Stormwater Retrofit Techniques for Restoring Urban Drainages in Massachusetts and New Hampshire

Small MS4 Permit Technical Support Document, April 2011

Draft NPDES Permits Call for Stormwater Retrofits

The 2010 draft NPDES Small MS4 general permits for Massachusetts and New Hampshire (herein referred to as the draft permits) may require the retrofitting of existing unmanaged and/or inadequately managed stormwater runoff in impaired watersheds as summarized in **Table 1**. While new development is required to manage stormwater on-site, older developments may have been constructed before stormwater management was required or modern criteria were established. Retrofits include new installations or upgrades to existing Best Management Practices (BMPs) in developed areas where there is a lack of adequate stormwater treatment (**Figure 1**). Stormwater retrofit goals may include, among other things, the correction of prior design or performance deficiencies, flood mitigation, disconnecting impervious areas, improving recharge and infiltration performance, addressing pollutants of concern, demonstrating new technologies, and supporting stream restoration activities.

Table 1. References to Retrofit Requirements in the MA and NH Draft NPDES Permits.

Stormwater Retrofit Requirements	Draft NPDES Permit Section	
	NH	MA*
MS4s discharging to impaired waters with an approved TMDL must implement specific BMPs to meet reduction targets**	2.2.1; Appendix F	2.2.1; Appendix G
MS4s discharging to impaired waters without an approved TMDL must identify and implement BMPs to address impairment as part of their Stormwater Management Program (SWMP)	2.2.2	2.2.2
Increased discharges to impaired waters must provide additional BMPs or enhanced control of an existing discharge	--	2.3.1
Inventory and rank MS4-owned properties and infrastructure based on retrofit potential	2.3.6.8(b)	2.4.6.9(c)
Report on MS4-owned properties and infrastructure that have been retrofitted with BMPs	2.3.6.8(d)	2.4.6.9(d)
Design and install stormwater controls at municipal facilities, where needed, as part of the Stormwater Pollution Prevention Plan (SWPPP)	2.3.7.2	2.4.7.2
* MA permit sections listed are from the draft North Coastal Small MS4 General Permit **Appendices F and G identify waste load targets for those small MS4s for which there are approved TMDLs.		

Figure 1. Structural retrofits such as the bioretention, bioswale, and sand filter shown here can be used to capture, treat, and/or infiltrate unmanaged runoff. Public open space and large parking lots are common retrofit locations.

Retrofitting to Meet Total Maximum Daily Load (TMDL) Reductions

MS4s discharging to impaired watersheds with approved TMDLs may now be required to retrofit existing development in order to meet pollutant reduction targets. Draft permit appendices F and G for New Hampshire and

Massachusetts, respectively, provide a listing of small MS4s subject to approved TMDLs and their respective load reduction targets and permit requirements.

Retrofitting the Charles River Watershed
(draft MA North Coastal permit, Section 2.2.1(d))

MS4s within the Charles River or within its tributary watershed must also develop Phosphorus Control Plans (PCPs) that identify, prioritize, and provide design/construction schedules for the structural and non-structural control measures necessary to reduce Total Phosphorous (TP). Structural control measures include practices that reduce or disconnect impervious cover, enhance infiltration, or otherwise treat stormwater. Non-structural measures include pollution prevention and source control activities (e.g., street sweeping). Permittees must also estimate costs and identify third party implementers in the PCP.

Progress on development of the PCP must be reported by the MS4 in the second year NPDES annual report. Implementation of the PCP must start no later than four years from the effective date of the NPDES permit and be completed within 10 years. Beginning one year after implementation of the PCP, the permittee must begin estimating annual TP load reductions based on implementation.

The Stormwater Retrofit Process

A widely accepted approach (Schueler et al., 2007) to stormwater retrofitting at the small watershed scale is summarized in brief below:

1. Evaluate local need and capacity for retrofitting in your MS4. Determine if your jurisdiction falls within the Charles River Watershed or other TMDL watersheds, and identify your pollutant reduction requirements. If there are redevelopment projects in the planning stage, identify any federal, state and local requirements for improving on-site stormwater management. Have you already conducted a retrofit inventory?

2. Using GIS, institutional knowledge and blueprints as appropriate, identify potential retrofit locations at publicly-owned properties (e.g., parks, schools, and municipal maintenance yards), street rights-of-way, culverts/outfalls, and existing detention practices. Target large parking lots, rooftops, or other impervious areas (public or privately-owned) that lack stormwater management and are considered directly connected to the MS4. Identify sites that are prone to flooding, chronic contamination, and/or have a high maintenance burden (**Figure 2**).

3. Conduct a retrofit investigation by visiting each location to verify current conditions and identify potential retrofit treatment options and constraints. Use this opportunity to verify if impervious cover on site is directly-connected to the MS4 or disconnected. Eliminate sites where retrofitting is infeasible or impractical due to existing constraints (e.g., land use, environmental conditions, presence of utilities, or other limitations).

4. Develop an inventory of potential retrofit candidates, with illustrative concept sketches, site photos, and basic drainage calculations (**Figure 3**).

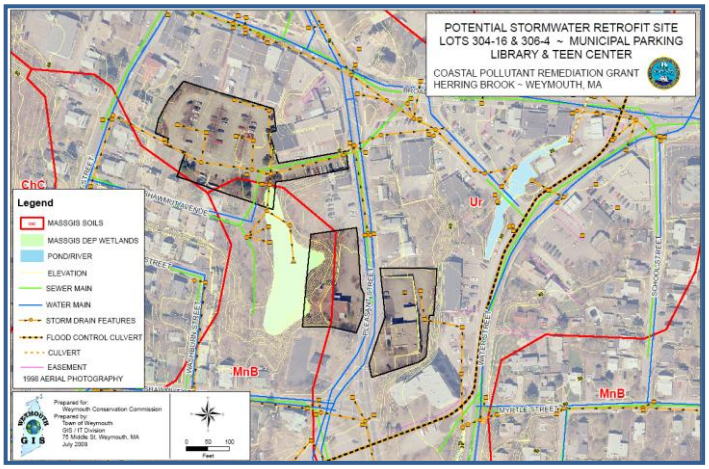

Figure 2. Mapping analysis used to identify potential locations for retrofits in Weymouth, MA showing aerial imagery, parcel ownership, stormwater infrastructure and utilities, topography, soils, and hydrology. The MassGIS and NH's GRANIT websites are good sources of GIS data and can be found at www.mass.gov/mgis/ and www.granit.unh.edu/, respectively.

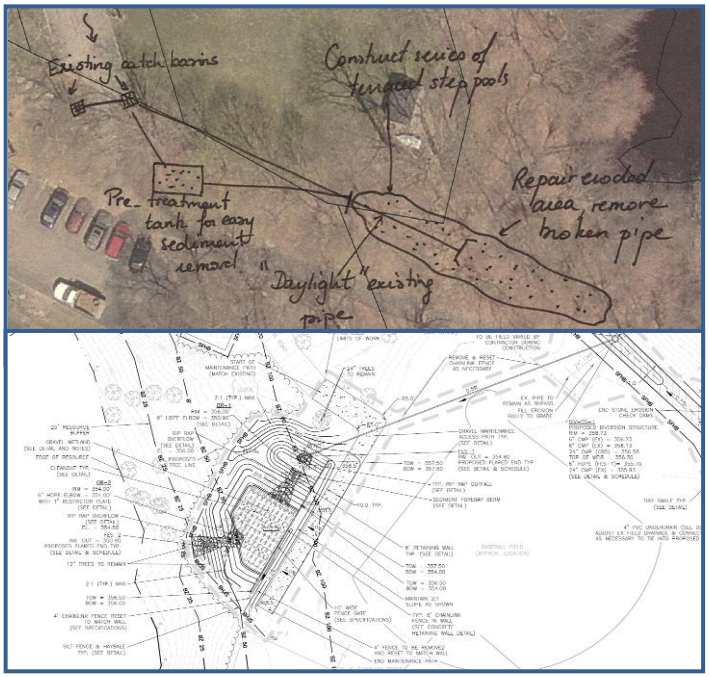

Figure 3. Concept sketches can be done by hand. Once priorities have been identified, concepts can be further advanced to engineering design and construction plans.

5 Evaluate and rank retrofit concepts based on predetermined factors such as pollutant reduction requirements, BMP feasibility and performance, impervious cover disconnection, cost, visibility, property ownership, and community support.

The draft permits require an inventory and ranking of all MS4-owned properties and infrastructure for retrofit potential within two years of the effective date of the permit.

6 Model watershed treatment benefits for various implementation scenarios to help determine the most cost-effective approaches to implementation. There are a number of existing public models that could be used to assist in the evaluation of implementation scenarios, such as the Center for Watershed Protection's Watershed Treatment Model (WTM), Pitt and Voorhees' Source Loading and Management Model (SLAMM), or EPA's new System for Urban Stormwater Treatment and Analysis Integration (SUSTAIN) developed by TetraTech. These models can be uploaded at www.cwp.org; www.winslamm.com/; and www.epa.gov/ednnrmrl/models/sustain/index.html.

MS4s in the Charles River Watershed subject to Phosphorous Control Plans must establish 2010 baseline Total Phosphorous Loads, and report annual load reductions based on retrofit implementation pursuant to Sections 2.2.1(vi) and 2.2.1(x) of the draft MA North Coastal permit.

7 Take the top projects to final design and construction stages (**Figure 4**). Allow additional time to complete site surveys, necessary state and local permitting, contractor bidding and specifications, and, in some cases, generate public support. The time required to secure implementation funding will likely vary depending on the primary source of funds (i.e., stormwater utility, general or capital budgets, or grants).

Beginning with the third year annual report, permittees will be required to report on completed retrofit projects. Permittees are encouraged to also report non-MS4 and private sector retrofit projects.

8 Provide inspection and maintenance services for the life of the retrofit (**Figure 5**). MS4 programs should establish a BMP tracking system to ensure long-term maintenance of existing and retrofitted facilities.

Figure 4. As an example of a priority retrofit taken to final design and construction, this shows the installation of a bioretention facility at a nature center in Massachusetts.

Figure 5. Ensuring the long-term maintenance of sand filters, swales, bioretention facilities, and other BMPs is a critical component of a municipal stormwater management program.

Do the Performance Objectives for Retrofits and New Developments Differ?

Yes. In the draft small MS4 general permits for MA and NH, the primary objective for new development is to achieve a condition of pre-development hydrology. As a practical matter, this can be accomplished by preventing a discharge from the 90th percentile storm (about a one-inch rainfall event in Massachusetts and New Hampshire). In contrast, the primary objective for a retrofit is to improve the hydrology of an existing site and reduce the discharge of stormwater as much as possible. In many cases, retrofits provide an opportunity to remedy past design and/or performance deficiencies.

Are Certain Structural Practices Preferred?

Yes. While all retrofit sites are unique and no single solution fits all, in general, preferred practices are those that provide for increased infiltration, evapotranspiration and rainwater harvesting because these practices reduce stormwater runoff volume while also providing water quality benefits. Retrofits that provide for infiltration (e.g., infiltration basins and trenches, bioretention systems, rain gardens, and swales) where little or no infiltration currently exists are likely to improve site hydrology. Infiltration practices also help to recharge groundwater aquifers, although practices located near public drinking water sources should carefully consider the impact of infiltrating stormwater discharges on drinking water sources.

Depending on the water quality/TMDL goals for the watershed, permittees should also consider retrofitting existing BMPs to maximize pollutant removal. The retrofitting of dry detention ponds, for instance, may provide the most cost-effective approach to capture and treat large drainage areas.

Where Can We Find BMP Performance Efficiencies?

Both the Massachusetts and New Hampshire Stormwater manuals include pollutant removal efficiencies for various stormwater practices. These can be found at www.mass.gov/dep/water/laws/policies.htm#storm and des.nh.gov/organization/divisions/water/stormwater/manual.htm, respectively.

Other reliable sources of pollutant removal rates can be found in Appendix D of Schueler et al. (2007), the University of Massachusetts at Amherst, Stormwater Technologies Clearinghouse at www.mastep.net/, or the University of New Hampshire Stormwater Center at www.unh.edu/erg/cstev/.

Where Can I go for More Permit Information?

For more information regarding the new permit requirements for Massachusetts and New Hampshire, go to: www.epa.gov/ne/npdes/stormwater/index.html

Load reduction targets for small MS4s in Massachusetts and New Hampshire that are subject to approved TMDLs are available at:
www.epa.gov/ne/npdes/stormwater/ma/Appendix-G-Small-MS4-MA.pdf

www.epa.gov/ne/npdes/stormwater/nh/Appendix-F-Small-MS4-NH.pdf

Additional Retrofitting Resources

Charles River Watershed BMP Factsheets
www.crwa.org/projects/stormwater/stormwaterBMPs.html

Rhode Island Stormwater Design and Installation Manual. 2010.
www.dem.ri.gov/programs/benviron/water/permits/ripdes/stwater/pdfs/desgnmnl.pdf

Schueler, T., Hirschman, D., Novotney, M., and J. Zielinski. 2007. Urban Watershed Restoration Manual No. 3: Urban Stormwater Retrofit Practices.
www.cwp.org/

USEPA Webcast Series: The Art and Science of Stormwater Retrofitting.
www.epa.gov/npdes/outreach_files/webcast/apr0908/107156_od/107156_od.html

Municipal Retrofit Case Studies

Catskill Watershed Corporation- Stormwater Retrofit Grant Program
www.cwconline.org/programs/strm_wtr/strm_wtr1.html#retro

Center for Landuse Education and Research (CLEAR), University of Connecticut, Eagleville Brook TMDL and Retrofit Project website:
www.clear.uconn.edu/eagleville/Eagleville_TMDL/Home.html

Charlottesville, VA - Stormwater Stewardship on Public Lands Program
www.charlottesville.org/index.aspx?recordid=259&page=635

Massachusetts Institute of Technology (MA) - Stata Center web.mit.edu/environment/ehs/topic/stata.html

Montgomery County, MD - Rainscapes Program
www.montgomerycountymd.gov/dectmpl.asp?url=%5Ccontent%5Cdep%5Cwater%5Crainscapes.asp

Portland, OR - Clean River Rewards Program
www.portlandonline.com/BES/index.cfm?c=edeef

Portland, OR - Downspout Disconnection Program
www.portlandonline.com/BES/index.cfm?c=edaib

Sanitation District No. 1 of Northern Kentucky- Public Service Park. www.sd1.org/

Seattle, WA - Natural Drainage Systems Program
www.seattle.gov/util/About_SPU/Drainage_&_Sewer_System/GreenStormwaterInfrastructure/NaturalDrainageProjects/index.htm

Villanova University - Best Management Practice Demonstration Park www3.villanova.edu/VUSP/