# Incorporating impervious cover into water quality plans

## A new strategy for developing pollution control goals for highly urbanized areas.

In February 2007, the U.S. EPA entered the next generation of watershed-based pollution control by issuing a Total Maximum Daily Load (TMDL) based not on a specific pollutant but on impervious cover.

The goals for Connecticut's 2.4-square-mile Eagleville Brook Watershed integrate aspects of urban development. Since then, similar TMDLs have been or are being developed across the Northeast, including in Maine, Massachusetts, and North Carolina. In Connecticut, 238 square miles of impervious cover (about 5% of the state) was added between 1985 and 2006. This work is expected to become a national model by which communities can use a framework of impervious cover management to meeting water quality goals.

Typically, TMDLs are managed by local jurisdictions through a waste load allocation established by the state. In this case, the Connecticut Department of Environmental Protection (DEP) determined that a biological impairment — such as low fish densities in some areas and large amounts of aquatic habitat completely unoccupied in others — existed, but couldn't be attributed to one specific pollutant. Instead, the impairment was attributed to an array of pollutants transported by stormwater and linked to urbanization, and — more directly — impervious cover.

The Eagleville Brook TMDL was created to improve the quality of streams impaired by urbanization. Eagleville Brook is a small watershed that drains much of the University of Connecticut campus.

The brook is on the 2008 list of state waterbodies not meeting quality standards due to very low aquatic life use support scores, the causes of which are cited as "unknown." The watershed flows to an impoundment of the Willimantic River, a tributary of the Thames River basin, which encompasses much of the eastern one-third of the state.

In 2005 – 2006, the DEP conducted statewide research comparing stream health, as indicated by metrics for benthic macroinvertebrate populations, to watershed impervious cover estimates provided by the university's Center for Land Use Education and Research.

As urban watersheds become even more urbanized, runoff causes elevated concentrations of pollutants, altered channel morphology, and reduced biotic integrity. Of the 125 stream segments that were studied, no segment with more than 12% impervious cover in its immediate upstream catchment area met the state's aquatic life criteria for a healthy stream. This became the foundational research supporting the impervious cover TMDL framework and setting the impervious cover goal at 11%.

The university and the Town of Mansfield responded by partnering to evaluate the feasibility of the maximum pollutant level concept and document a general methodology that would allow other communities to implement a similar program. The project team included the university's Center for Land Use Education and Research, the Center for Watershed Protection, and the Horsley-Witten Group engineering firm.

### Field assessments yield opportunity

The project team began by analyzing mapping data for the watershed: state hydrography and topography, the university's infrastructure and building footprints, and the town's stormwater infrastructure. They determined that 18%, or 218 acres, is impervious cover — higher than the 11% target. Most is concentrated in the highly urbanized section of the university's campus. On the other hand, the town's portion of the watershed is primarily composed of rural residential development.

In July 2009, the team conducted field work to identify opportunities to disconnect impervious cover using

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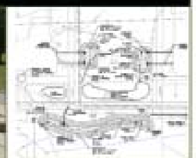
### WHAT IS IMPERVIOUS COVER?

According to the U.S. EPA, it is the amount of land cover in roads, buildings and parking lots, and turf grass cover in a watershed, which can seriously impact biotic integrity (fish community health) in associated streams.

## Site C4/5: Education/Gentry Buildings and Sundial Garden

Integrating Stormwater and Landscape Management

**Project Summary**



| Parameter | C4/5-a | C4/5-d | C4/5-e |
|---|---|---|---|
| Impervious Cover Treated (acres) | 0.12 | 0.07 | 0.34 |
| Runoff Reduction Volume (cu ft per 1" rain event) | 162 | 101 | 474 |
| TN Removal (lb/yr) | 1.42 | 0.89 | 4.17 |
| TP Removal (lb/yr) | 0.16 | 0.1 | 0.48 |
| TSS Removal (lb/yr) | 35.73 | 22.25 | 104.98 |
| Estimated Cost | $11,000 | $3,000 | $13,000 |

***Site Description***

The proposed retrofit concept is located on the UConn Campus at the Education and Gentry Buildings. These two buildings are mirrored in design, and are separated by the Sundial Garden quad area.

***Existing Conditions***

The roof leaders from both buildings are directly connected to the stormdrain system. The adjacent green space in the Sundial Garden is highly compacted. Across the walkway in the student center quad, the soils are somewhat compacted. Several areas of localized soil erosion were noted.

***Proposed Concept***

Several retrofit opportunities were identified at each building (Figure 1). The locations of these projects are shown in attachment B:

- C4/5 (a) – Direct the front roof leaders into raised stormwater planter beds.
- C4/5 (b) – Direct the two downspouts near the main building entrances into cisterns. Water from the cistern can be used to water the building landscaping.
- C4/5 (c) – Amend the soils to restore the pervious area in the Sundial Garden and plant trees and a vegetative buffer along the southwest edge of the garden to reduce runoff and soil erosion.
- C4/5 (d) – Divert the two downspouts above the building side entrance into a bioretention area in the Sundial Garden. These bioretention areas can be incorporated into additional landscaping plans for this Garden.
- C4/5 (e) – Construct a large linear bioretention area along the walkway. Divert the walkway and terrace runoff into the area using berms or trench drains.



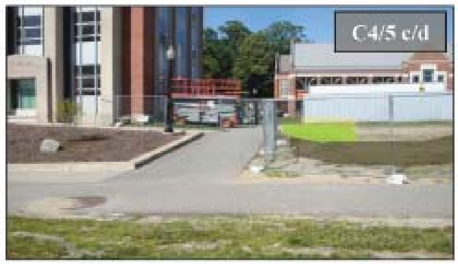




**Figure 1.** (C4/5-a) Potential location for stormwater planter boxes. (C4/5-b) Potential location for a cistern. (C4/5-c/d) Compaction in the Sundial Garden area and the proposed location of soil amendments and bioretention. (C4/5-e) Proposed location of larger bioretention project.

## Project goals

1. To develop site-specific recommendations for the University of Connecticut and Town of Mansfield to use in developing water quality management plans for the Eagleville Brook watershed.
2. To incorporate these plans into the context of a watershed-based plan.
3. To identify best management practices that can be implemented immediately or in the near term.
4. To document a methodology that other communities can use to develop standards, practices, and regulations for protecting water resources from existing and future development.
5. To create an effective, innovative collaboration between the state and the university that can serve as an example program for Connecticut's Responsible Growth Initiative and the nation.

**The University of Connecticut plans to treat 28 acres — the equivalent of 62,000 cubic feet of rain in a 1-inch storm — of drainage area including rooftops, parking lots, and streets with rain gardens, planters, and bioretention practices.** Illustrations: Center for Watershed Protection

the Retrofit Reconnaissance Inventory (RRI) developed by the Center for Watershed Protection.

Members evaluated the retrofit potential of 51 sites by analyzing drainage patterns, drainage areas, impervious cover, available space, and other constraints such as conflicts with utilities and land uses, site access, and potential impacts to natural areas. They also sought to verify subwatershed drainage boundaries and identify impervious cover that was already disconnected. They found:

- Discrepancies in the original watershed boundary as contained in the state hydrography data layer; the watershed is actually 26 acres smaller
- 51 acres of impervious cover are already disconnected via sheet flow to a large forested area, undetected diversion to another watershed, or being treated by a best management practice
- Several impervious surfaces in the center of campus drain to highly compacted pervious areas with reduced ability to infiltrate stormwater. So although they were considered pervious when determining the original estimates, the team also considered impervious portions draining to compact pervious areas without a best management practice to be directly connected to the watershed.

Unless there were obvious constraints and/or evidence that a retrofit would offer few or no benefits, a stormwater retrofit concept was developed. Of the 110 potential retrofits the team identified, most are on the university campus. The team then identified 10 priority projects based on pollutant removal capability, runoff reduction, integration with other improvements, and cost.

Although impervious cover will be used to measure progress in this TMDL, the ultimate goal is to restore the watershed's biological communities by improving the brook's water quality.

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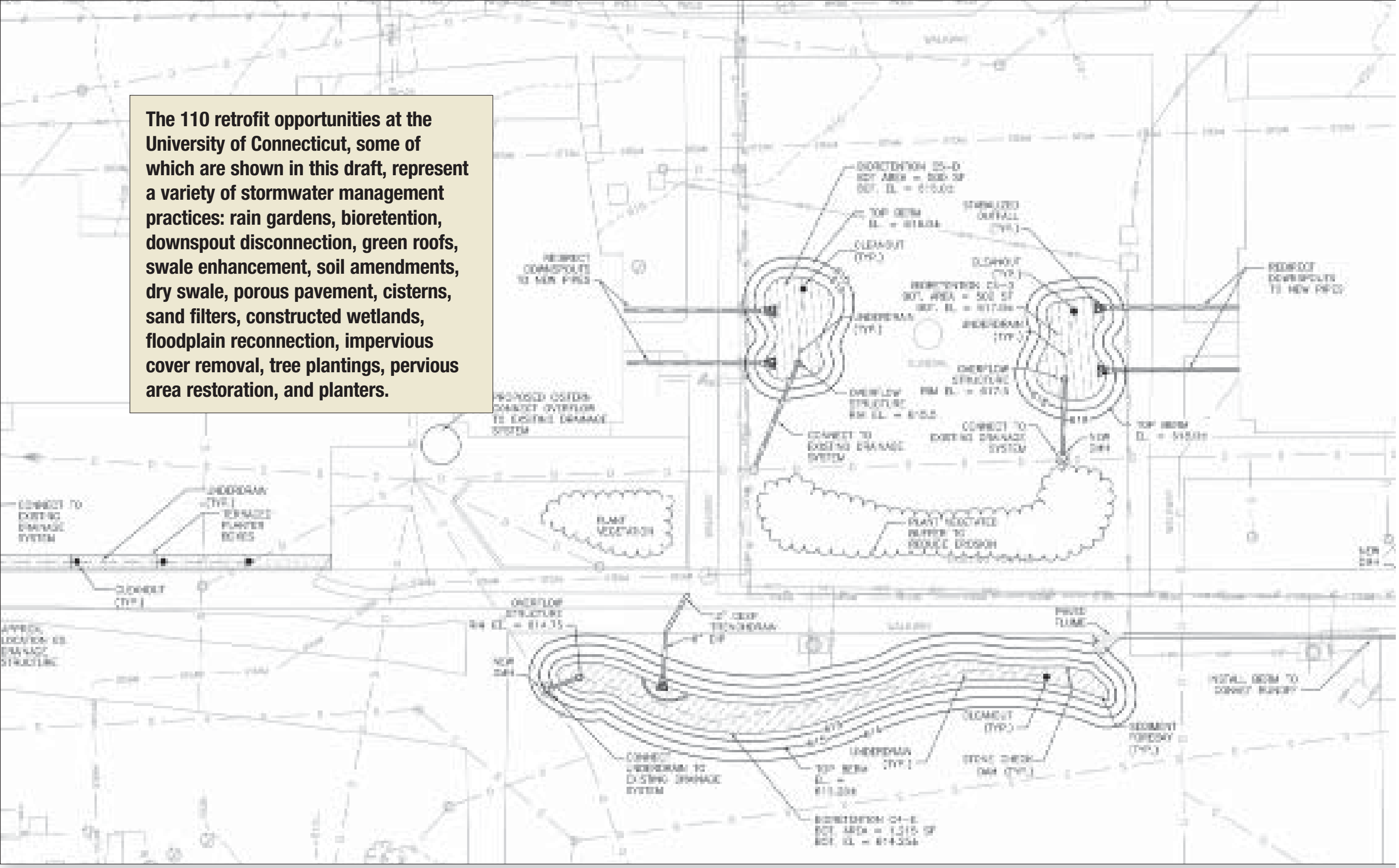

The 110 retrofit opportunities at the University of Connecticut, some of which are shown in this draft, represent a variety of stormwater management practices: rain gardens, bioretention, downspout disconnection, green roofs, swale enhancement, soil amendments, dry swale, porous pavement, cisterns, sand filters, constructed wetlands, floodplain reconnection, impervious cover removal, tree plantings, pervious area restoration, and planters.

Thus, several questions still need to be addressed:

- How are discrepancies in impervious cover estimates and watershed boundaries addressed in regard to the TMDL regulatory framework?
- Is the "effective" watershed impervious cover comparable to actual watershed impervious cover, and what should be the process for accounting for each in development and implementation of maximum pollutant levels?
- How should stormwater managers account for "partial" or "ineffective" treatment, such as undersized or under-managed stormwater management practices, of impervious cover? Do these practices get partial credit?
- What happens if there aren't enough on-the-ground opportunities to meet target pollutant levels due to the lack of publicly-owned properties and uncooperative land owners?

Moving forward, the DEP's Bureau of Water Management will collect surface water flow and benthic macroinvertebrate data to measure the TMDL's impact on the watershed's aquatic life. The bureau and the Conneticut Inland Fisheries Division also will gather and analyze data regarding fish populations. The data will be incorporated into a watershed-based action plan that's in the draft phase.

Overall, accounting for impervious cover when developing water quality objectives makes sense because it typically is easier to generate a community response than with many other pollutants, such as bacteria or heavy metals. An impervious cover TMDL is easy to understand and measure, and it can result in a quick path to implementation.

Although not yet quantified, the progress so far in Eagleville Brook supports this view. Based on this experience, combining an integrative indicator like impervious cover with an accounting system like a TMDL provides a promising approach for helping communities design land use plans that protect water resources. **PW**

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