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Urban Subwatershed Restoration Manual Series

Manual 1: An Integrated Framework to Restore Small Urban Watersheds (T. Schueler, 2005). Introduces the basic concepts and techniques of urban watershed restoration, and sets forth the overall framework we use to evaluate subwatershed restoration potential. The manual emphasizes how past subwatershed alterations must be understood in order to set realistic expectations for future restoration. Presents a simple subwatershed classification system to define expected stream impacts and restoration potential. Defines seven broad groups of restoration practices, and describes where to look in the subwatershed to implement them. Presents a condensed summary of a planning approach to craft effective subwatershed restoration plans.

Manual 2: Methods to Develop Restoration Plans for Small Urban Watersheds (T. Schueler, A.

Kitchell, 2005). Manual 2 contains detailed guidance on how to put together an effective plan to restore urban subwatersheds. The manual outlines a practical, step-by-step approach to develop, adopt and implement a subwatershed plan in your community. Within each step, the manual describes 32 different desktop analysis, field assessment, and stakeholder involvement methods used to make critical restoration management decisions.

Manual 3: Urban Stormwater Retrofit Practices Manual (T. Schueler, D. Hirschman, M. Novotney, J. Zielinski, 2007). Outlines the basics of retrofits, describes the 13 unique locations where they can be found, and presents rapid methods to find, design and deliver retrofits to meet a wide range of subwatershed objectives. The manual contains updated costs for retrofit practices, updated pollutant removal data for stormwater treatment options, a design point method to estimate individual retrofit removal rates, and practical tips to support the design, permitting and construction of retrofit projects. In short, the manual provides all the resources needed to develop an effective local retrofit program.

Manual 4: Urban Stream Repair Practices (T. Schueler, K. Brown, 2004). This stream repair manual concentrates on practices used to enhance the appearance, stability, structure, or function of urban streams. Presents three broad approaches to urban stream repair - stream cleanups, simple repairs, and more sophisticated comprehensive repair applications. Outlines how to set appropriate restoration goals, how to choose the best combination of stream repair practices to meet the goals, and how to assess stream repair potential at the subwatershed level. Finally, the manual offers practical advice to help design, permit, construct and maintain stream repair practices in a series of more than 30 profile sheets.

Manual 8: Pollution Source Control Practices (T. Schueler, C. Swann, T. Wright, S. Sprinkle, 2005). This manual presents several methods to assess subwatershed pollution sources in order to develop and target education and/or enforcement efforts that can prevent or reduce polluting behaviors and operations. Manual 8 outlines more than 100 different "carrot" and "stick" options that can be used for this purpose. The manual also presents profile sheets that describe 21 specific stewardship practices for residential neighborhoods, and 15 pollution prevention techniques for control of storm water hotspots.

Manual 9: Municipal Pollution Prevention/Good Housekeeping Practices (M. Novotney and R. Winer, 2008). This manual provides "how to" guidance, and outlines the Center's most recent ideas on how municipal pollution prevention/good housekeeping practices can be used to address local water quality issues and watershed restoration goals. The manual is intended primarily for use by smaller NPDES Phase II communities and other unregulated communities interested in protecting and restoring local water resources.

Manual 10: Unified Stream Assessment: A User's Manual (A. Kitchell, T. Schueler, 2005). The Unified Stream Assessment, or USA, is a rapid technique to locate and evaluate problems and restoration opportunities within the urban stream corridor. It describes how to perform the USA, and interpret the data collected to determine the stream corridor restoration potential for your subwatershed.

Manual 11: Unified Subwatershed and Site Reconnaissance: A User's Manual (T. Wright, C. Swann, K. Cappiella, T. Schueler, 2005). Examines pollution sources and restoration potential within upland areas of urban subwatersheds. The manual provides detailed guidance on how to perform each of its four components: the Neighborhood Source Assessment, Hotspot Site Investigation, Pervious Area Assessment and the analysis of Streets and Storm Drains. Together, these rapid surveys help identify upland restoration projects and source control to consider when devising subwatershed restoration plans.

Urban Watershed Forestry Manual Series

Part 1: Methods for Increasing Forest Cover in a Watershed (K. Cappiella, T. Wright, T. Schueler, 2005). This manual introduces the emerging topic of urban watershed forestry and presents new methods for systematically measuring watershed forest cover and techniques for maintaining or increasing this cover. The audience for this manual includes the local watershed planner or forester.

Part 2: Conserving and Planting Trees at Development Sites (K. Cappiella, T. Schueler, T. Wright, 2006). Presents specific ways to enable developers, engineers or landscape architects to incorporate more trees into a development site. The proposed approach focuses on protecting existing trees, planting trees in stormwater treatment practices, and planting trees in other pervious areas of the development site. This manual introduces conceptual designs for stormwater treatment practices that utilize trees as part of the design (referred to as stormwater forestry practices).

Part 3: Urban Tree Planting Guide (K. Cappiella, T. Schueler, J. Tomlinson, T. Wright, 2006). Provides detailed guidance on urban tree planting that is applicable at both the development site and the watershed scale. Topics covered include: species selection, site preparation, tree planting and maintenance techniques, and special considerations for urban tree planting. Includes an urban tree selection guide spreadsheet to assist with species selection for your site.

Wetlands and Watersheds Article Series

Article 1: Direct and Indirect Impacts of Urbanization on Wetland Quality (T. Wright, J. Tomlinson, T. Schueler, K. Cappiella, A. Kitchell, D. Hirschman, 2006). Reviews the direct and indirect impacts of urbanization on wetlands, and describes how impacts to wetlands affect watershed health.

Article 2: Using Local Watershed Plans to Protect Wetlands (K. Cappiella, A. Kitchell, T. Schueler, 2006). Presents detailed methods for integrating wetland management into the local watershed planning process.

Article 3: Adapting Watershed Tools to Protect Wetlands (K. Cappiella, T. Schueler, J. Tasillo, T. Wright, 2005). Describes 37 techniques for protecting wetlands through local programs and ordinances.

Article 4: A Local Ordinance to Protect Wetland Functions (B. Strommen, K. Cappiella, D. Hirschman, J. Tasillo, 2007). Outlines the key elements of an effective ordinance to protect wetlands from the indirect impacts of land development, and provides adaptable model ordinance language.

Article 5: The Next Generation of Stormwater Wetlands (K. Cappiella, L. Fraley-McNeal, M. Novotney, T. Schueler, 2008). This article revisits the design of stormwater wetland systems based on lessons learned from the field, and presents new concepts and design objectives for stormwater wetlands.

Article 6: The Importance of Protecting Vulnerable Streams and Wetlands at the Local Level (K. Cappiella, L. Fraley-McNeal, 2007). Makes the case for expanded local protection of vulnerable streams and wetlands that may not be fully protected by state or federal law due to their perceived isolation from perennial or navigable waters. Also summarizes state and local approaches to closing this gap.

Articles from Watershed Protection Techniques Special Issue on Urban Lake Management

- Why Urban Lakes Are Different (T. Schueler, J. Simpson, 2001).
- Crafting a Lake Protection Ordinance (K. Cappiella, T. Schueler, 2001).
- Managing Lakes for Pure Drinking Water (A. Kitchell, 2001).

- Evaluating the Impact of Watershed Treatment (D. Caraco, 2001).
- Managing Phosphorus Inputs Into Lakes (T. Schueler, 2001).
- Crafting an Accurate Phosphorus Budget for Your Lake (D. Caraco, T. Brown, 2001).
- In-Lake Treatment to Restore Urban Lakes (T. Davenport, S. Kaynor, 2001).
- Determining the Trophic State of Your Lake (T. Brown, J. Simpson, 2001).
- The Influence of Septic Systems at the Watershed Level (C. Swann, 2001).
- Land Use/Impervious Cover Relationships in the Chesapeake Bay (K. Cappiella, K. Brown, 2001).

Articles from The Practice of Watershed Protection

Below are articles from The Practice of Watershed Protection that pertain specifically to this topic. To purchase the hardbound book or CD of these articles, please visit our store. For citing these articles, add the article author and title to the following: The Practice of Watershed Protection. 2000. T. Schueler and H. Holland, eds. Center for Watershed Protection. Ellicott City, MD. Authors of each individual article are listed as initials at the end of the article, with full names as follows: Carol Anne Barth (CAB), Ken Brown (KBB), Ted Brown (EWB), Whitney Brown (WEB), Deborah Caraco (DSC), Richard Claytor (RAC), Hye Yeong Kwon (HYK), Jennifer McClean (JMC), Ron Ohrel (RLO), Janet Pelley (JP), Eric Reeves (ER), Chris Swann (CS) and Jennifer Zielinski (JAZ).

1. The Importance of Imperviousness
2. Hydrocarbon Hotspots in the Urban Landscape: Can They Be Controlled?
3. Influence of Snowmelt Dynamics on Stormwater Runoff Quality
4. Nutrient Movement from the Lawn to the Stream?
5. Urban Pesticides: From the Lawn to the Stream
6. Cars are Leading Source of Metal Loads in California
7. Sources of Urban Stormwater Pollutants Defined in Wisconsin
8. Is Rooftop Runoff Really Clean?
9. First Flush of Stormwater Pollutants Investigated in Texas
10. Dry Weather Flow in Urban Streams
11. Multiple Indicators Used to Evaluate Stream Conditions in Milwaukee
12. Characterization of Heavy Metals in Santa Clara Valley
13. Simple and Complex Stormwater Pollutant Load Models Compared
14. Impact of Suspended and Deposited Sediments
15. Stormwater Pollution Source Areas Isolated in Michigan
16. Diazinon Sources in Runoff From the San Francisco Bay Region
17. Microbes in Urban Watersheds: Concentrations, Sources and Pathways
18. Effects of Urbanization on Small Streams in the Puget Sound Ecoregion
19. Dynamics of Urban Stream Channel Enlargement
20. Stream Channel Geometry Used to Assess Land Use Impacts in the Northwest
21. Habitat and Biological Impairment in Delaware Headwater Streams
22. Comparison of Forest, Urban and Agricultural Streams in North Carolina

23. Historical Change in a Warmwater Fish Community in an Urbanizing Watershed
24. Fish Dynamics in Urban Streams Near Atlanta, Georgia
25. Housing Density and Urban Land Use As Stream Quality Indicators
26. A Study of Paired Catchments Within Peavine Creek, Georgia
27. The Tools of Watershed Protection
28. Basic Concepts in Watershed Planning
29. Crafting Better Watershed Plans
30. Economics of Watershed Protection
31. Microbes and Urban Watersheds: Implications for Watershed Managers
32. Methods for Estimating Effective Impervious Area of Urban Watersheds
33. Impact of Stormwater on Puget Sound Wetlands
34. Loss of White Cedar in New Jersey Linked to Stormwater Runoff
35. Wetter Is Not Always Better: Flood Tolerance of Woody Species
36. The Compaction of Urban Soils
37. Can Urban Soil Compaction Be Reversed
38. Choosing Appropriate Vegetation for Salt-Impacted Roadways
39. The Architecture of Urban Stream Buffers
40. Urbanization, Stream Buffers and Stewardship in Maryland
41. Invisibility of Stream and Wetland Buffers in the Field
42. Techniques for Improving the Survivorship of Riparian Plantings
43. Impact of Riparian Forest Cover on Mid-Atlantic Stream Ecosystems
44. The Return of the Beaver
45. An Introduction to Better Site Design
46. The Benefits of Better Site Design in Residential Subdivisions
47. The Benefits of Better Site Design in Commercial Development
48. Changing Development Rules in Your Community
49. The Economics of Urban Sprawl
50. Skinny Streets and One-Sided Sidewalks: A Strategy for Not Paving Paradise
51. Use of Open Space Design to Protect Watersheds
52. Muddy Water In; Muddy Water Out?
53. Clearing and Grading Regulations Exposed
54. Practical Tips for Construction Site Phasing
55. Keeping Soil in Its Place
56. Strengthening Silt Fences
57. The Limits of Settling
58. Improving the Trapping Efficiency of Sediment Basins
59. Performance of Sediment Controls at Maryland Construction Sites
60. Construction Practices: The Good, the Bad and the Ugly
61. Delaware Program Improves Construction Site Inspection
62. Enforcing Sediment Regulations in North Carolina
63. Why Stormwater Matters
64. Comparative Pollutant Removal Capability of Stormwater Treatment Practices
65. Irreducible Pollutant Concentrations Discharged From Stormwater Practices
66. Stormwater Strategies for Arid and Semiarid Watersheds
67. Microbes and Urban Watersheds: Ways to Kill 'Em
68. The Economics of Stormwater Treatment: An Update

69. Trends in Managing Stormwater Utilities
70. Pond/Wetland System Proves Effective in New Zealand
71. Performance of Stormwater Ponds and Wetlands in Winter
72. Performance of a Stormwater Pond/Wetland System in Colorado
73. Performance of Two Wet Ponds in the Piedmont of North Carolina
74. Performance of Stormwater Ponds in Central Texas
75. Pollutant Removal Dynamics of Three Canadian Wet Ponds
76. A Tale of Two Regional Wet Extended Detention Ponds
77. Performance of a Dry Extended Pond in North Carolina
78. Influence of Groundwater on Performance of Stormwater Ponds in Florida
79. Environmental Impact of Stormwater Ponds
80. Pollutant Dynamics of Pond Muck
81. The Pond Premium
82. Water Reuse Ponds Developed in Florida
83. Trace Metal Bio-accumulation in the Aquatic Community of Stormwater Ponds
84. Human and Amphibian Preferences for Dry and Wet Stormwater Pond Habitat
85. Dragonfly Naiads as an Indicator of Pond Water Quality
86. Establishing Wildflower Meadows in New Jersey Detention Basins
87. Persistence of Wetland Plantings Along the Aquatic Bench of Stormwater Ponds
88. Return to Lake McCarrons
89. Nutrient Dynamics and Plant Diversity in Stormwater Wetlands
90. Adequate Treatment Volume Critical in Virginia Stormwater Wetland
91. Pollutant Removal by Constructed Wetlands in an Illinois River Floodplain
92. Pollutant Dynamics Within Stormwater Wetlands: I. Plant Uptake
93. Pollutant Dynamics Within Stormwater Wetlands: II. Organic Matter
94. Pollutant Removal Capability of a "Pocket" Wetland
95. Performance of Gravel-based Wetland in a Cold, High Altitude Climate
96. The StormTreat System: A New Technology for Treating Stormwater Runoff
97. Vegetated Rock Filters Used to Treat Stormwater Pollutants in Florida
98. Practical Tips for Establishing Freshwater Wetlands
99. Broad-leaf Arrowhead: A Workhorse of the Wetlands
100. Mosquitos in Constructed Wetlands: A Management Bugaboo?
101. Failure Rates of Infiltration Practices Assessed in Maryland
102. Longevity of Infiltration Basins Assessed in Puget Sound
103. A Second Look at Porous Pavement/Underground Recharge
104. The Risk of Groundwater Contamination from Infiltration of Stormwater
105. Developments in Sand Filter Technology to Treat Stormwater Runoff
106. Further Developments in Sand Filter Technology
107. Performance of Delaware Sand Filter Assessed
108. Field Evaluation of a Stormwater Sand Filter
109. Innovative Leaf Compost System Used to Filter Runoff in Northwest
110. Bioretention as a Stormwater Treatment Practice
111. Multi-Chamber Treatment Train Developed for Stormwater Hot Spots
112. Performance of Biofilters in the Pacific Northwest
113. Runoff and Groundwater Dynamics of Two Swales in Florida
114. Performance of Grassed Swales Along East Coast Highways

115. Pollutant Removal Pathways in Florida Swales
116. Ditches or Biological Filters? Classifying Pollutant Removal in Open Channels
117. Performance of Dry and Wet Biofilters Investigated in Seattle
118. Level Spreader/Filter Strip System Assessed in Virginia
119. Performance of Oil/Grit Separators in Removing Pollutants at Small Sites
120. Performance of a Proprietary Stormwater Treatment Device: The Stormceptor
121. New Developments in Street Sweeper Technology
122. The Value of More Frequent Cleanouts of Storm Drain Inlets
123. Dealing with Septic System Impacts
124. Recirculating Sand Filters: An Alternative to Conventional Septic Systems
125. Use of Tracers to Identify Sources of Contamination in Dry Weather Flow
126. Understanding Watershed Behavior
127. On Watershed Education
128. Choosing the Right Watershed Management Structure
129. The Peculiarities of Perviousness
130. Toward a Low Input Lawn
131. Homeowner Survey Reveals Lawn Management Practices in Virginia
132. Nitrate Leaching Potential From Lawns and Turfgrass
133. Insecticide Impact on Urban and Suburban Wildlife
134. Minimizing the Impact of Golf Courses on Streams
135. Groundwater Impacts of Golf Course Development in Cape Cod
136. Practical Pollution Prevention Practices Outlined for West Coast Service Stations
137. Practical Pollution Prevention Emphasized for Industrial Stormwater
138. Milwaukee Survey Used to Design Pollution Prevention Program
139. Rating Deicing Agents: Road Salt Stands Firm
140. Pollution Prevention for Auto Recyclers
141. An Introduction to Stormwater Indicators
142. Assessing the Potential for Urban Watershed Restoration
143. Stormwater Retrofits: Tools for Watershed Enhancement
144. Sligo Creek: Comprehensive Stream Restoration
145. Bioengineering in Four Mile Run, Virginia
146. Coconut Rolls Used For Natural Streambank Stabilization
147. Pipers Creek: Salmon Habitat Restoration in the Pacific Northwest
148. The Longevity of Instream Habitat Structures
149. Stream Daylighting in Berkeley, CA Creek
150. Parallel Pipe Systems as a Stream Protection Technique

Stormwater Management Publications

Stormwater BMP Design Supplement for Cold Climates (D. Caraco, R. Claytor, 1997). Some of the challenges of cold climates, such as freezing temperatures and high runoff during snowmelt events, influence the effectiveness of traditional stormwater designs. This document describes modifications to traditional stormwater designs to make them more effective in these environments.

Design of Stormwater Filtering Systems (R. Claytor, T. Schueler, 1996). Explores ten filter designs used to treat stormwater runoff, including bioretention, sand filters, and grass swales. Provides detailed schematics and design criteria for stormwater management, along with alternative design configurations, sizing guidance, and easy to follow step-by-step design examples. Describes the most applicable development conditions for each filter, and outlines key feasibility factors. Illustrated with over 50 figures and 60 tables.

Stormwater Management Pond Design Example for Extended Detention Wet Pond (R. Claytor, Jr., 1995). This 73-page stormwater management pond design example sets forth a step-by-step approach for the design of a stormwater management wet extended detention pond in the mid-Atlantic piedmont region of the United States.

Stormwater BMPs in Virginia's James River Basin: An Assessment of Field Conditions & Programs (Center for Watershed Protection, 2009). This report provides findings from a 2008 visual survey of stormwater management BMPs in eight localities and a review of four local stormwater management programs in the James River basin. This report provides results and recommendations regarding proper BMP design, construction, and maintenance methods as well as programmatic features that can affect the types and quality of stormwater BMPs that are installed within a locality. This study was part of the broader Extreme BMP Makeover project, a three-year endeavor to aggressively improve the pollutant reduction achieved by stormwater management practices serving development in the James River watershed.

Runoff Reduction Method Technical Memo (Center for Watershed Protection and Chesapeake Stormwater Network, 2008). This memo uses extensive background research on BMP performance to determine the ability for the BMP to reduce the overall volume of runoff in addition to pollutant removal. The method also incorporates built-in incentives for environmental site design, such as preserving forests and reducing soil disturbance and impervious cover.

National Pollutant Removal Performance Database Technical Brief (Version 3.0) (L. Fraley-McNeal, T. Schueler, R. Winer, 2008). The National Pollutant Removal Performance Database v. 2 was recently updated to include an additional 27 studies published through 2006. The updated database was statistically analyzed to derive the median and quartile removal values for each major group of stormwater BMPs. The data are presented as box and whisker plots for the various pollutants found in stormwater runoff.

National Pollutant Removal Performance Database for Stormwater Treatment Practices, version 2 (R. Winer, 2000). The second edition modifies, clarifies, and expands upon the original National Database of BMP Pollutant Removal Performance. This comprehensive report contains summaries of more than 135 urban pollutant removal monitoring studies. Includes a statistical and graphical comparison of removal rates for six groups of stormwater management practices: ponds, wetlands, open channels, filters, infiltration and on-site devices. In addition, key research gaps in terms of parameters and practices are identified.

The National Stormwater Quality Database, Version 1.1: A Compilation and Analysis of NPDES Stormwater Monitoring Information (A. Maestre, and R. Pitt, University of Alabama; and Center for Watershed Protection, 2005). This report summarizes the National Stormwater Quality Database v. 1.1 (NSQD), which contains selected water quality information from the monitoring carried out as part of the U.S. EPA's NPDES Phase I stormwater permit applications and subsequent permits, during the period of 1992 to 2002. This database contains about 3,765 events from 360 sites in 65 communities from throughout the U.S.

The Economics of Stormwater BMPs in the Mid-Atlantic Region (W. Brown, T. Schueler, 1997). This report presents cost data (1996-97) for urban stormwater practices, updates cost prediction equations, and assesses the cost-effectiveness of the BMPs most commonly used in the MidAtlantic region, including dry ED ponds, wet ponds, wetlands, and sand filters.

Monitoring to Demonstrate Environmental Results: Guidance to Develop Local Stormwater Monitoring Studies Using Six Example Study Designs (N. Law, L. Fraley-McNeal, K. Cappiella, and R. Pitt, University of Alabama, 2008). A joint effort between the Center and the University of Alabama, the manual presents the broad concepts and methods behind setting up special monitoring studies in support of the NPDES stormwater permitting program. The monitoring study designs cover a range of monitoring areas depending on the sophistication of the monitoring program -- from characterizing the quality of stormwater to developing a paired watershed study that breaks down the larger issue of protecting water quality into manageable components that can be addressed on a priority basis. Each study design covers the essential elements of establishing a monitoring program to include scoping, budgeting, funding and staffing needs as well as equipment and sampling requirements. Special issues associated with each monitoring study design are also covered for those unforeseen but inevitable problems.

Deriving Reliable Pollutant Removal Rates for Municipal Street Sweeping and Storm Drain Cleanout Programs in the Chesapeake Bay Basin (N. Law and K. DiBlasi and U. Ghosh, University of Maryland Baltimore County, 2008). This research project report provides information to support pollutant removal efficiencies for street sweeping and storm drain

cleanout practices for Phase I and II communities in the Chesapeake Bay watershed. Information and data was gathered for this project through a comprehensive literature review, a basin-wide municipal survey of existing street sweeping and storm drain cleanout practices, and an intensive field monitoring program within two study catchments located in Watershed 263 in Baltimore, MD and additional sites in Baltimore County.

Managing Stormwater in Your Community: A Guide for Building an Effective Post-Construction Program (Center for Watershed Protection, 2008). This guide provides stormwater professionals with practical guidance, insights, and tools to build effective programs. The guide is accompanied by several downloadable "tools." The tools are designed to be used and modified by local stormwater managers to help with program implementation and can be downloaded individually below.

- Tool 1: Stormwater Program Self-Assessment. The desired outcome for conducting this self-assessment is to generate short-term and long-term action items to build a more effective program.
- Tool 2: Program & Budget Planning Tool. The program & budget planning tool is a spreadsheet tool that is meant to assist stormwater managers with program planning, goal setting, and phasing.
- Tool 3: Post-Construction Stormwater 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.
- Tool 4: 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.
- Tool 5: Stormwater Manual Builder. This 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.
- Tool 6: Plan Review, BMP Construction, and Maintenance Checklists. The checklists in this tool are designed to be used by stormwater program managers, design consultants, plan reviewers, inspectors, and parties responsible for maintenance.
- Tool 7: Performance Bond Tool. This tool is intended to provide local stormwater managers with basic information regarding performance bonds. It introduces to performance bonds, provides sample performance bond forms, sample performance bond instructions and a bond estimator spreadsheet.
- Tool 8: BMP Performance Verification Checklist. Tool 8 is a downloadable checklist that will help local program authorities provide a consistent set of questions for applicants proposing to use manufactured and proprietary BMPs. The goal of this tool is to provide more of a level playing field so that all applicants provide the same type of BMP performance information and data as a basis for approving particular devices. The tool does not promote or "pre-approve" any particular device, but is applicable for the review of all proprietary BMPs. The checklist is

accompanied by an explanation and instructions for using the checklist, technical appendices that elucidate the complex world of BMP performance, and a matrix that compares existing BMP verification protocols, such as TARP, TAPE, and NJCAT.

Better Site Design Publications

Better Site Design: A Handbook for Changing Development Rules in Your Community (Center for Watershed Protection, 1998). Covering everything from basic engineering principles to actual vs. perceived barriers to implementing better site designs, the handbook outlines 22 guidelines for better developments and provides detailed rationale for each principle. Better Site Design also examines current practices in local communities, details the economic and environmental benefits of better site designs, and presents case studies from across the country. Includes a sample Codes & Ordinances Worksheet.

Consensus Agreement on Model Development Principles to Protect Our Streams, Lakes, and Wetlands (Center for Watershed Protection, 1998). This companion to Better Site Design outlines the series of 22 nationally endorsed principles developed by the Site Planning Roundtable, a national cross-section of diverse planning, environmental, home builder, fire, safety, public works, and local government personnel, and details basic rationale for their implementation.

Redevelopment Roundtable Consensus Agreement: Smart Site Practices for Redevelopment and Infill Projects (Center for Watershed Protection, 2001). This publication documents the Center's Redevelopment Roundtable Project and outlines the resulting model development principles, which are designed to promote more environmentally-friendly redevelopment and infill projects.

Better Site Design: An Assessment of the Better Site Design Principles for Communities Implementing Virginia's Chesapeake Bay Preservation Act (K. Brown, R. Claytor, H. Holland, H. Kwon, R. Winer, J. Zielinski, 2007 rev.).

Local Site Planning Roundtable Documents:

- Recommended Development Principles for Richland County, South Carolina: Consensus of the Site Planning Roundtable (Richland County, SC, Center for Watershed Protection, Inc.,

2009).

- Recommended Model Development Principles for Carroll County, Maryland: Consensus of the Builders for the Bay Site Planning Roundtable (Carroll County, MD, Center for Watershed Protection, Home Builders Association of Maryland, Alliance for the Chesapeake Bay, 2009).

- Recommended Model Development Principles for Baltimore County, Maryland: Consensus of the Builders for the Bay Site Planning Roundtable (Baltimore County , MD, Center for Watershed Protection, Home Builders Association of Maryland, Alliance for the Chesapeake Bay, 2006).

- Recommended Model Development Principles for Blair County, Pennsylvania: Consensus of the Local Site Planning Roundtable (Baltimore County , MD, Center for Watershed Protection, Home Builders Association of Maryland, Alliance for the Chesapeake Bay, 2006).

- Recommended Model Development Principles for James City County, Virginia: Consensus of the Local Site Planning Roundtable (Center for Watershed Protection, Alliance for the Chesapeake Bay, Peninsula Housing and Builders Association, James City County, 2004).

- Recommended Model Development Principles for East Hempfield, West Hempfield and Manor Townships, and Lancaster County, Pennsylvania: Consensus of the Local Site Planning Roundtable (Center for Watershed Protection, Building Industry Association of Lancaster County, Alliance for the Chesapeake Bay, 2004)

- Recommended Model Development Principles for Lower Paxton Township and Susquehanna Township: Paxton Creek Watershed: Consensus of the Local Site Planning Roundtable (Center for Watershed Protection, Home Builders Association of Metropolitan Harrisburg, Pennsylvania Builders Association, 2003).

- Recommended Model Development Principles for Harford County, MD: A Consensus of the Local Site Planning Roundtable (Center for Watershed Protection, Home Builders Association of Maryland, Alliance for the Chesapeake Bay, 2003).

- Model Development Principles for the Central Rappahannock: A Consensus of the Central Rappahannock Roundtable (Center for Watershed Protection, Friends of the Rappahannock, 2001).

- Recommended Model Development Principles for Cecil County, MD: A Consensus of the Cecil County Site Planning Roundtable (Center for Watershed Protection, 2001).

- Recommended Model Development Principles for Frederick County, MD (Center for Watershed Protection, 1999).

Other Center Publications

Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments. Outlines practical, low cost, and effective techniques for Phase II NPDES MS4 communities and others seeking to establish Illicit Discharge Detection and Elimination (IDDE) programs and investigate non-stormwater entries into storm drainage systems. It details the types of testing used to detect illicit discharges, information on estimating program costs in terms of capital and personnel expenses, and timelines that estimate how long

program implementation will take.

Impacts of Impervious Cover on Aquatic Systems. A comprehensive exploration of more than 225 multi-disciplinary studies documenting the hydrological, physical, water quality, and biological impacts of urbanization and its accompanying impervious cover. Covering many different eco-regions, climatic zones and stream types and with more than 100 graphics and tables, this 150-page report represents the Center's most thorough examination of imperviousness to date.

The Smart Watershed Benchmarking Tool. Using lessons learned from around the country, this self-assessment tool helps local program managers make better decisions on watershed restoration priorities to maximize the performance of staff and financial resources. Local watershed groups can also use this tool by determining how their community compares to others and work with their local governments to encourage adoption of practices that would strengthen watershed restoration efforts. It includes an overview of smart watershed programs, its benefits and applications for local communities; step-by-step guidance on how to complete the tool and interpret community scores; case studies and tips for implementing the programs; and further details on restoration budgeting.

Stream Restoration Practices: An Initial Assessment. Numerous stream restoration techniques are being employed that vary from "hard" structural approaches to "soft" bioengineering approaches. Examines 24 different types of stream restoration practices and includes over 450 individual practice installations. Each practice was evaluated in the field according to four simple visual criteria: structural integrity, function, habitat enhancement, and vegetative stability.

Impervious Cover and Land Use in the Chesapeake Bay. This report summarizes a Center study that analyzed 12 suburban land uses in four Chesapeake Bay watershed communities. The study derived impervious cover-land use coefficients that can be used along with land use data to estimate current and future impervious cover in your own watershed. Included in the report is a method of using these numbers to estimate impervious cover, a detailed study methodology, a review of other methodologies, and an analysis of research documenting the relationship between impervious cover and stream quality.

The Economic Benefits of Protecting Virginia's Streams, Lakes, and Wetlands and The Economic Benefits of Better Site Design in Virginia

Annotated Septic System Bibliography. An exhaustive list of sources that address the Effects and Costs of Septic Systems Within the Chesapeake Bay

A User's Guide to Watershed Planning in Maryland. This guide for developing watershed plans in Maryland provides a common planning framework for Maryland communities, assembles planning resources into one place, integrates regulatory drivers, and presents methods necessary for completing a watershed plan. The guide represents a compilation of information gathered from 25 interviews with state agency program managers and local government staff and incorporates a review of more than 47 local watershed planning surveys.

Watershed Vulnerability Analysis. The Watershed Vulnerability Analysis provides guidance on delineating subwatersheds, estimating current and future impervious cover, and identifying factors that would alter the initial classification of individual subwatersheds. This technical release outlines a basic eight-step process for creating a watershed plan for either a large watershed or jurisdiction.

Adopt-A-Pond Program Document. This report provides educational materials on the function, maintenance, and benefits of stormwater ponds; lessons learned from other Adopt-A-Pond programs; and a process for a watershed group to implement an Adopt-A-Pond program.

Developing and Implementing a Stream Watch Program. This document provides educational materials on the impacts of humans on streams, to provide lessons learned from other Stream Watch Programs, and to provide a process for a watershed group to implement a Stream Watch Program.

Watershed Planning Needs Survey of Coastal Plain Communities. This memorandum summarizes the methods, results and analyses of a web-based survey developed and implemented by the Center to assess the needs and current practices of watershed planning in coastal communities. The information generated from the survey, designed around the eight tools of watershed protection, will be used to determine the watershed techniques that are most commonly applied, the major gaps in watershed management, and examples of innovative programs and practices in the Coastal Plain.

State and Regional Stormwater Manuals

Coastal Stormwater Supplement to the Georgia Stormwater Management Manual, First Edition. This document builds on the information presented in the Georgia Stormwater Management Manual to provide comprehensive guidance on managing post-construction stormwater runoff on development sites located within Georgia's 24-county coastal region. Inside the CSS, you'll find detailed guidance on an innovative, green infrastructure-based approach to stormwater management that has its roots in natural resource protection and better site design.

Georgia Stormwater Manual. Georgia Stormwater website links to both Volumes of the Georgia Stormwater Manual - Volume 1: Stormwater Policy Guidebook is a policy document designed to provide guidance on the basic principles of effective stormwater management for Georgia communities. Volume 2: Technical Handbook is a technical engineering handbook for implementing stormwater management measures for new development and redevelopment.

New York Stormwater Management Design Manual. Provides designers with a general overview on how to size, design, select, and locate stormwater management practices at a development site to comply with State stormwater performance standards. This manual is a key component of the Phase II State Pollution Discharge Elimination System (SPDES) general permit for stormwater runoff from construction activities from all sizes of disturbance.

Minnesota Stormwater Management Design Manual. The Center worked with Minnesota-based Emmons & Olivier Resources, a large committee of state regulators, and other stakeholders to craft the Minnesota Stormwater Manual, the most comprehensive one in the Upper Midwest to date. This manual provides an updated discussion of cold climate issues as they influence design of stormwater practices, like the challenge of high snowfall, springtime snowmelt, and Minnesota's thousands of sensitive lakes, trout streams, and wetlands that merit special protection. The related issue papers, also from this site, introduced new stormwater concepts to the state, such as unified sizing criteria, special receiving water performance standards, and stormwater credits.

2002 Vermont Stormwater Manuals

Watershed Plans

Guánica Bay Watershed Management Plan. This report by the Center for Watershed Protection for the Puerto Rico Department of Environmental and Natural Resources presents a framework for managing the Guánica Bay watershed in southwestern Puerto Rico.

James River Vulnerability Analysis. A vulnerability analysis of James River sub-watersheds to identify which watersheds contribute the most sediment to the James River from stormwater runoff. The project evaluates existing information for sub-watersheds and identifies priority watersheds for protection.

Coral Bay Watershed Management Plan: A Pilot Project for Watershed Planning in the USVI. This report presents a framework for managing the Coral Bay Watershed, St. John, USVI based on a pilot watershed planning study conducted primarily with the USVI Department of Planning and Natural Resources Division of Coastal Zone Management.

Bronx River Watershed Assessment and Management Report. In 2005, the Center with Biohabitats, Inc. conducted extensive Bronx River Watershed Stream Corridor and Upland Assessments, and in 2007 finalized the Bronx River Watershed Assessment and Management Report.

Little Lick Creek Local Watershed Plan. The Little Lick Creek (NC) Local Watershed Plan recommends nine comprehensive watershed management strategies for restoring the Watershed's water quality and aquatic habitat in the short-term and protecting them in the long-term.

Centennial and Wilde Lake Watershed Restoration Plan. This watershed management plan provides a summary of the recommendations for Centennial and Wilde Lake watersheds (Howard Co. MD) from a baseline analysis, stream assessment, upland pollution prevention, and retrofit fieldwork and stakeholder process.

Paxton Creek Baseline and Stormwater Retrofit Assessment. Result of a detailed stream and subwatershed assessments in the Upper Paxton Creek North and Lower Paxton Creek North subwatersheds - a restoration plan for the two Paxton Creek North subwatersheds that summarizes baseline conditions, outlines goals and recommendations, and identifies priority restoration projects with conceptual designs for future implementation.

Powhatan Creek Watershed Management Plan. This Virginia watershed management plan is designed to protect and restore this historically significant creek.

Yarmouth Creek Watershed Management Plan. This watershed management plan identifies critical issues and an action plan to protect this relatively pristine Virginia watershed.

Factsheets and Outreach Materials

DIY Rain Barrel/Rain Garden Installation Guide. Use this 11x17 handout the Center developed for the South River Federation to provide an extensive how-to for both rain barrels and rain gardens!

Sample Homeowner Survey. Designed to gauge level of interest in backyard practices

Sample Community Factsheets - Are You Loving Paxton Creek to Death? An educational brochure with information on the Paxton Creek watershed and specific actions that homeowners, business owners, developers and local governments can do to help protect and restore Paxton Creek. Fact sheets on: Lawns and Landscaping, Downspout Disconnection, Stream Buffer Management, Outdoor Storage, Dumpster Management, Better Site Design, and Erosion and Sediment Control.

Audits

Watershed Protection Program Audit (8 Tools Assessment). This tool provides an example audit designed to identify regulatory and programmatic tools and gaps in your watershed protection planning strategy and is organized by the Center for Watershed Protection's Eight Tools of Watershed Protection. These tools roughly correspond to the stages of the development cycle from initial land use planning, site design, and construction.

The Codes and Ordinances Worksheet. The Codes & Ordinances Worksheet, or COW, is a simple worksheet that you can use to see how the local development rules in your community stack up against the model development principles outlined in Better Site Design. This PDF will allow you to enter data in the fields and save.

Needs and Capabilities Assessment (NCA). This tool helps communities to quickly organize known programs and resources that can be potentially applied to watershed protection and restoration, as well as identify potential resources that may not have been considered.

Comparative Subwatershed Analysis (CSA). This tool contains information on the Comparative Subwatershed Analysis that helps screen subwatersheds within a community to find the ones with the greatest restoration potential. A brief description of the subwatershed "metrics" used to provide a general indication of restoration potential is also included.

Field Assessment Forms

USSR field assessment forms for ArcPad. Use of the forms assumes that the reader has basic ArcGIS knowledge and skills. Users must open the zip folders and extract all the files to a folder onto a local computer. All dbf files must stay in the same folder as the shapefile, since the form references back to the dbf files to fill in the drop down menus on the forms. The Center would appreciate any feedback from users on improvements they make to the forms and would be interested in having users share back the forms with the changes made. We can then continue to offer newer versions of the forms as corrections or improvements are integrated. There is also a BMP evaluation form created for a different project that may be of interest to readers, although there is no guidance manual for the form.

Unified Stream Assessment Field Forms. Included are Storm Water Outfalls, Severe Bank Erosion, Impacted Buffer, Stream Crossing, Channel Modification, Trash and Debris, Utility Impacts, Miscellaneous, Reach Level Assessment, Photo Inventory. Refer to USRM Manual 10 Unified Stream Assessment: A User's Guide for supporting documentation.

Unified Subwatershed and Site Reconnaissance Field Forms. Includes Neighborhood Source Assessment, Hotspot Site Investigation, Pervious Area Assessment, and Streets and Storm Drains. Refer to USRM Manual 11: Unified Subwatershed and Site Reconnaissance: A User's Guide for supporting documentation.

NSA jr. Field Form. Neighborhood Source Assessment Short Form for High Density Residential Areas

Urban Reforestation Site Assessment. An appendix of Urban Tree Planting Guide, Part 3 of the Urban Watershed Forestry Guide, The Urban Reforestation Site Assessment (URSA) is used to collect detailed information about planting site conditions. It provides a tool to help organize important data to help determine where and what to plant, and what special methods are needed to prepare the site and reduce conflicts due to existing site constraints. Used to collect data at the most promising reforestation sites in an urban watershed, in order to develop detailed planting plans. All available information about an individual planting area is contained in a single form.

Contiguous Forest Field Form. Use the Contiguous Forest Assessment field sheet to develop good representative characterization of the land under consideration for protection.

Wetland Impacts Assessment. Presented in Wetlands & Watersheds Article #2: Using Local Watershed Plans to Protect Wetlands, this form includes guidance for completing the assessment.

Retrofit Reconnaissance Investigation Form

Stream Repair Investigation Form

Watershed Treatment Model

The Watershed Treatment Model (Version 3.1). This publication documents the Watershed Treatment Model (WTM), a simple spreadsheet that tracks pollutant sources and the effectiveness of various watershed treatment options in urban and urbanizing watersheds. The WTM can be used to develop TMDLs for nutrients or sediment; direct bacteria detective work in urbanized watersheds; determine the effectiveness of watershed education programs; and target the future program in a Phase II community.