answer is **less than 45 feet**, give yourself **3** points* ☞ [ ]

Does the code allow utilities to be placed under the paved section of the ROW? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ [ ]

Notes on ROW Width (include source documentation such as name of document, section and page #):

4. Cul-de-Sacs

What is the minimum radius allowed for cul-de-sacs? _____ feet

*If your answer is **less than 35 feet**, give yourself **3** points* ☞

*If your answer is **36 feet to 45 feet**, give yourself **1** point* ☞ [ ]

Can a landscaped island be created within the cul-de-sac? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ [ ]

Are alternative turnarounds such as "hammerheads" allowed on short streets in low density residential developments? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ [ ]

Notes on Cul-de-Sacs (include source documentation such as name of document, section and page #):

Code and Ordinance Worksheet *Subtotal Page 5* [ ]

Development Feature	*Your Local Criteria*

5. Vegetated Open Channels

Are curb and gutters required for most residential street sections? YES/ NO

*If your answer is **NO**, give yourself **2** points* ☞ [ ]

Are there established design criteria for swales that can provide stormwater quality treatment (i.e., dry swales, biofilters, or grass swales)? YES/ NO

*If your answer is **YES**, give yourself **2** points* ☞ [ ]

Notes on Vegetated Open Channel (include source documentation such as name of document, section and page #):

6. Parking Ratios

What is the minimum parking ratio for a professional office building (per 1000 ft^2 of gross floor area)? _____ spaces

*If your answer is **less than 3.0 spaces**, give yourself **1** point* ☞ [ ]

What is the minimum required parking ratio for shopping centers (per 1,000 ft^2 gross floor area)? _____ spaces

*If your answer is **4.5 spaces or less**, give yourself **1** point* ☞ [ ]

What is the minimum required parking ratio for single family homes (per home)? _____ spaces

*If your answer is **less than or equal to 2.0 spaces**, give yourself **1** point* ☞ [ ]

Are your parking requirements set as maximum or median (rather than minimum) requirements? YES/ NO

*If your answer is **YES**, give yourself **2** points* ☞ [ ]

Notes on Parking Ratios (include source documentation such as name of document, section and page #):

7. Parking Codes

Is the use of shared parking arrangements promoted? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ [ ]

Are model shared parking agreements provided? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ [ ]

Are parking ratios reduced if shared parking arrangements are in place? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ [ ]

If mass transit is provided nearby, is the parking ratio reduced? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ [ ]

Notes on Parking Codes (include source documentation such as name of document, section and page #):

Code and Ordinance Worksheet *Subtotal Page 6* [ ]

8. Parking Lots

What is the minimum stall width for a standard parking space? _____ feet

*If your answer is **9 feet or less**, give yourself **1** point* ☞ [ ]

What is the minimum stall length for a standard parking space? _____ feet

*If your answer is **18 feet or less**, give yourself **1** point* ☞ [ ]

Are at least 30% of the spaces at larger commercial parking lots required to have smaller dimensions for compact cars? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ [ ]

Can pervious materials be used for spillover parking areas? YES/ NO

*If your answer is **YES**, give yourself **2** points* ☞ [ ]

Notes on Parking Lots (include source documentation such as name of document, section and page #):

9. Structured Parking

Are there any incentives to developers to provide parking within garages rather than surface parking lots? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ [ ]

Notes on Structured Parking (include source documentation such as name of document, section and page #):

10. Parking Lot Runoff

Is a minimum percentage of a parking lot required to be landscaped? YES/ NO

*If your answer is **YES**, give yourself **2** points* ☞ [ ]

Is the use of bioretention islands and other stormwater practices within landscaped areas or setbacks allowed? YES/ NO

*If your answer is **YES**, give yourself **2** points* ☞ [ ]

Notes on Parking Lot Runoff (include source documentation such as name of document, section and page #):

Code and Ordinance Worksheet *Subtotal Page 7* [ ]

Time to Assess: Principles 1 - 10 focused on the codes, ordinances, and standards that determine the size, shape, and construction of parking lots, roadways, and driveways in the suburban landscape. There were a total of **40** points available for Principles 1 - 10. What was your total score?

Subtotal Page 5 ____ + Subtotal Page 6 ____ + Subtotal Page 7 ____ = ☐

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

_____

_____

_____

_____

11. Open Space Design

Are open space or cluster development designs allowed in the community? YES/ NO

*If your answer is **YES**, give yourself **3** points* ☞

*If your answer is **NO**, skip to question No. 12* ☐

Is land conservation or impervious cover reduction a major goal or objective of the open space design ordinance? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ ☐

Are the submittal or review requirements for open space design greater than those for conventional development? YES/ NO

*If your answer is **NO**, give yourself **1** point* ☞ ☐

Is open space or cluster design a by-right form of development? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ ☐

Are flexible site design criteria available for developers that utilize open space or cluster design options (e.g., setbacks, road widths, lot sizes) YES/ NO

*If your answer is **YES**, give yourself **2** points* ☞ ☐

Notes on Open Space Design (include source documentation such as name of document, section and page #):

Code and Ordinance Worksheet *Subtotal Page 8* ☐

Development Feature	*Your Local Criteria*

12. Setbacks and Frontages

Are irregular lot shapes (e.g., pie-shaped, flag lots) allowed in the community?	YES/ NO
*If your answer is **YES**, give yourself **1** point* ☞	
What is the minimum requirement for front setbacks for a one half (½) acre residential lot?	_____ feet
*If your answer is **20 feet or less**, give yourself **1** point* ☞	
What is the minimum requirement for rear setbacks for a one half (½) acre residential lot?	_____ feet
*If your answer is **25 feet or less**, give yourself **1** point* ☞	
What is the minimum requirement for side setbacks for a one half (½) acre residential lot?	_____ feet
*If your answer is **8 feet or less**, give yourself **1** points* ☞	
What is the minimum frontage distance for a one half (½) acre residential lot?	_____ feet
*If your answer is **less than 80 feet**, give yourself **2** points* ☞	

Notes on Setback and Frontages (include source documentation such as name of document, section and page #):

13. Sidewalks

What is the minimum sidewalk width allowed in the community?	_____ feet
*If your answer is **4 feet or less**, give yourself **2** points* ☞	
Are sidewalks always required on both sides of residential streets?	YES/ NO
*If your answer is **NO**, give yourself **2** points* ☞	
Are sidewalks generally sloped so they drain to the front yard rather than the street?	YES/ NO
*If your answer is **YES**, give yourself **1** point* ☞	
Can alternate pedestrian networks be substituted for sidewalks (e.g., trails through common areas)?	YES/ NO
*If your answer is **YES**, give yourself **1** point* ☞	

Notes on Sidewalks (include source documentation such as name of document, section and page #):

14. Driveways

What is the minimum driveway width specified in the community?	_____ feet
*If your answer is **9 feet or less (one lane) or 18 feet (two lanes)**, give yourself **2** points* ☞	

Code and Ordinance Worksheet *Subtotal Page 9*

Can pervious materials be used for single family home driveways (e.g., grass, gravel, porous pavers, etc)? YES/ NO

*If your answer is **YES**, give yourself **2** points* ☞ [ ]

Can a "two track" design be used at single family driveways? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ [ ]

Are shared driveways permitted in residential developments? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ [ ]

Notes on Driveways (include source documentation such as name of document, section and page #):

15. Open Space Management

Skip to question 16 if open space, cluster, or conservation developments are not allowed in your community.

Does the community have enforceable requirements to establish associations that can effectively manage open space? YES/ NO

*If your answer is **YES**, give yourself **2** points* ☞ [ ]

Are open space areas required to be consolidated into larger units? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ [ ]

Does a minimum percentage of open space have to be managed in a natural condition? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ [ ]

Are allowable and unallowable uses for open space in residential developments defined? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ [ ]

Can open space be managed by a third party using land trusts or conservation easements? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ [ ]

Notes on Open Space Management (include source documentation such as name of document, section and page #):

16. Rooftop Runoff

Can rooftop runoff be discharged to yard areas? YES/ NO

*If your answer is **YES**, give yourself **2** points* ☞ [ ]

Do current grading or drainage requirements allow for temporary ponding of stormwater on front yards or rooftops? YES/ NO

*If your answer is **YES**, give yourself **2** points* ☞ [ ]

Notes on Rooftop Runoff (include source documentation such as name of document, section and page #):

Code and Ordinance Worksheet *Subtotal Page 10* [ ]

Time to Assess: Principles 11 through 16 focused on the regulations which determine lot size, lot shape, housing density, and the overall design and appearance of our neighborhoods. There were a total of **36** points available for Principles 11 - 16. What was your total score?

Subtotal Page 8 ____ + Subtotal Page 9 ____ + Subtotal Page 10 ____ = ☐

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

_____

_____

_____

_____

_____

17. Buffer Systems

Is there a stream buffer ordinance in the community? YES/ NO

*If your answer is **YES**, give yourself **2** points* ☞ ☐

If so, what is the minimum buffer width? _____ feet

*If your answer is **75 feet or more**, give yourself **1** point* ☞ ☐

Is expansion of the buffer to include freshwater wetlands, steep slopes or the 100-year floodplain required? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ ☐

Notes on Buffer Systems (include source documentation such as name of document, section and page #):

18. Buffer Maintenance

If you do not have stream buffer requirements in your community, skip to question No. 19

Does the stream buffer ordinance specify that at least part of the stream buffer be maintained with native vegetation? YES/ NO

*If your answer is **YES**, give yourself **2** points* ☞ ☐

Does the stream buffer ordinance outline allowable uses? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☐

Code and Ordinance Worksheet *Subtotal Page 11* ☐

Development Feature	*Your Local Criteria*

Does the ordinance specify enforcement and education mechanisms? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞

Notes on Buffer Systems (include source documentation such as name of document, section and page #):

19. Clearing and Grading

Is there any ordinance that requires or encourages the preservation of natural vegetation at residential development sites? YES/ NO

*If your answer is **YES**, give yourself **2** points* ☞

Do reserve septic field areas need to be cleared of trees at the time of development? YES/ NO

*If your answer is **NO**, give yourself **1** point* ☞

Notes on Buffer Maintenance (include source documentation such as name of document, section and page #):

20. Tree Conservation

If forests or specimen trees are present at residential development sites, does some of the stand have to be preserved? YES/ NO

*If your answer is **YES**, give yourself **2** points* ☞

Are the limits of disturbance shown on construction plans adequate for preventing clearing of natural vegetative cover during construction? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞

Notes on Tree Conservation (include source documentation such as name of document, section and page #):

21. Land Conservation Incentives

Are there any incentives to developers or landowners to conserve non-regulated land (open space design, density bonuses, stormwater credits or lower property tax rates)? YES/ NO

*If your answer is **YES**, give yourself **2** points* ☞

Is flexibility to meet regulatory or conservation restrictions (density compensation, buffer averaging, transferable development rights, off-site mitigation) offered to developers? YES/ NO

*If your answer is **YES**, give yourself **2** points* ☞

Notes on Land Cons. Incentives (include source documentation such as name of document, section and page #):

Code and Ordinance Worksheet *Subtotal Page 12*

22. Stormwater Outfalls

Is stormwater required to be treated for quality before it is discharged?	YES/ NO
*If your answer is **YES**, give yourself **2** pointS* ☞	
Are there effective design criteria for stormwater best management practices (BMPs)?	YES/ NO
*If your answer is **YES**, give yourself **1** point* ☞	
Can stormwater be directly discharges into a jurisdictional wetland without pretreatment?	YES/ NO
*If your answer is **NO**, give yourself **1** point* ☞	
Does a floodplain management ordinance that restricts or prohibits development within the 100-year floodplain exist?	YES/ NO
*If your answer is **YES**, give yourself **2** points* ☞	

Notes on Stormwater Outfalls (include source documentation such as name of document, section and page #):

Code and Ordinance Worksheet *Subtotal Page 13* ☐

Time to Assess: Principles 17 through 22 addressed the codes and ordinances that promote (or impede) protection of existing natural areas and incorporation of open spaces into new development. There were a total of 24 points available for Principles 17 - 22. What was your total score?

Subtotal Page 11 ____ + Subtotal Page 12 ____ + Subtotal Page 13 ____ = ☐

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

_____

_____

_____

_____

_____

To determine final score, add up subtotal from each **Time to Assess**

Principles 1 - 10 (Page 8) _____

Principles 11 - 16 (Page 11) _____

Principles 17 - 22 (Page 13) _____

TOTAL ☐

SCORING (A total of **100** points are available):		
Your Community's Score		
90- 100	☞	Congratulations! Your community is a real leader in protecting streams, lakes, and estuaries. Keep up the good work.
80 - 89	☞	Your local development rules are pretty good, but could use some tweaking in some areas.
79 - 70	☞	Significant opportunities exist to improve your development rules. Consider creating a site planning roundtable.
60 - 69	☞	Development rules are inadequate to protect your local aquatic resources. A site planning roundtable would be very useful.
less than 60	☞	Your development rules definitely are not environmentally friendly. Serious reform of the development rules is needed.

TOOL 5

Post-Construction Guidance Manual

Stormwater Manual Builder

This is one of several tools designed to assist local stormwater managers with the development of their post-construction stormwater program. The tools are a companion to the Post-Construction Guidance Manual (www.cwp.org/postconstruction). The following tools are available:

Tool 1: Post-Construction Stormwater Program Self-Assessment

Tool 2: Program & Budget Planning Tool

Tool 3: Post-Construction Stormwater Model Ordinance

Tool 4: Codes & Ordinance Worksheet (COW)

Tool 5: Stormwater Manual Builder

Tool 6: Plan Review, BMP Construction, and Maintenance Checklists

Tool 7: Performance Bonds

Tool 8: BMP Evaluation Tool

For more information on the Post-Construction Guidance Manual, contact the Center for Watershed Protection, 8390 Main Street, 2nd floor, Ellicott City, MD 21046, 410-461-8323

center@cwp.org

www.cwp.org.

USERS' GUIDE TO THE POST-CONSTRUCTION MANUAL BUILDING TOOL

The number of stormwater guidance manuals created by states, regional entities, and localities has proliferated in recent years. As of 2006, approximately 36 states, the District of Columbia, several Canadian provinces and U.S. territories, and an uncounted number of localities and regional entities have developed stormwater guidance manuals. Because of the abundance of existing stormwater knowledge, most communities do not need to recreate the wheel and create a project review manual and/or engineering design manual from scratch. The trick to using the existing knowledge to develop a local stormwater manual is determining how to carefully adapt the abundant amount of existing guidance to meet local needs.

Adapting existing stormwater knowledge to develop a local stormwater manual can be a daunting task. If the existing stormwater guidance manuals were stacked on top of one another, the stack would be over ten feet high. The stack would contain tens of thousands of pages of material, much of which is redundant or recycled from other stormwater guidance manuals. To help local stormwater managers sort through the stacks of existing manuals to find the unique and useful information they need, this **Manual Building Tool** was developed. During the development of this tool, 51 state, provincial and territorial, and local stormwater guidance manuals were reviewed. The manuals that were reviewed came from every part of the country (and some parts outside of the country) and contain a wealth of useful stormwater knowledge.

The tool is intended to provide local stormwater managers with references to most useful existing stormwater guidance manuals and quick links to the most detailed and up-to-date information on particular post-construction stormwater management topics. While scoping out and developing content for local stormwater manual(s), stormwater managers will likely come across a number of topics that they need additional information about. This **Manual Building Tool** will help stormwater managers find this information by providing them with quick links to useful guidance materials. Instead of having to sort through the stacks of existing manuals to find the most useful information, stormwater managers can use this **Manual Building Tool** to quickly find the most useful information on the topics they are most interested in. Once they find the most appropriate material, the information can be customized to fit local conditions.

This **Manual Building Tool** includes a directory of selected state and local stormwater guidance manuals, two summary matrices that summarize the content of the existing statewide guidance manuals, and two manual reference indices that provide links to the 3 to 4 most useful design and policy manuals for over 50 different post-construction stormwater management topics. These topics are summarized in Table 1 on the next page.

The actual tool is contained within an associated spreadsheet.

Tool 5 Users' Guide: Table 1. Summary of the Manual Building Tool

Topic Areas for Design Manual	Topic Areas for Policy and Procedures Manual

• Stormwater Management Criteria
  – Stable Conveyance/Channel Protection
  – Flood Control
  – Groundwater Recharge
  – Water Quality
• Special Criteria for Sensitive Receiving Waters
  – Groundwater Protection
  – Surface Water Protection
  – Trout Stream Protection
  – Wetland Protection
  – Site-Based Pollutant Load Reduction
• Special Criteria for Tricky Development Situations
  – Ultra-Urban/Small Site Practices
• Pollution Source Control/Hotspot Management
• Smart Growth
• Low-Impact Development
• BMP Selection Matrices
• BMP Fact Sheets
• Detailed BMP Design/Performance Specifications
  – Bioretention
  – Filtration
  – Infiltration
  – Open Channels
  – Stormwater Ponds
  – Stormwater Wetlands
  – Green Rooftops
  – Porous Pavement
  – Rain Barrels
  – Rain Gardens
  – Experimental/Proprietary BMPs
• Hydrologic and Hydraulic Models
• Design Examples
• Stormwater Credits
• Detailed Landscaping Guidance
• Detailed BMP Operation and Maintenance Requirements
• Karst Topography
• Arid/Semi-Arid Climate
• Cold Climate
	• Ordinance Applicability
	  – Redevelopment Criteria
	  – Single-Family Lot Criteria
	• Application/Submittal Requirements
	• Plan Review Process
	• Plan Review Checklists
	• Permit Coordination
	• Maintenance Agreements and Plans
	• Deeds of Easement
	• Performance Bonds
	• Waiver/Fee-in-Lieu Programs
	• Construction Inspection Procedures
	• Construction Inspection Checklists
	• Maintenance Inspection Procedures
	• Maintenance Inspection Checklists
	• Violations, Enforcement and Penalties

TOOL 6

Post-Construction Guidance Manual

Plan Review, BMP Construction & Maintenance Checklist

This is one of several tools designed to assist local stormwater managers with the development of their post-construction stormwater program. The tools are a companion to the Post-Construction Guidance Manual (www.cwp.org/postconstruction). The following tools are available:

Tool 1: Post-Construction Stormwater Program Self-Assessment

Tool 2: Program & Budget Planning Tool

Tool 3: Post-Construction Stormwater Model Ordinance

Tool 4: Codes & Ordinance Worksheet (COW)

Tool 5: Stormwater Manual Builder

Tool 6: Plan Review, BMP Construction, and Maintenance Checklists

Tool 7: Performance Bonds

Tool 8: BMP Evaluation Tool

For more information on the Post-Construction Guidance Manual, contact the Center for Watershed Protection, 8390 Main Street, 2nd floor, Ellicott City, MD 21046, 410-461-8323

center@cwp.org

www.cwp.org.

USERS' GUIDE FOR THE POST-CONSTRUCTION CHECKLIST TOOL

The **Post-Construction Checklist Tool** is a supplement to the Post-Construction Guidance Manual. The checklists in the tool are designed to be used by stormwater program managers, design consultants, plan reviewers, inspectors, and parties responsible for maintenance. The following table outlines some of the intended uses of the checklists by these various parties.

Use of the Post-Construction Checklist Tool by Various Parties	
Stormwater Program Managers	• Provide content for local design or policy and project review manuals). • Use the ***stormwater BMP checklists*** to keep track of design modifications – based on lessons learned in the field – by routinely updating the content of the checklists and coordinating the checklists with design manual updates. • Use the ***non-structural practice checklists*** as a means to promote integration of low-impact development (LID) techniques into post-construction plans, as a supplement to stormwater credit or LID policies, and to ensure that these practices are constructed and maintained properly.
Design Consultants	• Use the ***plan review checklists*** to check that all necessary information is provided on concept and design plans. • Use the ***stormwater BMP checklists*** as an aid for designing various structural and non-structural practices.
Plan Reviewers	• Use the ***plan review checklists*** to verify that submittals for concept and design plans are complete prior to initiating a full review. • Use the ***plan review checklists*** and the ***stormwater BMP checklists*** as guides to help review plans.
Inspectors	• Use the ***construction inspection checklists*** to help verify the proper phasing, installation, and initial stabilization of a range of structural and non-structural practices.
Parties Responsible for Maintenance: municipalities, HOAs, etc.	• Use the ***maintenance inspection checklists*** during the periodic (e.g., annual or semi-annual) inspection of a range of structural and non-structural practices. • Help identify routine and non-routine maintenance tasks and repairs that are needed for stormwater BMPs.

The checklists are provided in Microsoft Excel format. The various checklist categories are listed below. Please note that it is anticipated that local stormwater managers should customize the checklists based on local codes, design guidelines and lessons learned.

POST-CONSTRUCTION DEVELOPMENT PLAN REVIEW

General Stormwater Management Plan Review
- Stormwater Management Concept Plan Review
- Stormwater Management Design Plan Review

Structural Post-Construction Stormwater BMPs
- Stormwater Ponds
- Stormwater Wetlands
- Filtration Practices
- Infiltration Practices
- Bioretention Facilities
- Open Channel Systems

Non-Structural Post-Construction Stormwater BMPs
- Natural Area Conservation and Restoration
- Sheetflow to Buffer
- Impervious Area Disconnection
- Grass Channels

CONSTRUCTION INSPECTION

Structural Post-Construction Stormwater BMPs
- Stormwater Ponds
- Stormwater Wetlands
- Filtration Practices
- Infiltration Practices
- Bioretention Facilities
- Open Channel Systems

Non-Structural Post-Construction Stormwater BMPs
- Natural Area Conservation and Restoration
- Sheetflow to Buffer
- Impervious Area Disconnection
- Grass Channels

MAINTENANCE INSPECTION

Structural Post-Construction Stormwater BMPs

- Stormwater Ponds
- Stormwater Wetlands
- Filtration Practices
- Infiltration Practices
- Bioretention Facilities
- Open Channel Systems

Non-Structural Post-Construction Stormwater BMPs

- Natural Area Conservation and Restoration
- Sheetflow to Buffer
- Impervious Area Disconnection
- Grass Channels

TOOL 7

Post-Construction Guidance Manual

Performance Bond

This is one of several tools designed to assist local stormwater managers with the development of their post-construction stormwater program. The tools are a companion to the Post-Construction Guidance Manual (www.cwp.org/postconstruction). The following tools are available:

Tool 1: Post-Construction Stormwater Program Self-Assessment

Tool 2: Program & Budget Planning Tool

Tool 3: Post-Construction Stormwater Model Ordinance

Tool 4: Codes & Ordinance Worksheet (COW)

Tool 5: Stormwater Manual Builder

Tool 6: Plan Review, BMP Construction, and Maintenance Checklists

Tool 7: Performance Bonds

Tool 8: BMP Evaluation Tool

For more information on the Post-Construction Guidance Manual, contact the Center for Watershed Protection, 8390 Main Street, 2nd floor, Ellicott City, MD 21046, 410-461-8323

center@cwp.org

www.cwp.org.

Users' Guide to the Post-Construction Performance Bond Tool

USERS' GUIDE TO THE POST-CONSTRUCTION PERFORMANCE BOND TOOL

Performance bonds are financial tools used to guarantee that construction work affecting the public interest is performed in an appropriate manner and in accordance with appropriate codes and ordinances. In a typical stormwater management performance bond, a site developer or property owner guarantees that construction of stormwater practices will be completed in accordance with the terms of a stormwater ordinance and an approved stormwater management design plan. Should the site developer or property owner fail to initiate or complete construction of the stormwater practices according to the terms of the ordinance and approved design plan, the performance bond ensures that enforcement action can be taken by the jurisdiction at the site developer's or property owner's expense.

Fundamentally, a performance bond is a legal contract between the jurisdiction and the site developer or property owner. Depending on a jurisdiction's bonding requirements and bond forms, there may be up to three parties named in the contract, including:

- Principal: The party responsible for completing the requirements of the contract according to the approved stormwater management design plan and stormwater ordinance. The Principal is typically either the property owner or a site developer with appropriate authority to act on the property owner's behalf.
- Guarantor: The party providing the security or collateral in the form of a Cashier's Check, Letter of Credit, or Surety Bond. Depending on the form of security or collateral provided, the Guarantor may or may not be explicitly named in the contract.
- Beneficiary: The party receiving the benefits should the Principal fail to comply with the requirements of the stormwater management design plan and stormwater ordinance. The jurisdiction within which the project is taking place is always the Beneficiary. Should the Principal fail to comply with the stormwater management design plan and/or stormwater ordinance, the Beneficiary would receive up to the full amount of the Bond from the Guarantor in a timely manner.

PERFORMANCE BOND PROCESS

The total dollar value of a performance bond is usually calculated as a percentage (typically 100%) of the estimated construction cost of the stormwater practice(s). Depending on the jurisdiction, either the Stormwater Authority or the applicant is responsible for determining the total required dollar value of the performance bond, based on the estimated construction cost. The estimate can be completed using cost information from past projects or from established cost estimating tools, such as the RS Means manuals. See the **Performance Bond Cost Estimating Worksheet.**

Once a performance bond has been submitted by a site developer or property owner, it is reviewed and approved by the jurisdiction. Typically, the performance bond for a particular project is submitted at the same time as the stormwater management design plan and must be accepted before the stormwater management design plan is approved.

DURATION FOR PERFORMANCE BONDS

Performance bonds should remain in full force and effect for the full duration of a site development or redevelopment project. They are usually released within a defined period of time following project completion, typically within 60 days of issuance of a Stormwater Certificate of Completion by the Stormwater Authority or final acceptance of the stormwater

management practices by the Stormwater Authority. A local stormwater manager may also wish to adopt provisions for a partial pro-rata release of the performance bond at the completion of various stages or phases of construction

A local stormwater manager may also wish to extend the duration of a performance bond to cover an additional reasonable period of time (e.g. an additional 90 days) during which the stormwater BMPs are tested during storm events and initial maintenance activities are monitored. Alternatively, a local stormwater manager may require the issuance of a maintenance bond for site development and redevelopment projects. Similar in legal structure to a performance bond, a maintenance bond is a guarantee that the site developer, property owner, or responsible maintenance party will maintain a site's stormwater practices for a fixed period of time (e.g., two years). At the end of the period for the maintenance bond, the jurisdiction may inspect the system and extend the maintenance bond requirement if all of the original contract stipulations are not met.

PERFORMANCE BOND TOOL

To those unfamiliar with contract law and legal terminology, determining what should or shouldn't be included in a performance bond program can be challenging. To eliminate some of the confusion and help local stormwater managers develop a performance bond program, this **Performance Bond Tool** was developed. The tool includes:

- Basic introduction to performance bonds
- Sample performance bond forms
- Sample performance bond instructions
- Sample bond estimating worksheet (Excel format)

Please note that this **Performance Bond Tool** is only intended to provide local stormwater managers with basic information regarding performance bonds. It does not contain all of the guidance necessary to create and administer a local performance bond program, which requires expertise in contract law and familiarity with general legal terminology. Therefore, it is highly recommended that local stormwater managers enlist the help of a qualified attorney to assist in the development of a local performance bond program. At the very least, all performance bond procedures and standard forms should be reviewed and approved by an attorney before they are put into use. Links to several example performance bond programs can be found in the **Manual Building Tool**.

Stormwater Management Performance Bond (Surety)

BOND NUMBER _____

FOR CITY/TOWN/VILLAGE USE ONLY

Project Name: _____

File Number: _____

CITY/TOWN/VILLAGE OF *[NAME OF CITY/TOWN/VILLAGE]*
STORMWATER MANAGEMENT PERFORMANCE BOND
(SURETY)

KNOW ALL MEN BY THESE PRESENTS, that _____ _____, as Principal, and _____ _____, a corporation in the State of _____, duly authorized as a surety company to transact business in the State of _____, as Surety, are held and firmly bound unto the *[City/Town/Village]* of *[Name of City/Town/Village]*, a municipal corporation under the laws of the State of *[State]*, as Obligee, in the amount of _____ _____ Dollars ($ _____), for the payment whereof Principal and Surety unconditionally bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal desires to engage in land development or redevelopment activity in accordance with the terms of *[Chapter/Section/Ordinance]* *[No.]* *[of the Code]* of the *[City/Town/Village]* of *[Name of City/Town/Village]* on property owned by _____ _____ and described as _____ _____ as shown on the plans entitled _____ prepared by _____ and dated _____.

AND WHEREAS, the Principal has submitted to the *[Name of Stormwater Authority]* for approval a Stormwater Management Design Plan for the above described land development or redevelopment activity, that satisfies the requirements of *[Chapter/Section/Ordinance]* *[No.]* *[of the Code]* of the *[City/Town/Village]* of *[Name of City/Town/Village]*, which is by reference made a part of this Bond and is hereinafter referred to as "the Stormwater Management Design Plan".

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is such that if approval is granted by the *[Name of Stormwater Authority]* for the above described Stormwater Management Design Plan, and, if Principal shall promptly and faithfully perform the activities required under the Stormwater Management Design Plan and all changes thereof, and, if Principal shall fully secure and protect the Obligee from all liability and from all loss or expense of any kind, including all court costs and attorneys' fees made necessary or arising from the failure, refusal or neglect of Principal to comply with all obligations assumed by Principal in connection with the performance of activities required under the Stormwater Management Design Plan and all changes thereof, then this obligation shall be null

and void; otherwise it shall remain in full force and effect.

Surety hereby stipulates and agrees that no extension of time, alteration of or addition to the above described Stormwater Management Design Plan shall in any way affect its obligation under this Bond and Surety does hereby waive notice of any extension of time, alteration of or addition to the above described Stormwater Management Design Plan.

Whenever Principal shall fail and is declared by the Obligee to have failed to perform the activities required under the Stormwater Management Design Plan and all changes thereof, the Obligee having performed Obligee's obligations under the terms of *[Chapter/Section/Ordinance]* *[No.]* *[of the Code]* of the *[City/Town/Village]* of *[Name of City/Town/Village]* ;

(1) Surety, upon demand of Obligee, may take over and promptly complete the activities required under the Stormwater Management Design Plan and all changes thereof.

(2) Obligee, after reasonable notice to Surety, or without notice to Surety in case of emergency, may arrange to complete the activities required under the Stormwater Management Design Plan and all changes thereof. Surety shall reimburse Obligee such reasonable expenses incurred during this process; however, in no event shall the aggregate liability of Surety exceed the amount of this Bond.

No right of actions shall accrue on this Bond to or for the use of any person or corporation other than the Obligee named herein.

This bond shall terminate at the expiration of sixty (60) days from the date of issuance of a Stormwater Certificate of Completion by the *[Name of Stormwater Authority]* ; however, such termination shall not discharge said Surety from any liability already accrued under this obligation.

CERTIFICATION

Signed and sealed this _____ day of _____ , 20 _____.

_____	_____
PRINICPAL	SURETY
By _____	By _____
SIGNATURE	SIGNATURE
Title _____	Title _____
	Address _____
_____	_____
ATTEST (Corporate Secretary)	_____

(ATTACH SURETY'S POWER OF ATTORNEY)

ACKNOWLEDGEMENT

STATE OF _____

COUNTY OF _____

I, _____ a Notary Public in and for said county, do hereby certify that _____ who is personally known to me to be the same person whose name is subscribed to the foregoing instrument on behalf of SURETY, appeared before me this day in person and acknowledged respectively, that he/she signed, sealed, and delivered said instrument as his/her free and voluntary act for the uses and purposes therein set forth.

Given under my hand and notarial seal this _____ day of _____ , 20 _____ .

_____ My commission expires _____

NOTARY SIGNATURE

APPROVAL

APPROVAL AS TO FORM

_____ _____

[City/Town/Village] Attorney Date

ACCEPTANCE

_____ _____

Authorized Agent of Stormwater Authority Date

Stormwater Management Performance Bond (Non-Surety)

BOND NUMBER _____

FOR CITY/TOWN/VILLAGE USE ONLY

Project Name: _____

File Number: _____

CITY/TOWN/VILLAGE OF *[NAME OF CITY/TOWN/VILLAGE]*
STORMWATER MANAGEMENT PERFORMANCE BOND
(NON-SURETY)

KNOW ALL MEN BY THESE PRESENTS, that _____ _____, as Principal, is held and firmly bound unto the *[City/Town/Village]* of *[Name of City/Town/Village]*, a municipal corporation under the laws of the State of *[State]*, as Obligee, in the amount of _____ _____ Dollars ($ _____), for the payment whereof Principal unconditionally binds itself, its heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents. To secure the above described payment, Principal has provided the Obligee with the following security, in the full amount of this Bond;

☐ Irrevocable Letter of Credit No. _____ issued by _____

☐ Cashier's Check No. _____

WHEREAS, the Principal desires to engage in land development or redevelopment activity in accordance with the terms of *[Chapter/Section/Ordinance]* *[No.]* *[of the Code]* of the *[City/Town/Village]* of *[Name of City/Town/Village]* on property owned by _____ _____ and described as _____

_____

as shown on the plans entitled _____

prepared by _____

and dated _____.

AND WHEREAS, the Principal has submitted to the *[Name of Stormwater Authority]* for approval a Stormwater Management Design Plan for the above described land development or redevelopment activity, that satisfies the requirements of *[Chapter/Section/Ordinance]* *[No.]* *[of the Code]* of the *[City/Town/Village]* of *[Name of City/Town/Village]*, which is by reference made a part of this Bond and is hereinafter referred to as "the Stormwater Management Design Plan".

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is such that if approval is granted by the *[Name of Stormwater Authority]* for the above described Stormwater Management Design Plan, and, if Principal shall promptly and faithfully perform the activities required under the Stormwater Management Design Plan and all changes thereof, and, if Principal shall fully secure and protect the Obligee from all liability and from all loss or expense of any kind, including all court costs and attorneys' fees made necessary or arising from the failure, refusal or neglect of Principal to comply with all obligations assumed by Principal in connection with the performance of activities required

under the Stormwater Management Design Plan and all changes thereof, then this obligation shall be null and void; otherwise it shall remain in full force and effect.

Whenever Principal shall fail and is declared by the Obligee to have failed to perform the activities required under the Stormwater Management Design Plan and all changes thereof, the Obligee having performed Obligee's obligations under the terms of *[Chapter/Section/Ordinance]* *[No.]* *[of the Code]* of the *[City/Town/Village]* of *[Name of City/Town/Village]* , the above described security shall be forfeited to the Obligee to ensure the completion of the activities required under the Stormwater Management Design Plan and all changes thereof. No right of actions shall accrue on this Bond to or for the use of any person or corporation other than the Obligee named herein.

This Bond shall terminate at the expiration of sixty (60) days from the date of issuance of a Stormwater Certificate of Completion by the *[Name of Stormwater Authority]* ; however, such termination shall not discharge said Principal from any liability already accrued under this obligation.

CERTIFICATION

Signed and sealed this _____ day of _____ , 20 _____.

_____

PRINICPAL

By _____

SIGNATURE

Title _____

_____

WITNESS

ACKNOWLEDGEMENT

STATE OF _____

COUNTY OF _____

I, _____ a Notary Public in and for said county, do hereby certify that _____ who is personally known to me to be the same person whose name is subscribed to the foregoing instrument on behalf of PRINCIPAL, appeared before me this day in person and acknowledged respectively, that he/she signed, sealed, and delivered said instrument as his/her free and voluntary act for the uses and purposes therein set forth.

Given under my hand and notarial seal this _____ day of _____ , 20 _____ .

_____ My commission expires _____

NOTARY SIGNATURE

APPROVAL

APPROVAL AS TO FORM

_____ _____

[City/Town/Village] Attorney Date

ACCEPTANCE

_____ _____

Authorized Agent of Stormwater Authority Date

Irrevocable Letter of Credit

IRREVOCABLE LETTER OF CREDIT

(On Bank or Lending Institution Letterhead)

Letter of Credit Number: _____
Date: _____

[City/Town/Village] of *[Name of City/Town/Village]*
[Street Address]
[City, State, Zip Code]

Attn: *[Authorized Agent of Stormwater Authority]*

Gentlemen,

We hereby extend our irrevocable credit to the *[City/Town/Village]* of *[Name of City/Town/Village]*, a municipal corporation under the laws of the State of *[State]*, in the amount of _____ Dollars ($ _____), to guarantee that land development or redevelopment activity on property owned by _____ and described as _____ as shown on the plans entitled _____ prepared by _____ and dated _____, will be promptly and faithfully completed by _____ in accordance with the terms of *[Chapter/Section/Ordinance]* *[No.]* *[of the Code]* of the *[City/Town/Village]* of *[Name of City/Town/Village]*.

We hereby guarantee that the above described amount shall be available upon demand by the *[City/Town/Village]* of *[Name of City/Town/Village]*, available by your draft drawn on site, marked "Drawn under Letter of Credit Number _____", and accompanied by this Letter of Credit and a signed statement by an authorized agent of the *[Name of Stormwater Authority]* certifying that the Obligee has failed to perform the development or redevelopment activity in accordance with the terms of *[Chapter/Section/Ordinance]* *[No.]* *[of the Code]* of the *[City/Town/Village]* of *[Name of City/Town/Village]*. Partial and multiple draws will be accepted and any draft may draw up to the entire remaining balance of this Letter of Credit.

The *[City/Town/Village]* of *[Name of City/Town/Village]* may submit its site drafts without the consent of _____ or any other party. Said drafts shall be duly honored upon presentation of documents as specified within this Letter of Credit.

This letter of credit shall terminate at the expiration of sixty (60) days from the date of issuance of a Stormwater Certificate of Completion by the *[Name of Stormwater Authority]*.

Very truly yours,

_____

BANK OR LENDING INSTITUTION

By _____

SIGNATURE

Title _____

Instructions for Stormwater Management Performance Bond

INSTRUCTIONS FOR STORMWATER MANAGEMENT PERFORMANCE BOND

GENERAL INSTRUCTIONS

- Allowable forms of performance bond securities include Surety Bonds (Insurance Company Bonds), Letters of Credit, and Cashier's Checks.

- The value of all performance bonds and accompanying securities will be 100% of estimated construction cost.

- All bond forms shall be submitted in triplicate (white, yellow, pink). Each form shall contain original signatures and original Notary Public acknowledgement.

- All completed forms shall be transmitted to the Stormwater Authority for processing. No stormwater permits will be issued until the bond forms are completed and accepted.

- Once received by the Stormwater Authority, all three copies of the completed bond forms will be forwarded to the *[City/Town/Village]* attorney (under an appropriate letter of transmittal), who will approve the documents as to form. Upon approval, the *[City/Town/Village]* attorney will keep the yellow copy and return the white and pink copies to the Stormwater Authority. The stormwater authority will retain the white copy. The applicant will be provided with the yellow copy.

- For Surety Bonds, the bond number shall be the Surety's bond number. For Non-Surety Bonds, the bond number shall be the project file number.

INSTRUCTIONS FOR SURETY BONDS

- Requires only the Surety bond form.

- The bond number shall be the Surety's bond number.

- Notary Public shall complete Acknowledgement section.

  Principal (Applicant)
  Paragraph 1
  Principal shall enter name/corporation name.

  Paragraph 2
  Principal shall enter name of property owner upon which development or redevelopment activity will occur.
  Principal shall enter brief description of development or redevelopment activity.

Principal shall enter title of engineering plans prepared for development or redevelopment activity.
Principal shall enter name of entity that prepared the engineering plans for the development or redevelopment activity.
Principal shall enter date of engineering plans.

Certification
Principal shall enter name/corporation name in certification section.
Principal (or representative) shall sign name in certification section.
Principal (or representative) shall enter title.
Attest (witness) shall sign name.

Surety
Header
Surety shall insert bond number in upper left-hand corner of first page.

Paragraph 1
Surety shall insert corporation name.
Surety shall insert state of incorporation.
Surety shall insert state within which the development or redevelopment activity will occur.

Certification
Surety shall enter date.
Surety shall enter corporation name.
Attorney-in-fact shall sign name and include title.
Attorney-in-fact shall include agency address
Surety shall furnish three (3) copies of Power of Attorney form; one for each bond form.

INSTRUCTIONS FOR NON-SURETY BONDS

- Requires the Non-Surety bond form and the appropriate form of security (letter of credit or cashier's check).

- For Non-Surety Bonds, the bond number will be the same as the project file number.

- Notary Public shall complete Acknowledgement section.

Principal (Applicant)
Paragraph 1
Principal shall enter name/corporation name.
Principal shall check appropriate form of security and enter appropriate information.

Paragraph 2
Principal shall enter name of property owner upon which development or redevelopment activity will occur.
Principal shall enter brief description of development or redevelopment activity.
Principal shall enter title of engineering plans prepared for development or redevelopment activity.
Principal shall enter name of entity that prepared the engineering plans for the development or redevelopment activity.
Principal shall enter date of engineering plans.

Certification
Principal shall enter name/corporation name in certification section.
Principal (or representative) shall sign name in certification section.
Principal (or representative) shall enter title.
Attest (witness) shall sign name.

INSTRUCTIONS FOR LETTER OF CREDIT

- Requires Letter of Credit from bank and Non-Surety bond form.
- Bank shall prepare Letter of Credit on bank's letterhead in accordance with format and requirements of standard form.
- Applicant shall complete Non-Surety bond form.

INSTRUCTIONS FOR CASHIER'S CHECK

- Requires Cashier's Check issued by bank and Non-Surety bond form.
- Applicant shall complete Non-Surety bond form.

Tool 8: BMP Performance Verification Tool (for Proprietary BMPs)

Center for Watershed Protection, Inc.

December 31, 2008

Introduction to the BMP Performance Verification Tool

The number and types of proprietary stormwater BMPs have proliferated rapidly. While determining pollutant removal rates for non-proprietary structural BMPs is a constant challenge, the task of assigning and verifying rates for the ever-expanding menu of proprietary devices is even more daunting. Manufacturer claims can be difficult to verify, and the removal mechanisms and design flows of many proprietary devices are not clearly stated.

Local stormwater managers must make decisions about which BMPs are acceptable for use in their community and yet the vast majority of local stormwater managers may not have the benefit of state-level programs to assist with these decisions.

This BMP (Best Management Practice) Performance Verification Tool is designed for use by local stormwater managers to guide decision-making about BMP verification and approval.

The Tool guides local stormwater managers through a deliberate, systematic, repeatable and transparent process of performance evaluation. It consists primarily of:

1. A checklist that can be incorporated into the local regulatory program and modified for a community's specific needs.
2. A table that describes and differentiates between the major existing BMP performance verification protocols and testing progams.
3. An appendix that describes basic concepts and definitions in BMP performance verification.

It is hoped that dissemination of this performance tool will result in a systematic evaluation process that promotes equitable and non-arbitrary evaluation of proprietary devices for the joint benefit of local stormwater programs, project civil engineers, and the BMP industry.

How to Use the Tool

The checklist contains 5 basic steps (or tabs) that can be completed by either the local stormwater approval authority or the BMP vendor to help clarify the basic design, strengths and weaknesses of a specific device, and whether or not to approve use of the device for a given project or site.

This process can also be used to determine whether the BMP should be pre-approved for other similar sites or applications, so that the process does not need to be repeated with every new site plan seeking to utilize the same BMP. A description of each step in the BMP Tool Checklist is provided below.

Tool 8: BMP Performance Verification Tool (for Proprietary BMPs)

Center for Watershed Protection, Inc.
December 31, 2008

The Checklist

The checklist consists of the following sections which are to be filled out as indicated below.

Section 1: BMP Approval Context (To be completed by local program authority) This includes basic information on the context under which a device is being considered for use, including pollutants of concern with special attention to particle size distribution.

Section 2: BMP Information (To be completed by vendor)
This tab includes basic parameters, such as warranty information, product history and precedent, and design strategy employed by the device to treat water quality and/or quantity.

Section 3: Performance Testing and Performance Verification (To be completed by vendor) This section asks the vendor to define any independent performance certifications provided by the major verification entities as well as the results of any in-house testing.

Section 4: Maintenance (To be completed by vendor) This section asks the vendor a series of basic questions regarding maintenance and provides a list of itemized annual maintenance costs for the regulator or project engineer to consider.

Section 5: Total Device Costs (To be completed by vendor) This section contains a simple spreadsheet to make sure all cost parameters are included in cost estimation, including unit costs, shipping, special design considerations and installation.

Section 6: Decision Status (To be completed by local program authority) The local program authority uses the information compiled in Sections 1 through 4 of the checklist, along with professional judgment, to approve, conditionally approve, or deny use of the BMP for the site in question and/or for general use within the jurisdiction.

A “conditional approval” may permit the vendor to install a small number of devices in the jurisdiction for testing purposes or allow the local program authority to request more information from the vendor prior to making a final decision and/or apply specific “conditions of approval” to accepting the BMP. The “Decision Status” tab provides suggested conditions of approval based on various “red flags” regarding pollutant removal requirements, maintenance issues, or the design and function of the device. The local program authority should modify or customize the decision status tab to best meet the local regulatory context.

The user should note that the checklist includes parameters that are the basis to approve, conditionally approve, or deny use of the specific BMP. However, these parameters are not comprehensive. Local approval authorities will likely have unique requirements and are encouraged to revise, lengthen, shorten or create a new list of parameters in order to best document BMP approval decisions.

Appendices

A set of technical appendices are provided to assist the local program authority in understanding and setting minimum criteria for evaluating BMPs and navigating the world of BMP evaluation and testing.

- Appendix A: Evaluating BMP Efficiency
- Appendix B: Review of Existing BMP Evaluation Protocols and Testing Bodies
- Appendix C: Additional Resources
- Appendix D: References

Summary of Recommendations

Evaluating BMP Performance:

- Don't confuse BMP efficiency with BMP performance or effectiveness (see Appendix A for more information).
- Avoid using percent removal as the single measure of BMP efficiency. Rather, statistically determine the difference between influent and effluent quality, and/or focus on runoff reduction. See Appendix A for further explanation and guidance.
- As a general rule, concentration-based methods often result in slightly lower performance efficiencies than mass-based methods.
- Using concentration data alone may be misleading if the concentration is near the "irreducible level," which is the concentration below which the BMP cannot effectively trap or treat more pollutants.
- Use Suspended Sediment Concentration (SSC) when available in lieu of Total Suspended Solids (TSS) as measure of sediment concentration.
- Clearly identify the particle size distribution (PSD) being used by the vendor in testing the BMP.
    - The PSD should primarily consist of fine to medium size particles of 5-250 micron size range.
- Use flow-weighted, event mean concentrations (EMCs) so that the less frequent, larger storms do not dominate evaluation methods.
- Set minimum standards for vendor data quality objectives (DQOs).
- Determine the relative maintenance burden and requirements early in the BMP evaluation process – at the time of initial plan review.

Available Resources:

- Check to see if your State agency has already approved a specific proprietary device for use in the State.
- If you are in CA, MA, MD, NJ, PA, VA, or IL you can look to the results of demonstration projects using TARP (testing protocols by state environmental agencies.
    - Note however that your state (if participating in TARP) may have specific caveats for BMP performance testing, so results from other TARP participants should be scrutinized.
- You can consider using those BMPs certified by NJCAT, which uses TARP testing protocol, but note that NJCAT tests use caveats specific to NJ.
    - NJCAT has certified 10 BMPs in 10 years.
- If your project is in MA, look to MASTEP for guidance, which is specific to Massachusetts. MASTEP also uses TARP testing protocols. Unfortunately no BMPs have been certified by MASTEP to date.
- If you reside in Washington State, you can defer to TAPE, which has approximately 13 devices certified for general use in the State.
- The International BMP Database has information on 340+ BMPs and is a good source for quality controlled data, but is not geographically specific and The Database is not a certifying or BMP-approving entity. You can use this Tool to help you scrutinize the results posted in The Database and decide if the BMP in question is appropriate for your needs.
    - The EPA Urban BMP Tool is a more user-friendly compilation of information on approximately 275 BMPs previously compiled by The International BMP Database.

Acronyms:

MASTEP: Massachusetts - Stormwater Evaluation Project
NJCAT: New Jersey Corporation for Advanced Technology
TAPE: Technology Assessment Protocol - Ecology
TARP: Technology Acceptance and Reciprocity Partnership

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Acknowledgments

This tool was made possible, in part, through a grant from CONTECH Stormwater Solutions. We thank CONTECH for their support and foresight to see the utility of a tool such as this. The final product was in no way influenced by the interests of CONTECH to promote certain products or suggest their approval by state or local agencies.

Peer review of the tool was provided by many individuals. We would like to thank the following individuals for volunteering their time to make edits and recommendations on the various iterations of the tool. They include: Joe Battiata and Jim Lenhart of CONTECH Stormwater Solutions; Scott Perry and Maita Pang of Imbrium Systems; Denise Y. Campbell of PEPCO Holdings Inc., Walter Caldwell, Tim Karikari, Pablo Gonzalez, Massoud Massoumi and Abdi Musse regulators with the Government of the District of Columbia Watershed Protection Division; Catherine Johnson of the Orange County Environmental Protection Division; Michael Clar of ECOSITE Inc; Vincent Berg of Aqua Shield Inc.; Mohsin Siddique of DC Water and Sewer Authority; and staff from The Center including Kelly Collins, Greg Hoffmann, Bernadette DeBlander, Neely Law, Mike Novotney and Karen Cappiella.

A draft version of the tool was presented to other private sector industry staff and State regulators at a Virginia BMP Clearinghouse Research Protocol Subcommittee in 2008. Subcommittee members, including staff from AMERICAST (makers of Filterra©), Imbrium Systems, CONTECH Stormwater Solutions, Hydro International, Scott Crafton of Virginia Department of Conservation and Recreation, and Jane Walker of Virginia Polytechnic Institute and State University's Virginia Water Resources Research Center, were invited to give comments.

The Center staff who worked on this tool include: Alexi Boado, Neely Law, David Hirschman, and Karen Cappiella.

Major Stormwater BMP Evaluation Protocols & Testing Bodies

January 2008	TARP (Technology Acceptance Reciprocity Partnership)	TAPE (Technology Assessment Protocol – Ecology, WA)	NJCAT (New Jersey Corporation for Advanced Technology)	International BMP Database (ASCE BMP Database)	ETVP (Envir. Tech. Verification Program)	MASTEP (MA - Stormwater Evaluation Project)
Entity Type	Data/testing standardization.	State-specific performance testing.	State-specific performance testing.	Data clearinghouse.	Performance testing.	State-specific performance verification.
Primary documents used to make this comparison:	The Technology Acceptance Reciprocity Partnership *Protocol for* Stormwater Best Management Practice Demonstrations, 7/2003 (Revised) http://www.dep.state.pa.us/dep/deputate/pollprev/techservices/tarp/pdffiles/Tier2protocol.pdf	Guidance for Evaluating Emerging Stormwater Treatment Technologies, 2004 (revised) http://www.ecy.wa.gov/biblio/0210037.html. http://www.ecy.wa.gov/pubs/0210037.pdf	http://www.njcat.org/ewebeditpro/items/O56F8236.doc http://www.state.nj.us/dep/dsr/bscit/NJStormwater_TierII.pdf http://www.state.nj.us/dep/dsr/bscit/Documents.htm http://www.state.nj.us/dep/dsr/bscit/TestProcedure_Dec%2703_.pdf http://www.state.nj.us/dep/dsr/bscit/BMPManual.pdf http://www.njcat.org/verification/protocol.cfm	FAQ Background v1.pdf (updated October 14, 2007) http://www.asce.org/community/waterresources/nsbmpdb.cfm http://cedb.asce.org/cgi/WWWdisplay.cgi?9903169 -Verbal communication with Jane Clary from Wright Engineers. -Policy on Inclusion of Proprietary Device Data in the International Stormwater BMP Database1	http://www.nsf.org/business/water_quality_protection_center/index.asp?program=WaterQuaProCen ETV Verification Protocol Stormwater Source Area Treatment Technologies, V.4.1 3/2002 http://www.nsf.org/business/water_quality_protection_center/pdf/StormwaterProtocolDraft4-1.pdf -verbal communication with Jim Bachhuber of EarthTech Inc.	http://www.mastep.net http://www.mastep.net/documents/finalS319FY04.pdf
Year Established	2001	2001	1997	1996	1999-2007 (~20 BMPs tested until funds dried up.)	2004
Host(s) / Partners	Pennsylvania Dept of Environmental Protection; University of Massachusetts @ Amherst	Washington State University Dept. of Ecology ("Ecology")	NJCAT is an independent non-profit, private-public collaboration. New Jersey Department of Environmental Protection (Commissioner serves as an *ex-officio* board member).	Started 1996: EPA, ASCE (asce.org). In 2004 added: WERF (werf.org); EWRI of ASCE (ewrinstitute.org); USDOT-FHA (fhwa.dot.gov); APWA (apwa.net); WWE (wrightwater.com); GEOSYNTEC (geosyntec.com).	The Wet Weather Flow Technologies Pilot is operated under the direction of the USEPA National Risk Management Research Laboratory, Urban Watershed Management Branch, Edison, NJ, and its verification partner, NSF International (NSF). EPA gave National Sanitation Foundation grant. NSF subcontracted EarthTech Inc. (developed field testing protocol, analyzed data and wrote report),	University of Massachusetts at Amherst with funding from an EPA s. 319 competitive grant to the MA Department of Environmental Protection (MADEP) ;http://www.mass.gov/dep/

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					USGS did field monitoring and data collection.	
Endorsed by / Geographic Scope (*Note inclusion in more than one program)	*CA, *MA, MD, *NJ, PA, VA, IL.	WA, (*CA also, personal communication – Larry Kauffman of Filterra Inc.)	*NJ	Not geographically specific. Includes data from US, Canada and Sweden. Florida Department of Environmental Protection BMP Database Integrated into the Database.	Nation-wide/Not regional. Testing took place in GA, MI and WI.	*MA
Supporting URL(s)	http://www.dep.state.pa.us/dep/deputate/pollprev/techservices/tarp/ (Searchable database)	http://www.ecy.wa.gov/biblio/0210037.html http://www.ecy.wa.gov/programs/wq/stormwater/newtech/index.html	http://www.njcat.org	http://bmpdatabase.org/ or http://nswbmp.geosyntec.com/index.htm (website and database maintained by GeoSyntec and Wright Water Engineers)	http://www.epa.gov/etv/verifications/protocols-index.html	http://www.mastep.net/index.cfm
Reciprocity	Formalized via MOU between signatory states, (*CA, *MA, MD, *NJ, PA, VA, IL.) but each state has superseding state-specific requirements.	WA State only. However, laboratory and/or field performance data obtained in states using other protocols such as the ETV and TARP Protocols will be considered for PLD and GULD status within the constraints of TAPE.	N/A. NJCAT is NJ specific and performance verification is not collaborative across states. NJ uses TARP testing protocol with special requirements. (See below)	N/A. IBMPDB is not state or regionally specific. • Data is solicited by IBMPDB from all sectors. • Entity does NOT verify or approve. • There is a standard reporting protocol.	N/A. ETVP is not state or regionally specific. Not recommending BMPs. Just verifying vendor claims.	N/A. MA use only. However, MASTEP uses TARP Tier II verification and testing protocol.

Major Stormwater BMP Evaluation Protocols & Testing Bodies

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				• Data is quality controlled by partners and statistical analysis of data performed by partners.		
Certification / Approval of a Specific BMP for use?	YES, but by states individually.	YES	YES	NO	NO	YES
Performance Verification?	YES, but by states individually.	YES	YES	NO	YES (as per project name)	YES
# of BMPs as of October 2008.	N/A – This is only a testing protocol.	30 See: http://www.ecy.wa.gov/programs/wq/stormwater/newtech/technologies.html	12 See: http://www.state.nj.us/dep/dsr/bscit/CertifiedMain.htm	343 See: http://bmpdatabase.org/Docs/Summary%20of%20BMP%20Types%20by%20State.pdf	10 See: http://www.epa.gov/nrmrl/std/etv/vt-wqp.html#SWSATD http://www.epa.gov/nrmrl/std/etv/pubs/600s07003.pdf	45 proprietary devices or devices with proprietary components, but none have achieved "Category 1". (see below) See: http://www.mastep.net/database/data.cfm
Purpose of Entity / Protocol	This stormwater protocol ensures that technologies are evaluated in a uniform manner assuring minimum standards for quality assurance and quality control (QA/QC). In addition, the protocol establishes an interstate reciprocity pathway for technology and regulatory acceptance. (NJ BMP	Characterize, with a reasonable level of statistical confidence, an emerging technology's effectiveness in removing pollutants …for an intended application and to compare test results with vendor's claims (p.13). Program is not intended to be used for conducting research on	NJCAT's environmental/energy technology program integrates education and training, develops testing protocols and verifies the performance of innovative technologies that improve protection of human health and the environment. NJCAT verification provides the regulators and the marketplace	The purpose of this project is to improve water quality nationwide by sharing consistent and transferable information on stormwater best management practices. The database will help water quality professionals across the U.S. learn about successful BMPs and apply proven	Verification of performance claims for air & water pollution control, recycling, and greenhouse gas technologies. Verification of a technology under the ETV program does not constitute "certification" or "approval" by NSF or EPA. Rather it means that the	The goal of this project is to provide technology transfer information via a searchable website, about innovative stormwater Best Management Practices (BMPs) to MADEP, conservation commissions, local officials, and other BMP users to help them make

Major Stormwater BMP Evaluation Protocols & Testing Bodies

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	Manual, 2004) Using the Tier guidance document will: **1)** Reduce duplicative demonstration and testing of technologies; **2)** Expedite multi-sate technology acceptance; **3)** Reduce cost for both vendors and state regulators. The TARP program does not specify target performance standards, only data collection and quality control standards. Use TARP to determine if product meets performance claims. First providing general guidance on data collection and evaluation (**Tier 1**); and eventually providing technology specific guidance for specific classes of technologies (**Tier 2**) followed by guidance for permitting and approvals of certain technologies (**Tier 3**). The Tier II protocol	experimental devices. Ecology will not consider an application for a Pilot Level Designation (**PLD**), Conditional Use Designation (**CUD**), or a General Use Level Designation (**GULD**) unless the application includes sufficient performance data that clearly demonstrates acceptable feasibility and the likelihood that it will achieve desired performance levels at actual full-scale field conditions.	with the assurance that environmental performance claims are valid, credible and supported by quality independent test data and information. The New Jersey Corporation of Advanced Technology (NJCAT) verifies laboratory and field performance claims and the NJDEP reviews and certifies the NJCAT verification. (J. Lenhart, 2007)	methods to local water quality projects. By adding individual BMP study findings to the database, users can enrich its usefulness for a national audience. 1) Develop scientifically-based BMP performance monitoring and reporting protocols (GUIDANCE). 2) Collect and evaluate existing BMP design and performance data for meeting the monitoring and reporting protocols, (PERFORMANCE ASSESSMENT) . 3) Design, create, and populate a national stormwater BMP database with studies that meet the protocols, (DATABASE). 4) Develop BMP performance evaluation protocols, and (MONITORING PROTOCOL). 5) Evaluate the data collected	technology has been evaluated in accordance with a recognized ETV Protocol and that the results are available in an approved Verification Report and Verification Statement. This protocol describes the steps to be followed to ensure that verification activities are carried out in a consistent and objective manner that assesses the relevant performance characteristics of stormwater treatment technologies. It describes, in general terms, the process of selecting and documenting the verification tests to be conducted. The protocol also establishes requirements for sample collection and analysis and data reduction and reporting. The protocol provides guidelines for the preparation of verification test plans for specific technologies and test sites.	appropriate technology implementation decisions. Our objective is to assist communities to maximize environmental benefits of grant programs by focusing efforts on technologies that have the most promising potential to reach specific water quality objectives. A database/clearinghouse of stormwater treatment technologies has been created and information is being sought from product vendors. The searchable database includes a catalogue of various proprietary BMPs, their intended use and most importantly the status of verification of their performance claims. Technologies submitted to MASTEP undergo a

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Major Stormwater BMP Evaluation Protocols & Testing Bodies

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	document includes a section outlining specific requirements for participating states. However, even this summary does not address all of the additional requirements and modifications implemented by the individual TARP states. (Communication, Stephen George, GeoSyntec) A requirement of **Conditional Interim Certification** is the execution of field monitoring conducted in accordance with the Tier II Protocol to verify field performance claims relative to laboratory claims (TARP, 2003).			and report initial findings. Entity does NOT verify or approve BMPs.		performance data review process before being added to the database.
Stormwater Technological Scope	Structural and non-structural stormwater BMPs.	Structural and non-structural.	Proprietary, structural, only.	Structural and non-structural stormwater BMPs.	Proprietary, commercially-available, only. Only structural BMPs tested during program life.	Structural BMPs only; including pretreatment.
Stormwater Quality - Quantity Goals	1. Directing and distributing flows; 2. Reducing velocities; 3. Removing contaminants. Proponent must make a performance claim that	Performance claims may be; **Qualitative** (e.g., advantages over other technologies, Operations and Maintenance, etc.) and/or; **Quantitative** (e.g., load reductions and removal	NJCAT uses TARP testing protocol with special requirements for TSS regarding; 1) Site selection: TSS influent characteristics such as influent loading and particle size	Influent and effluent median concentrations need to be statistically significant.	Verification of performance claims. May relate to expected load reductions or removal efficiencies for specific pollutants or categories of pollutants.	Verification of performance claims. Studies are compared with the TARP Tier 2 Protocol to determine if study design and quality

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	identifies the technology's intended use and predict the technology's capabilities to remove contaminants and/or control the quantity of stormwater runoff.	efficiencies for specific pollutants or categories of pollutants).	distribution will be the determining factors for site selection as follows: i. The mean influent concentration of the sediments must be in the range of 100-300 mg/L. ii. The mean particle size must not exceed 100 µm. 2) Stormwater Data Collection. • At least three (3) influent samples from the overall 15 to 20 storms must be tested to establish the particle size distribution (PSD) for the site. • ETC. See: http://www.state.nj.us/dep/dsr/bscit/NJStormwater_TierII.pdf		But the pollutant reduction performance of a technology shall be evaluated in relation to **one or more** of the following pollutant categories: • sediment / particulates; • nutrients; • heavy metals; • petroleum hydrocarbons; • bacteria.	assurance/quality control measures are sufficient to produce a valid data set.
Data Gathered by…	By vendor.	By vendor.	By vendor.	By vendors BUT third-party data collection required. Data submitted must comply with relevant BMP Database QA/QC review procedures.	Field testing done by 3rd party selected by NSF.	By the BMP manufacturers and others, including verification studies.
Field Testing Required?	Yes	Laboratory and/or field performance.	Yes.	Yes	Yes	Yes, as per TARP Tier II.
Pre-Treatment / Course	Only if necessary to support performance claim.	• "PreTreatment";50% removal of 50 micron-mean size OR 80% 125 micron-mean size TSS w/influent	Only if necessary to support performance claim.	Only if necessary to support performance claim.	Only if necessary to support performance claim.	See TARP Tier II.

Major Stormwater BMP Evaluation Protocols & Testing Bodies

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Materials		conc. >100 mg/L and < 200mg/L. For influent < 100 mg/L, effluent goal is 50mg/L and 20mg/L respectively. • "Less than Basic Treatment/ Retrofit/Train"; Course solids removal as part of pretreatment or treatment train (debris >500 microns)				
TSS	Required. • Requires particle size distribution analysis.	"Basic Treatment"; TSS reduction of 80% when influent is 100-200 mg/L; If influent >200mg/L TSS, highter treatment goal "may be appropriate". * Typical particle size distribution, *On annual average basis to the entire discharge volume (treated + bypassed).	• See above.	Parameters that are selected for evaluation must be present or consistently and reliably derivable from the data in the majority of BMP reports. (pg 29 of http://www.bmpdatabase.org/Docs/task3_1.pdf)	Only if necessary to support performance claim.	See TARP Tier II.
SSC	Required	N/A	Required	Same as above.	Only if necessary to support performance claim.	See TARP Tier II.
Nitrogen	Only if necessary to support performance claim.	Not included in TAPE.	Only if necessary to support performance claim.	Same as above.	Only if necessary to support performance claim.	See TARP Tier II.
Phosphorous	Only if necessary to support performance claim.	TP reduction of 50% when influent is 0.1-0.5 mg/L TP.	Only if necessary to support performance claim.	Same as above.	Only if necessary to support performance claim.	See TARP Tier II.
Metals	Only if necessary to support performance claim.	Optional. "Enhanced [metals] Treatment"; For enhanced heavy metal	Only if necessary to support performance claim.	Same as above.	Only if necessary to support performance claim.	See TARP Tier II.

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Major Stormwater BMP Evaluation Protocols & Testing Bodies

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		removal; Cu influent of 0.003-0.02 mg/L & Zn 0.02-0.3 mg/L.				
Bacteria	Only if necessary to support performance claim.	Not included in TAPE.	Only if necessary to support performance claim.	Same as above.	Only if necessary to support performance claim.	See TARP Tier II.
Hydrocarbons / petroleum products	Only if necessary to support performance claim.	Oil; goal of no ongoing or recurring visible sheen. Total max daily avg. conc. of 10mg/L AND max of 15 mg/L for discrete grab sample.	Only if necessary to support performance claim.	Same as above.	Only if necessary to support performance claim.	See TARP Tier II.
Certification and / or Verification Process	Step 1: Technology specifications, performance claims, Test QA Plan scope (includes QAPP), performance claim data (if available, all validated by TARP. Step 2: Field Test Step 3: State Review / Acceptance Step 4: Verification / Certification. Varies by state specific state requirements. (See Appendix D, p. 21 from TARP)	1-Sponsor implements QAPP 2-Sponsor submits TEER (Tech Evaluation Engineering Report) to Ecology and TRC (Tech Review Committee) 3-Ecology and TRC review QAPP and TEER 4-Ecology publish pertinent info and determination at (p. 2): http://www.ecy.wa.gov/programs/wq/stormwater/newtech/index.html Note: Data accepted from TAPE, ETV, & TARP.	Two Step Verification / Certification Process: 1) Verification based on laboratory data leading to **Interim Certification**; 2) Verification field testing (TARP- Tier II) leading to **Final Certification.** Verification Team consisting of NJCAT staff , private sector, and academics, does verification.	N/A, not purpose of IBMPDB	Performance *verification* consists of **3 Phases:** **1. Planning** – involves establishing and documenting the procedures to be followed during the verification of a specific technology. This includes identifying a field testing organization and personnel responsible for performance and oversight of the testing. **2. Verification Testing** – This phase involves establishing the required test conditions, conducting the required tests, and the collection of the relevant data. **3. Data Assessment and Reporting** – This last phase	Initially, all technologies are considered unrated with regards to existence of reliable performance data. Once information from verification studies is reviewed, a technology is rated as explained below.

Major Stormwater BMP Evaluation Protocols & Testing Bodies

January 2008	TARP (Technology Acceptance Reciprocity Partnership)	TAPE (Technology Assessment Protocol – Ecology, WA)	NJCAT (New Jersey Corporation for Advanced Technology)	International BMP Database (ASCE BMP Database)	ETVP (Envir. Tech. Verification Program)	MASTEP (MA - Stormwater Evaluation Project)
					includes all data analysis and the preparation and dissemination of a Verification Report and Verification Statement.	
Evaluation Determination "System" / Nomenclature	Meets / Does Not Meet Performance Claims.	Use-level designations for each BMP; 1-**GULD** confers a general acceptance. 2-**CUD** are allowed for use while field and lab testing occurs; testing not necessary at all installations. 3-**PLD** allows limited use for field testing; sponsor agrees to conduct field testing based on TAPE at all installations (p. 6-9).	Performance claims agreed upon by vendor and NJCAT. NJCAT determines whether the technology performs as claimed.	Influent and effluent median concentrations need to be statistical significant.	A **Verification Statement** is generated that provides a brief description of the testing conducted and a synopsis of the performance results. The Verification Statement is intended to provide verified vendors a tool by which to promote the strengths and benefits of their product.	Meets / Does Not Meet Performance Claims. See TARP Tier II. **Category 0**: Unrated. Data review not yet conducted by MASTEP **Category 1**: There is sufficient TARP-compliant or similar reliable data on this technology to be able to evaluate pollution removal efficiency claims **Category 2**: Studies are underway that offer promise for reliable data in the near future **Category 3**: There is at present insufficient reliable data to evaluate claims
Third Party	Not required for data	Require: 3rd party complete data	• Require: Third party data	Required.	Requires 3rd party for all facets of	See TARP Tier II.

Major Stormwater BMP Evaluation Protocols & Testing Bodies

January 2008	TARP (Technology Acceptance Reciprocity Partnership)	TAPE (Technology Assessment Protocol – Ecology, WA)	NJCAT (New Jersey Corporation for Advanced Technology)	International BMP Database (ASCE BMP Database)	ETVP (Envir. Tech. Verification Program)	MASTEP (MA - Stormwater Evaluation Project)
Involvement	gathering.	validation report, TEER summary, and make recommendations on technology use level, info for posting on website, and additional testing (if needed), etc. Recommends: 3rd party, 1) oversee QAPP prep and implementation, 2) prepare data validation report, 3) prepare TEER. Verification by ETV depends on third party testing.	collection. • Allowed (i.e., organizations like NSF), provided that such verification is conducted in accordance with the Tier II Protocol. • Allowed to be done by signatory states using Tier II protocol. • Other testing protocols may be considered if it is determined by the NJDEP to be equivalent to the Tier II Protocol.	• Performance data must be collected by a third party and not by staff of the manufacturer or distributor / sellers of the device.	protocol, including but not limited to staff from EPA and NSF International.	
Strengths	• The only multi-state BMP verification protocol. • Allows for data sharing across states and as such addresses technology review and approval barriers in policy and regulations. • De facto cost sharing mechanism, since states can share results of individual monitoring efforts. • Requires 3rd party data collection.	• Actually **certifies** specific BMPs for use in WA. • Allows **pilot** and **conditional** use applications of BMPs which allows vendors to more easily pay for field testing requirement. • Requires individual storm reports (total precipitation, influent peak flow, effluent peak flow, bypass peak flow, total volume, influent volume, effluent volume, bypass volume, etc.). • Has specific WA standards for petroleum, metals and phosphorous.	• Actually **certifies** specific BMPs for use in NJ. • Allows "**interim conditional certification**" for implementation on case-by-case basis, • NJCAT is quasi-governmental and has a mandate beyond just BMP performance validation; including education/training, outreach., identifying alternative funding sources (such as state/federal grants or loans), sponsoring technology forums, exchange programs and	• Contains information on **340+ BMPs.** • Not geographically limited. • Public-private partnership. • Requires 3rd party data collection. • Federal Partnership (EPA and ASCE)	• Not geographically limited. • Federal government leadership in testing and verification of performance claims. • Requires 3rd party involvement in all aspects of verification process.	• User-friendly description of BMP technologies and related performance analyses which uses TARP Tier II protocol. • Is a "quality of performance data" screening tool. • Will screen technologies based on availability of performance data. Searchable by ; • BMP Type, • Cost (per unit, per

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Major Stormwater BMP Evaluation Protocols & Testing Bodies

January 2008	TARP (Technology Acceptance Reciprocity Partnership)	TAPE (Technology Assessment Protocol – Ecology, WA)	NJCAT (New Jersey Corporation for Advanced Technology)	International BMP Database (ASCE BMP Database)	ETVP (Envir. Tech. Verification Program)	MASTEP (MA - Stormwater Evaluation Project)
		• Requires 3rd party data validation report, • Submission of TEER, • Makes recommendations on technology use level, • Posts relevant info on website, • Accepts data from—TAPE, ETV, and TARP.	seminars, and assisting in patenting, licensing, or other technology protection and transfer arrangements. • Provides guidance for experimental technologies for $1000 fee.			CFS, and cost per pound of pollutant treated); • Design considerations; • Site and Environmental Consideration; • Performance evaluation.
Weaknesses	• Does not certify technologies for use across states, only for acceptance of monitoring data for evaluation across member states. • Each state still has specific performance goals/expectations. • States, like MD, are allowing data submissions which are "weaker" / different than TARP standards (as per communication with Stewart Comstock, MDE and http://www.mde.state.md.us/assets/document/Proprietary%202005.pdf) • Does not test or provide	• Limited to WA State only. • Does not test or provide support for experimental systems. • Only ~13 certified for general use (GULD). • Not accepting new applications for emerging technologies as of 2008.	• Has only certified 10 proprietary BMPs in 10 years. • Limited only to NJ only. • Less stringent than TARP for TSS and storm water data collection. • Different standards across NJ's 3 regulatory program (See Appendix B, TARP, pg. 24) with SW oversight. • Cost of verification.	• Does not verify/certify BMPs • These testing protocols not agreed upon by potential implementing actors, such as state regulatory agencies. • Does not test or provide support for experimental systems. • Private sector does quality control. (Wright Engineers and GeoSyntec), which could create perceived conflict of interest.	• Only ~20 BMPs verified. • Short duration of ETV program before funding dried-up. • Does not test or provide support for experimental systems. • Non-structural systems never tested under this program.	• Out of 34 BMPs submitted for review, only 5 have studies that are underway that offer promise for reliable data in the near future. • No BMP has reached "Category 1" status. • Does not test or provide support for experimental systems.

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Major Stormwater BMP Evaluation Protocols & Testing Bodies

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	support for experimental systems.					

Major Stormwater BMP Evaluation Protocols & Testing Bodies

Abbreviations

APHA: American Public Health Association
ASCE: American Society of Civil Engineers
ASTM: American Society for Testing and Materials
AWWA: American Water Works Association
b/c: because
BMP: best management practice
CA: California
cfs: cubic feet per second
COV: coefficient of variance
Cu: copper
CUD: Conditional Use Designation
Ecology: Washington State Department of Ecology
EPA: U.S. Environmental Protection Agency
ETV: Environmental Technology Verification
EvTEC: Environmental Technology Evaluation Center
GULD: General Use Level Designation
hr: hour
HSPF: Hydrological Simulation Program--Fortran
MA: Massachusetts
MD: Maryland
Min: minute
MQO: Method Quality Objectives
NELAC: National Environmental Laboratory Accreditation Conference
NJ: New Jersey
NSF: NSF International
NWS: national weather station
ortho-P: orthophosphate
P: phosphorus
PA: Pennsylvania
ppt: precipitation
PSD: Particle Size Distribution

PLD: Pilot Level Designation
QA: quality assurance
QAPP: quality assurance project plan
QC: quality control
SD: standard deviation
SM: Standard Methods
SOP: standard operating procedure
TAPE: Technology Assessment Protocol - Ecology
TARP: Technology Acceptance and Reciprocity Partnership
TEER: technology evaluation engineering report
TRC: Technical Review Committee
TP: total phosphorus
TSS: total suspended solids
VA: Virginia
WA: Washington
Zn: zinc

Citations

Lenhart, James H. Evaluating BMP's Programs, Successes and Issues. CONTECH Stormwater Solutions, Portland OR, USA. 2007.

Introduction to Appendices

These appendices are provided as a supplement to the BMP Evaluation Tool Checklist. The information provided here is intended to assist local stormwater program authorities with understanding basic concepts and concerns regarding BMP performance and testing and setting criteria for evaluating BMPs in their community. A summary of the key recommendations for each Appendix section is provided below.

Appendix A. Evaluating BMP Efficiency

General Approaches to Evaluate BMP Efficiency

- When evaluating BMP efficiency, it is important to develop an understanding of the caveats and limitations of whichever method of evaluating efficiency is chosen.

Specific Methods to Compute BMP Efficiency

- Use of either the Efficiency Ratio method or the Summation of Loads method should be supplemented with an appropriate statistical test indicating if the differences in mean event mean concentrations (EMCs) between the outflow and inflow are statistically significant.
- Alternative methods such as the Performance Expectation Functions and Effluent Probability Method may be used to address some of the assumptions and limitations imposed by historical methods to evaluate BMP efficiency.
- To be most effective for pollutant removal, it is desired to have distinct unit (treatment) processes operating in a treatment train or system, as opposed to a single treatment process. For instance, a BMP system that incorporates settling, filtering, and adsorption will be more effective than a BMP that uses only one of those processes.
- The overall BMP efficiency for a treatment train must consider how runoff characteristics (e.g., pollutant load or EMC) are changed by the first treatment process or BMP as the runoff is passed to each subsequent downgradient treatment process. It is inaccurate to simply sum the removal efficiencies of each BMP in the treatment train.

Biases Associated with Total Suspended Solids (TSS) Measurement

- Use of Suspended Sediment Concentration (SSC) data is recommended over Total Suspended Solids (TSS) to gauge BMP efficiency.
- Stormwater managers can request that vendors provide performance data based on SSC as opposed TSS.

Influence of Particle Size Distribution (PSD) on BMP Design

- In order to ensure that proprietary devices are designed to adequately remove sediment and associated pollutants from stormwater, a PSD should be clearly defined in both the documentation for the device and within local stormwater standards and policy documents.

Appendix B. Review of Existing BMP Evaluation Protocols and Testing Bodies

- Local stormwater regulators can use the matrix provided to determine whether they wish to adopt an existing protocol to determine which BMPs to accept in their community
- When evaluating requests to use a manufactured BMP, regulators can request the vendor to provide information about whether the device has already been accepted, verified or tested by one of the entities described in the matrix.

Appendix C. Additional Resources

Appendix D. References

A. Evaluating BMP Efficiency

A.1. Introduction

Information on BMP efficiencies is needed at both the site and watershed scales. At the site level, BMP efficiency information is needed to help identify the most appropriate practice that will meet a community's pollutant reduction targets or water quality standards. At the watershed scale, MS4 communities can use the information to determine how well a suite of practices is working to meet, for example, TMDL targets.

Despite this need, it has been found that reported pollutant efficiencies of BMPs may be misrepresented and poorly supported by the monitoring data (Lenhart 2007, ASCE and USEPA 1999). Much of the variability in BMP performance may be compounded by poor monitoring data and by the number of variables that affect BMP function, and thus its pollutant removal capabilities (Table 1).

Table 1. Variables that affect BMP function (Compiled from CWP 2007 and ASCE and U.S. EPA 1999).

- Design factors (presence/absence of vegetation, geometry, flow path length, etc)
- Geographic location
- Drainage area
- Land use and Land cover
- Soil type
- Watershed Slopes
- Soil compaction
- Rainfall intensity
- Flow rate
- Particle size distribution of influent
- Latitude
- Season
- Vegetation
- Upstream controls (non-structural and structural)
- Inter-event timing
- Maintenance of the BMP

A.2. General Approaches to Evaluate BMP Efficiency

Methods to evaluate the pollutant removal efficiency of BMPs are evolving as our understanding of stormwater and ways to treat stormwater improve. Research has shown that BMP efficiencies vary depending upon the method of computation (ASCE and USEPA 1999, Strecker et al. 2001, Winkler 2005, Winkler and Bouthilette 2004). To have confidence in the efficiencies calculated, there is a need to understand the

sampling and analytical protocols followed and the assumptions of those methods used to compute efficiency.

The pollutant removal efficiency of a BMP refers to the pollutant reduction that is achieved by comparing the influent and effluent of a BMP or treatment train. Pollutant reduction can be determined on either a concentration or load/mass basis and is typically expressed as a percentage.

Concentration-Based Methods
Concentration-based methods use the ratio of pollutant concentrations or event mean concentrations (EMCs) at the outflow to pollutant concentrations or EMCs at the inflow as the basis for calculating BMP efficiency. As a general rule, concentration-based methods often result in slightly lower performance efficiencies than mass-based methods. This may be attributed to the fact that BMPs that reduce runoff volume are also reducing pollutant loads, but a concentration-in versus concentration-out study does not account for water losses that occur through infiltration and evapotranspiration, or storage within the BMP. For this reason, the pollutant removal efficiency of these types of BMPs may be under-reported using concentration-based methods.

Mass-Based Methods
Mass-based methods use pollutant loads as the basis for calculating BMP efficiency. Pollutant load is the total amount of a pollutant conveyed over a specified duration. The pollutant loading from a given storm can be estimated using pollutant EMCs and flow data. Mass-based methods are influenced by the volume of water entering the BMP and water losses within the BMP (e.g., evapotranspiration and infiltration), so they are more accurate for BMPs that reduce runoff volume (Winer, 2000).

Table 2 summarizes five historically common methods to calculate BMP pollutant removal efficiency. Only the Efficiency Ratio method and the Summation of Loads methods are still recommended for use by ASCE and EPA (2002). Use of either method should be supplemented with an appropriate statistical test indicating if the differences in mean EMCs between the outlow and inflow are statistically significant. The Performance Expectation Functions (PEF) and Effluent Probability Method (EPM) are alternative methods suggested by experts in the field to address some of the assumptions and limitations imposed by the methods presented in Table 2. These methods are described in more detail in Section A.3.

Table 2. Methods to Estimate BMP Efficiency (compiled from ASCE and USEPA 2002)			
Method	**Type of Method**	**Formula**	**Comments**
1. Efficiency Ratio (ER) Described in more detail in Section A.3	Concentration	$ER = 1 - \frac{\text{Average outlet EMC}}{\text{Average inlet EMC}}$ Where the $EMC = \frac{\sum_{j=1}^{n} CiVi}{\sum_{j=1}^{n} Vi}$ *Where: Ci = event inflow concentration; Vi = event inflow volume*	• Most useful when loads are directly proportional to the storm volume. • Weights EMCs from all storms equally. • The accuracy varies with BMP type. • Minimizes impacts of smaller/cleaner storms on performance calculations. • Can apply log normalization to avoid equal weighting of events.
2. Summation of Loads (SOL) Described in more detail in Section A.3	Mass	**SOL** $= \frac{\text{sum of outlet loads}}{\text{sum of inlet loads}}$ Where the Load = $CiVi$ *Ci = average concentration within period i; Vi = volume of flow during period i*	• Loads are calculated using concentration and flow volume and are summed for the number of events measured. • A small number of large storms can significantly influence results. • Removal of material is most relevant over entire period of analysis • Uses a mass balance approach. • Effluent concentration may still be high despite high removal efficiency • Lenhart (2007) uses example where sum of loads would fall below expected 80% removal and would not be accepted but in reality the concentration reduction of BMP was adequate.

Table 2. Methods to Estimate BMP Efficiency (compiled from ASCE and USEPA 2002)			
Method	**Type of Method**	**Formula**	**Comments**
3. Regression of Loads	Mass	Uses regression model methods to derive an equation where the effluent loads as a function of the influent loads such that Loads out = $\beta * LoadsIn$ = $\beta - \frac{\text{Loads out}}{\text{Loads in}}$, where β is a slope term in regression analysis. Percent reduction is approximated as, Percent Removal = 1 – β = 1 - $\frac{\text{Loads out}}{\text{Loads in}}$.	• Assumes removal efficiency is uniform over a range of operating conditions and concentrations. • The 'fit' of the regression line may be dominated by a few storm events and not represent the function of the BMP for all storm types. • "Forcing" the regression line to the origin (0,0) can misrepresent the data that is highly variable (e.g., scattered) • May require a complex regression equation to fit the data when a simple polynomial is not sufficient

Table 2. Methods to Estimate BMP Efficiency (compiled from ASCE and USEPA 2002)			
Method	**Type of Method**	**Formula**	**Comments**
4. Mean Concentration (MC)	Concentration	$MC = 1 - \frac{\text{average outlet concentration}}{\text{average inlet concentration}}$	• May be useful for bacteria where grab samples are taken and volume measurements are not part of the sampling protocol • May be useful to evaluate BMP effectiveness to reduce acute toxicity immediately downstream of the BMP as acute toxicity is measured as a threshold response (e.g. dose-response relationship such as LC50 that is the concentration of a chemical which kills 50% of a sample population over a short period of time). • Weights samples equally and may result in bias due to variance in sampling protocols • Not amenable to mass balance approach • Flows represent total event characteristics • Not appropriate where flow-weighted sampling is performed as it weights all storms equally
5. Efficiency of Individual Storm Loads (ISL) and Average Efficiency (AVEF)	Mass	$ISL = 1 - \frac{\text{Loads out}}{\text{Loads in}}$ $AVEF = \frac{\sum_{j=1}^{n} \text{Storm efficiency}_j}{m}$ *m = number of events*	• Average efficiency (AVEF) sums all of the individual efficiencies and divides by the number of events • Arithmetic averaging of percent removal treats all storms equally -- many small and few large storms would bias the results • Must have paired data and requires that inflow and outflow are related • Effluent concentration may still be high despite a high removal efficiency • Not all storms are equal and should not be computed as such to determine efficiency;

An example dataset (provided in Table 3) was used to illustrate how the various methods can arrive at different BMP efficiencies for the same storm event. Table 3 is a hypothetical dataset for a wet pond draining a ¼ to ½ acre single family residential neighborhood. The example assumes that a total of 11 storm events were sampled over a 1-year period using an automated sampler at the inflow and outflow of the pond. The total volume of runoff for each event was calculated based on the hydrograph for each storm. Concentration data, flow-weighted EMCs, or loads for total nitrogen (whichever was appropriate for the selected method) were used as inputs to the formulas provided in Table 2 to calculate the BMP efficiencies summarized in Table 4.

Table 3. Sample water quality monitoring dataset for Total Nitrogen for hypothetical wet pond.
Single family residential catchment (1/4 - 1/2 acre), drainage area 171 acres. Wet pond, paired inflow and outflow, composite samples

Hypothetical Monitoring Data Set						
Storm Event	**Total Nitrogen (mg/L) (EMC, flow-weighted)***		**Total Storm Water Volume (ft^3/d)**		**Total N Load (Kg)**** (EMC x Volume)	
	Influent	Effluent	Inflow	Outflow	In	Out
1	2.59	1.89	10022	5616	0.74	0.30
2	2.53	1.49	6998	6134	0.50	0.26
3	2.54	1.66	4851	3259	0.35	0.15
4	2.00	1.15	5614	2979	0.32	0.10
5	2.55	1.58	15982	8013	1.15	0.36
6	2.70	1.81	6773	3070	0.52	0.16
7	1.59	0.96	9092	6048	0.41	0.09
8	2.27	1.42	8921	4169	0.57	0.17
9	1.47	1.22	3246	2826	0.14	0.10
10	0.49	0.26	604	432	0.01	0.00
11	0.43	0.22	511	433	0.01	0.00
Column Sum (Total)	**21.15**	**13.67**			**4.71**	**1.68**
Average	**1.92**	**1.24**				

*A flow-weighted mean concentration is calculated by dividing the total load for the time period by the total discharge for the time period, which avoids the bias of giving equal weight to all storms
** The flow-weighted EMCs were used to calculate the total Nitrogen load

Table 4 illustrates that the BMP pollutant removal efficiencies for concentration-based methods (19% and 35%) are lower compared to those derived using mass-based methods (60-66%). The mass-based methods take into consideration the volume of stormwater passing through the BMP in its calculation. *This hypothetical analysis illustrates how the same dataset, using different evaluation methods, can arrive at very different conclusions.*

Table 4. BMP efficiencies using a variety of methods with same data set.		
Method	**Method Type**	**Calculated Efficiency**
1. Efficiency Ratio	CONCENTRATION	0.35 (35%)
2. Sum. of Loads	MASS	0.64 (64%)
3. Reg. of Loads	MASS	0.66 (66%)
4. Mean Concentration	CONCENTRATION	0.19 (19%)
5. Average Efficiency	MASS	0.60 (60%)

A.3. Elaboration on Specific Methods to Compute BMP Efficiency

Four methods for computing BMP efficiency are described in more detail in this section, along with guidance on evaluating BMP efficiency for a series, or treatment train, of BMPs. The efficiency ratio and summation of loads are the most commonly used performance measures, while the two additional methods presented address some of the limitations of the more common methods.

1. Efficiency Ratio Method
2. Summation of Loads
3. Performance Expectation Functions
4. Effluent Probability Method
5. Evaluating BMP Efficiency for Treatment Trains

Efficiency Ratio

The most commonly used concentration-based method is the Efficiency Ratio method, which is defined in terms of the average event mean concentration (EMC) of pollutants over a given time period. The term EMC is a statistical parameter used to represent the flow-proportional average concentration of a given parameter during a storm event. It is defined as the total constituent mass divided by the total runoff volume.

The Efficiency Ratio method is also referred to as the “percent removal” approach. Under most circumstances, this method can provide a useful means for quantifying the level of pollution resulting from a runoff event. However, there are several important considerations when using percent removal to evaluate BMP efficiency.

First, using concentration data alone may be misleading if the concentration is near the “irreducible level” (Schueler, 2000). A low or negative removal percentage can be recorded, even though outflow concentrations discharged from the BMP are relatively low. In other words, if relatively clean water is entering a BMP, then there is limited performance potential that can be achieved by the BMP.

Conversely, a BMP receiving highly polluted inflow can report a high percent removal, even though the effluent quality may still be elevated (Strecker et al., 2004). Another

way to conceptualize it would be to say that BMPs that treat the dirtiest water (runoff with relatively high pollutant concentrations) are likely to achieve higher percent removals (CWP, 2007) (Figure 1). Therefore, the BMP evaluation method needs to consider the storm conditions and stormwater volume under which the stormwater is sampled and efficiency measured.

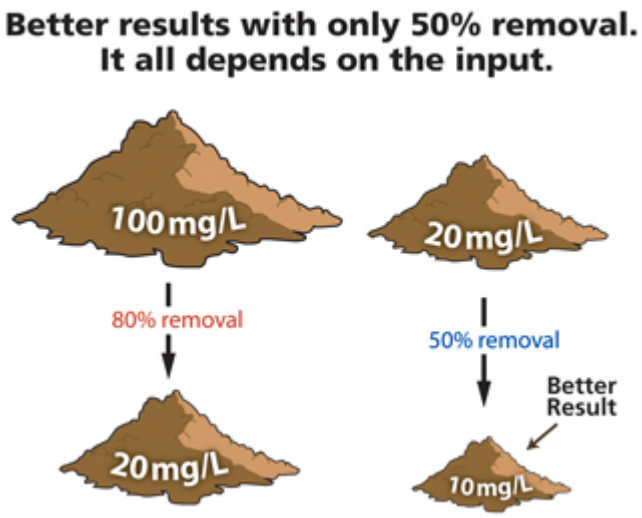

Figure 1: This figure demonstrates graphically how percent removal can be misleading if influent concentrations are not explicit. A BMP with 80% removal can yield dirtier effluent than one with 50% removal depending on the difference in influent concentrations. Source: http://cfpub.epa.gov/npdes/stormwater/urbanbmp/bmptopic.cfm

Due to these limitations, it is recommended that percent removal not be used as the only measure of BMP efficiency. The method should be supplemented with an appropriate statistical text indicating if the differences in mean EMCs between the outflow and inflow are statistically significant. A more complete review of issues pertaining to percent removal is provided by Jones et al. (2008).

Summation of Loads

The most commonly used mass-based method is referred to as the Summation of Loads and defines efficiency based on the ratio of the sum of all incoming loads to the sum of all outgoing loads. This method is considered a more accurate calculation than Efficiency Ratio for certain types of BMPs that reduce runoff because it accounts for water losses.

Biases may result using a mass-based method if the mass removal from a large storm event is averaged with many small storm events. That is, the performance of the BMP would be more heavily influenced by the larger storm event that transports more material in stormwater compared to smaller storms. This can result in a BMP pollutant removal efficiency that is high, but is significantly influenced by a single storm event. Further, although a relatively large amount of material was removed by the BMP, the effluent concentration may still be high and not meet water quality standards.

Performance Expectation Functions (PEF)

The PEF method suggested by Lenhart (2007) takes into consideration how BMP pollutant removal efficiencies can be influenced by influent concentrations and flow volumes. The PEF is a graphical representation of data that defines a specific or desired output of either effluent concentration or percent removal (Personal communication, Sean Darcy, CONTECH Stormwater Solutions Inc., 2008).

The determination of using the effluent concentration or percent removal to evaluate the BMP is based on the quality of the influent concentration. A percent removal approach is suggested for 'dirtier' influent stormwater and concentration-based methods for cleaner stormwater. For example, if the influent concentration for TSS concentration is greater than 100 mg/L (e.g. "dirty" stormwater), the PEF for percent removal should be applied. If the TSS concentration is less than 100 mg/L, an effluent concentration-based PEF is recommended.

This method requires a significant amount of monitoring data and does not address the particle size issue associated with the TSS method of analyses or the irreducible concentration. Further, the percent removal PEF would not indicate the quality of the effluent where the effluent concentration may still be high even with a high percent removal.

Effluent Probability Method (EPM)

ASCE and US EPA (2002) recommend the Effluent Probability Method to evaluate BMP performance as it provides the ability to visualize the continuum in BMP efficiencies over a range of influent concentrations. The EPM determines first if the BMP is providing treatment (that the influent and effluent mean EMCs are statistically different from one another) and then examines either a cumulative distribution function of influent and effluent quality or a standard parallel probability plot.

Before any efficiency plots are generated, appropriate statistical tests should be conducted to determine if differences in influent and effluent mean EMCs are statistically significant. The most useful approach for examining these curves is to plot the results on a standard parallel probability plot (ASCE and EPA, 2002). A normal probability plot should be generated showing the log transform of both inflow and outflow EMCs for all storms for the BMP. If the log transformed data deviates significantly from normality, other transformations can be explored to determine if a better distributional fit exists. Probability plots should be supplemented with standard statistical tests that determine if the data is normally distributed. Statistical software packages are available to do these plots and are described in Burton and Pitt (2001). Box 1 summarizes some of the key statistics used in the effluent probability method.

Box 1: Exploratory Data Assessment (from ASCE and U.S. EPA, 1999).

- Determine the appropriate representation of the data (e.g. log-normal or other transformations) to approximate a normal distribution for further statistical analyses
- Develop box-and-whisker plots to visually compare inflow and outflow EMC of the BMP. The inflow and outflow EMCs are significantly different if the confidence intervals around the median concentrations do not overlap.
- Regression of inflow and outflow EMC to determine if there is relationship between the concentrations.

Evaluating BMP Efficiency for Treatment Trains

The application of any of the above methods to a treatment train requires additional computations. A treatment train is described as the application of a series of BMPs that capitalize on specific processes of a particular BMP type to treat pollutants of concern. The series of BMPs are designed and implemented to treat a wide range of pollutants of concern as the stormwater moves through all BMPs. Treatment trains are recommended because a single BMP is not always able to effectively treat multiple pollutants of concern.

For example, in a single BMP, there may be several “unit processes” that occur, such as sedimentation, adsorption and filtration. A dominant unit process may act as the major process for pollutant removal, such as sedimentation in a wet pond or filtration in a sand filter. To be most effective for pollutant removal, it is desired to have distinct unit processes operating in a treatment train or system.

To calculate the removal efficiency of a treatment train or system, it is necessary to consider how the first unit operation/process alters the characteristics of the incoming stormwater for the next unit operation/process. The removal efficiency is not necessarily additive.

An example from Morton (2006) is shown in Table 5. In this example, the influent concentration to the first BMP in the treatment train (BMP1) is equivalent to 100 “pollutant units.” The first BMP in the treatment train treats 10% of the incoming stormwater pollutant load (or concentration) and 90% of the pollutant load is untreated (e.g., 90 = 100 – (0.1 x 100)). The 90 pollutant units become the influent to the second BMP in the treatment train (BMP2). BMP2 has a removal efficiency of 25%. The 25% removal efficiency is applied to the 90 pollutant units and results in a treatment train removal efficiency of 22.5% (e.g., 25% of 90). The 67.5 pollutant units is the effluent from BMP2 and becomes the influent to BMP3. BMP3 has an 80% removal efficiency and results and treats 54% of the incoming pollutant (80% of 67.5).The BMP efficiency for the treatment train is the sum of the individual efficiencies estimated at 86.5%, rather than the individual BMP removal efficiencies.

Table 5. Calculating Efficiency of a Treatment Train (Morton 2006).			
Influent = 100 pollutant units	**BMP1**	**BMP2**	**BMP3**
BMP Removal Efficiency	10%	25%	80%
Treatment Train Removal Efficiency	10 %	22.5 %	54 %
Passing Thru	90 pollutant units	67.5 pollutant units	13.5 pollutant units
Treatment Train Efficiency = 10% + 22.5% + 54% = 86.5%			

A.4. Biases Associated with Total Suspended Solids (TSS) Measurement

Suspended sediment is the most regulated pollutant in the U.S. (Lenhart, 2007). In many communities, sediment is a primary pollutant of concern and is commonly evaluated using total suspended solids (TSS). TSS is a standard parameter in many BMP monitoring protocols (e.g. TARP).

The methods of analysis for TSS follow those initially developed for wastewater treatment, not stormwater control. Based on the inherent differences in wastewater quality and stormwater quality, such as particle-size distribution, research has demonstrated biases that result from using TSS as a measure to evaluate BMP pollutant removal efficiency. Specifically, research has shown that the use of TSS measurement methods can result in an underestimation of the amount of sediment when applied to the analysis of stormwater and natural waters (Lenhart, 2007; Gray et. al., 2000).

Current TSS methods use a subsample of the total sample for analysis and allow it to settle before analyzing. Due to the settling of larger particles, the subsample is not necessarily representative of the whole sample. Suspended Sediment Concentration (SSC) is presented as an alternative and more reliable method to estimate the amount of sediment in stormwater where the entire sample volume to include all particle sizes is used in the analysis. A recommendation of this report is to use SCC data rather than TSS to gauge BMP efficiency. Stormwater managers can request that vendors provide performance data based on SSC as opposed TSS.

A.5. Influence of Particle Size Distribution on BMP Design

Many regulators and stormwater practioners have identified sediment removal as the surrogate or bench mark for quantifying their water quality objectives. Sediment is a pollutant of interest in and of itself, and is commonly associated with other pollutants in stormwater -- including heavy metals, hydrocarbons, and phosphorus -- that adhere or adsorb to sediment. Researchers have found that finer sediment particle sizes (e.g., < 50 microns) provide more surface area by mass and tend to have more adhered

pollution, by mass. Therefore, BMPs designed to capture finer particles will have a higher overall pollutant removal capability, and, based on design features, are likely to also capture many of the larger particles.

Vaze and Chiew (2004) found that nearly all particulate TN (total nitrogen) and TP (total phosphorous) in stormwater was associated with particles between 11 and 150 microns. Morquecho et al. (2005) showed that total phosphorus and chemical oxygen demand are associated with particulates and in general decrease with decreasing particle size. Madge (2005) found that most bound TP and TN are contained in particle sizes of 5 to 20 microns and that removal of particles down to 5 microns would result in removal of 90% of TP and 37% of TN. Results from Lau and Stenstrom (2005) confirm earlier research, and the general belief supported by adsorption theory, that smaller particles have higher contaminant concentration. Specifically they found that the greatest mass of heavy metals and polynuclear aromatic hydrocarbons (PAHs) were associated with particles in the 100–250 micron range. German and Svensson (2002) and others found that concentrations of heavy metals are a function of particle diameter and proportional to the inverse of the particle diameter, and that a higher proportion of metals are found in particles of 125 microns or smaller.

The particle size distribution (PSD) designed to be captured governs the effluent water quality, as well as the size and cost of a stormwater treatment system. Analysis of particle sizes ranging from clays to sand indicate that settling velocity increases exponentially as particle size increases. Therefore, as the PSD used to define sediment removal for a BMP increases, the size and cost of a proprietary treatment system decreases. From an economic perspective, it would be cheaper to design a treatment system for coarse particles; however, the environmental benefit would be compromised (Personal communication, Scott Perry, Imbrium, 2008). For BMPs dependent on sedimentation as a unit process (wet vaults, swirl separators, vortex separators, and vaults), the detention time of the treatment system compared to the settling velocity would dictate size and cost.

In order to ensure that proprietary devices are designed to adequately remove sediment and associated pollutants from stormwater, a PSD should be clearly defined in both the documentation for the device and within local stormwater standards and policy documents. A defined PSD should include particle diameters, content and distribution of various size fractions, and densities (Personal communication, Scott Perry, Imbrium, 2008).

The interpretation of percent removal for sediment becomes very subjective in the absence of a PSD reference. For example, removing 80% TSS composed of coarse sands and gravel requires a much smaller, less costly device as compared to a device designed to remove 80% of fine silts and fine sands over the long term. Without clear guidance on PSD, low cost yet inadequate treatment systems may be implemented, to the detriment of downstream water resources. (Personal communication, Scott Perry, Imbrium, 2008).

Table 6 presents a recommended particle size distribution for evaluating manufactured treatment systems as part of the NJCAT (New Jersey Corporation of Advanced Technologies) TARP (Technology Acceptance Reciprocity Paternship) Tier 1 Lab protocol and that is utilized within the TARP program. This hypothetical distribution was selected because it represents the various particles that would be associated with typical stormwater runoff from a post construction site. As illustrated in Table 6, the highest percentage of particles is less than 250 microns in size. Although the particles less than 250 microns may represent a small fraction of the total particles (by volume), this is the range which is most frequently associated with adsorbed contaminants.

Table 6. Recommended particle size distributions for evaluating manufactured treatment systems.*

Particle Size in microns (μm)	Sandy Loam Percent by mass (%)	Description
1-2	5	Clay
2-50	2-8 um, 15%** 8-50 um, 25%	Silt
50-100	15	Very Fine Sand
100-250	30	Fine Sand
250-500	5	Medium Sand
500-1000	5	Course Sand

*Recommended density of all particles regardless of size is ≤2.65 g/cm^3

**The 8 um diameter is the boundary between very fine silt and fine silt according to the definition of American Geophysical Union. The reference for this division/classification is: Lane, E. W., et al. (1947). "Report of the Subcommittee on Sediment Terminology," Transactions of the American Geophysical Union, Vol. 28, No. 6, pp. 936-938. Source of data for this table; http://www.state.nj.us/dep/dsr/bscit/TestProcedure_Dec%2703_.pdf

B. Review of Existing BMP Evaluation Protocols and Testing Bodies

A brief summary of six major BMP evaluation protocols and testing bodies is provided below, followed by a more detailed matrix.

Environmental Technology Verification Program (ETVP) - The ETVP is an EPA funded performance verification/testing entity. The program subcontracted testing to the National Sanitation Foundation, whom, in turn, subcontracted the testing to EarthTech Inc. The program was started in 1997 and funding dried up in 2007 with a total of 20 storm water BMPs tested. Because the program verified performance claims and because it is not regionally or state specific, it cannot be considered a certification or approval entity.

Technology Assessment Protocol - Ecology (TAPE) - TAPE is a Washington State project started in 2001 to approve/certify BMPs for state-wide use. This protocol characterizes, with a reasonable level of statistical confidence, an emerging technology's effectiveness in removing pollutants for an intended application and to compare test results with vendor's claims.

New Jersey Corporation for Advanced Technology (NJCAT) - Established in 1997, NJCAT is a New Jersey-specific, independent, non-profit, private-public collaboration. NJCAT verifies laboratory and field performance claims, and the New Jersey Department of Environmental Protection (NJDEP) reviews and certifies the NJCAT verification. The Commissioner of NJDEP serves as an *ex-officio* board member. NJCAT is a performance testing and verification entity which uses TARP testing protocol with New Jersey-specific caveats.

MASTEP (MA -Stormwater Evaluation Project) - The Massachusetts Stormwater Evaluation Project is a state specific performance verification and BMP certification entity initiated in 2004 and operated out of the University of Massachusetts at Amherst. MASTEP uses TARP Tier II verification and testing protocols. To date, 34 devices have begun analysis but none have been endorsed by MASTEP.

Technology Acceptance Reciprocity Partnership (TARP): TARP was established in 2001. It is a consortium of states which have chosen to standardize data gathering and quality control during testing to minimize duplicative research and performance verification efforts and catalyze interstate technology acceptance. The consortium currently consists of CA, MA, MD, NJ, PA, VA and IL. This program is operated out of Pennsylvania Department of Environmental Protection and the University of Massachusetts at Amherst. States within the consortium can approve/certify BMPs for state-wide use, but state-specific caveats exist. This means that acceptance in one state does not categorically imply acceptance in another signatory state.

International BMP Database; This data clearinghouse was started in 1996 by American Society of Civil Engineers (ASCE) and EPA and took on new public and private sector members in 2004. This data clearinghouse includes data from the US,

Canada and Sweden. The Database is not an approval or certification authority. There is a standard reporting protocol. Data is quality controlled by partners and statistical analysis of data is performed and reported. The database can be found at; http://nswbmp.geosyntec.com/index.htm.

Searches can be done by:

- State and County of performance study;
- Structural BMP type;
- Water quality parameter;
- Watershed size; and
- Average storm volume.

C. Additional Resources

EPA Urban BMP Tool: This tool presents information previously compiled by the International BMP Database and the State of California in any easy to access format. The tool includes 220 performance studies of 275 BMPs conducted by public agencies, academic researchers, non-profit groups, and others. Searches can be done by:

- BMP type
- Pollutants measured and measurement techniques used
- Total volume of runoff reduced, or
- Keywords in the study

It also rates the study quality (on a three-tiered scale) based upon on thoroughness of monitoring data used. Top-tiered studies include statistical abstracts. When available, event mean concentrations (EMC) and volume data are reported. The tool can be found at: http://cfpub.epa.gov/npdes/stormwater/urbanbmp/bmpeffectiveness.cfm.

National Pollutant Removal Performance Database V.3; The NPRPD was developed by the Center for Watershed Protection for the EPA Office of Science and Technology in association with Tetra Tech, Inc. The latest version consists of 166 individual best management practice (BMP) performance studies published through 2006. The database was statistically analyzed to derive the median and quartile removal values for each major group of stormwater BMPs

University of New Hampshire - Stormwater Center (UNHSC)
UNH designed, constructed, and runs a facility that provides for the controlled testing of stormwater management designs and devices. The primary mission of the Center is the protection of water resources through effective stormwater management. Full site operation began in August 2004. Two full years of monitoring were completed in Fall 2006. It includes a pervious concrete test facility in collaboration with industry associations.

Currently the Center is acting as a technical resource for stormwater practitioners by studying a range of issues for specific stormwater management strategies including

design, water quality and quantity, cost, maintenance, and operations. The field research facility serves as a site for testing stormwater treatment processes, for technology demonstrations and workshops. The testing results and technology demonstrations are meant to assist in the planning, design, and implementation of effective stormwater management strategies for resource managers.

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Fact sheets and specifications are provided for various technologies, including treatment cost per acre, maintenance data, cost per acre, maintenance information, water quality performance as percent removal efficiency (for TSS, TPH-D, NO_3-N and Zn) , and peak flow reduction for the following devices:

- Porous asphalt;
- ADS Treatment Unit;
- Surface sand filter (NYS Stormwater Manual);
- Stormwater pond (NYS Stormwater Manual);
- Aqua-Swirl and Aqua-Filter
- VortSentry Hydrodynamic Separator (VS40)
- V2B1 Structural Stormwater Treatment System
- Continuous Deflective Separation (PMSU 20-15)
- Gravel Wetland (LID)
- Vegetated Swale (NYS Stormwater Manual) [NO PERFORMANCE DATA FOR THIS DESIGN]
- Porous Asphalt [STUDY IN PROGRESS]
- Tree Box Filter (LID) [NO PERFORMANCE DATA FOR THIS DESIGN]

Fact sheets are available at: http://www.unh.edu/erg/cstev/fact_sheets/index.htm.

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