ABOUT THE PROJECT
THE JORDAN COVE URBAN WATERSHED PROJECT IS LOCATED IN WATERFORD, CONNECTICUT ALONG THE COAST OF LONG ISLAND SOUND. THE STUDY Began IN 1995, AND WAS DESIGNED TO DETERMINE WATER QUANTITY AND QUALITY BENEFITS OF USING POLLUTION PREVENTION BEST MANAGEMENT PRACTICES (BMPS) IN A RESIDENTIAL SUBDIVISION. MONITORING TOOK PLACE FOR 10 YEARS.

Project funding was through the U.S. Environmental Protection Agency’s Clean Water Act Section 319 National Monitoring Program, and administered by the Connecticut Department of Environmental Protection, Nonpoint Source Management Program.

This brochure provides prospective developers, contractors, land use commissioners and others with low impact development project planning, study results and recommendations for reducing impacts of residential development on stormwater and runoff quality.

TABLE OF CONTENTS
Background 2
Project Overview 3
Study Design 4
Monitoring 5
Pre-construction Planning 6
Best Management Practices 7
Results: Construction 8
Results: Post-Construction 10
Conclusions 11
Contacts 12
WHAT IS THE PROBLEM?
JORDAN COVE IS A SMALL ESTUARY IN LONG ISLAND SOUND FED BY JORDAN BROOK. THE COVE HAS IMPAIRED WATER QUALITY BASED ON EXCESS BACTERIA. LONG ISLAND SOUND SUFFERS FROM HYPOXIA RELATED TO EXCESS NITROGEN.

PROJECT GOAL: The key project goal was to measure the effectiveness of urban stormwater best management practices in reducing runoff and protecting water quality.

SPECIFIC OBJECTIVES WERE TO:
1. Reduce sediment, bacteria, nitrogen, phosphorus, and stormwater runoff quantity during and after construction.
3. Evaluate selected BMPs (e.g. driveways, lawn management).

Stormwater Runoff
Runoff from urban areas is a major cause of water pollution throughout the United States. Pollutants can include bacteria, nutrients, sediment and metals. Common sources of pollutants are automobiles, lawn fertilizers, and pet wastes. Accelerated runoff comes from impervious surfaces, such as rooftops, sidewalks, streets, and driveways.
Study Design

PROJECT DESIGN WAS BASED ON A PAIRED WATERSHED APPROACH; ONE WATERSHED SERVED AS A CONTROL WHILE THE OTHER IS CALLED A TREATMENT WATERSHED.

CONTROL WATERSHED
The control watershed was an existing 14 acre residential watershed containing 43 lots built in 1988 in the same general vicinity of the treatment watersheds. Stormwater runoff was monitored at the outflow of a stormwater pipe at the watershed outlet. This watershed allowed us to adjust for weather differences year-to-year.

TRADITIONAL WATERSHED (TREATMENT)
The traditional watershed was five acres in size and now contains 17 residential lots. This watershed was developed using standard zoning and construction practices. It is accessed by a 24 foot wide asphalt road with typical curb and gutter stormwater conveyance system.

BMP WATERSHED (TREATMENT)
The four acre BMP watershed now contains 12 lots. A cluster approach was used to aggregate homes closer together, leaving more open space in the watershed. Shared driveway entrances reduce imperviousness. Lawn sizes are reduced and low-mow and no-mow areas are designated to reduce fertilizer and maintenance impacts. The access road is narrower [20 ft.] than typically allowed by ordinance and is constructed of interlocking concrete pavers that allow infiltration.
Monitoring

Precipitation, temperature, and discharge were continuously recorded in computers.

Water quality characteristics monitored using automated samplers include:

• Total suspended solids, total phosphorus, nitrate, ammonia, total Kjeldahl nitrogen, copper, lead, zinc, fecal coliform bacteria, and biochemical oxygen demand.

Why these variables?

These are common stormwater pollutants:
• Suspended solids cloud water and can harm fish habitat.
• Phosphorus and nitrogen stimulate excessive growth of algae; heavy metals can be toxic to aquatic life.
• Bacteria are indicators of potentially harmful pathogens.
• Biochemical oxygen demand can use up oxygen in lakes and rivers.

project schedule

<table>
<thead>
<tr>
<th>Period</th>
<th>Traditional Watershed</th>
<th>BMP Watershed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-construction Period</td>
<td>2003-2005</td>
<td>2002-2005</td>
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</table>
Pre-construction Planning

Planning for the Jordan Cove Urban Watershed Project involved a team approach comprised of many members. The Connecticut Department of Environmental Protection led a statewide search for a suitable project. The project had to be located in a priority watershed, in a town willing to be innovative, with a willing developer, and a watershed capable of being monitored. The team developed the design in an interactive manner among the project engineer, town officials, state and federal agencies, and the university. A university landscape architect class provided design concepts.

Deed Restrictions:
- Maintain swales and rain gardens.
- Restrict impervious additions.
- Maintain conservation zone and low-mow area.

Calibration Period
The calibration period is when baseline data is collected to compare to future monitoring data. Calibration allows year-to-year weather differences to be accounted for in the analysis. Calibration was conducted prior to construction.

### Technical Modifications of Existing Development Standards

<table>
<thead>
<tr>
<th>Consideration</th>
<th>Traditional Design</th>
<th>BMP/Cluster Design</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waivers needed</td>
<td>Specified materials</td>
<td>Alternative pavement</td>
<td>Must be approved by police and public works</td>
</tr>
<tr>
<td>Typical road width = 28 feet, reduced to 24 feet</td>
<td>Reduced road width to 20 feet for travel lane</td>
<td>Must be approved by police, fire and public works</td>
<td></td>
</tr>
<tr>
<td>Curb required</td>
<td>No curb, grassed swales</td>
<td>Pavers installed to maintain road edge</td>
<td></td>
</tr>
<tr>
<td>90 ft paved cul-de-sac radius</td>
<td>One-way cul-de-sac to reduce road width and turn radius, center unpaved</td>
<td>Further reduction in width and less need for snow plowing</td>
<td></td>
</tr>
<tr>
<td>Special design/operational control</td>
<td>Planning and zoning standards</td>
<td>Rain gardens</td>
<td>Retain roof runoff on site.</td>
</tr>
<tr>
<td>Home owner discretion</td>
<td>Vegetative management</td>
<td>Domestic animal management</td>
<td>Reduces pathogen runoff</td>
</tr>
<tr>
<td>Mitigation required</td>
<td>Road runoff piped to storm sewer</td>
<td></td>
<td>Need to manage stormwater entering site from adjacent public road</td>
</tr>
<tr>
<td>Creation of 13,400 sq ft wetland at subdivision entrance</td>
<td></td>
<td>Required to mitigate filling 5,000 sq ft of wetlands within subdivision</td>
<td></td>
</tr>
<tr>
<td>Discretionary actions</td>
<td>R-20 single-family zoning</td>
<td>Cluster and zero setback from lot lines</td>
<td>Allows more open space and natural landscaping</td>
</tr>
<tr>
<td>Open space not contiguous with all lots</td>
<td>Open space layout contiguous to all lots</td>
<td>Compact housing, natural landscaping</td>
<td></td>
</tr>
<tr>
<td>A driveway for each home</td>
<td>Combined driveways</td>
<td></td>
<td>Reduces curb cuts and impervious surface</td>
</tr>
</tbody>
</table>

www.canr.uconn.edu/jordancove.html
Best Management Practices (BMPs)

A BMP is a practice designed to minimize nonpoint source pollution. Below are examples of BMPs present in the Jordan Cove Urban Watershed Project.

**Rain Gardens**
Each lot contains a rain garden. These shallow depressions are designed to temporarily collect and treat runoff from roofs and yards.

**Open space**
A large portion of the subdivision is dedicated to open space and common usage.

**Swales**
Located along the sides of the roadway, these grass-lined channels are intended to slow runoff and allow water to infiltrate into the ground before leaving the subdivision. They replace a curb-and-gutter stormwater collection system.

**Education**
Education programs focused on lawn fertilization and maintenance.

**Driveways**
Driveways are constructed of different materials (crushed stone, pavers, asphalt) to compare runoff and pollution from them. Most driveways have shared entrances to reduce impervious surfaces.

**Road**
The main road is constructed with concrete pavers. These pavers allow infiltration of water through their open corners, and reduce stormwater runoff.

**Cul-de-sac**
Another rain garden (bioretention area) is located in the middle of the cul-de-sac. It is designed to collect and filter runoff from the road.

**Pets**
Pet waste is a large source of bacteria in residential areas. Pet wastes should be picked up and disposed of properly.
Results: Construction

BMPS WORK! BMP STORMWATER RUNOFF WAS MUCH LOWER THAN FROM THE TRADITIONAL WATERSHED DURING CONSTRUCTION.

RUNOFF

Traditional Watershed
- Runoff volume increased from the Traditional Watershed because of the impervious road and curb and gutter conveyance system.

BMP Watershed
- Runoff volume did not increase from the BMP Watershed because of a berm, swales, pavers, temporary retention basins, and bioretention.
Results: Construction

WATER QUALITY

Traditional Watershed

- Concentrations of pollutants in runoff did not increase for the Traditional Watershed because erosion & sediment control practices worked.
- The mass export of pollutants increased for the Traditional Watershed because flow increased.

BMP Watershed

- Concentrations of pollutants in runoff increased for the BMP Watershed because the swales were not stabilized.
- The mass export of pollutants did not increase for the BMP Watershed, except phosphorus and suspended solids, because concentrations of phosphorus and sediment did increase.

**Concentration** - the amount of a substance in a liter of water.

**Mass Export** - the total mass leaving the site calculated by multiplying the concentration times the runoff amount.
Results: Post-construction

BMPS CONTINUED TO WORK! BMP STORMWATER RUNOFF WAS NOT HIGHER THAN PRE-DEVELOPMENT LEVELS.

Aerial photo taken April 2004.

Runoff during this storm in 2003 showed a much lower peak and volume of runoff from the BMP watershed than from the others. The peak was delayed 15 minutes after the peak from the traditional watershed.

**RUNOFF**

**Traditional Watershed**
- Runoff volume and peak increased from the Traditional Watershed because of the impervious road surface.

**BMP Watershed**
- Runoff volume and peak did not increase from the BMP Watershed because of swales, pavers, and bioretention.
- This is the goal of Low Impact Development.
Results: Post-construction

WATER QUALITY

Traditional Watershed
- Concentrations of pollutants in runoff did not increase for the Traditional Watershed because the asphalt road conveys relatively clean water.
- The mass export of pollutants increased for the Traditional Watershed because flow increased.

BMP Watershed
- Concentrations of pollutants in runoff did not increase except for phosphorus and sediment. Sediment was low and below national averages.
- The mass export of pollutants increased for the BMP Watershed for sediment and phosphorus because concentrations increased. However, mass exports were less than from the traditional watershed.

DRIVEWAY STUDY
A study of three driveway types found that both paver and crushed stone driveways could reduce runoff.

EDUCATION RESULTS
One-on-one education was not as successful as anticipated. Based on survey results, we learned the following:

- There was no difference in lawn care practices among the three watersheds, including fertilization frequency.
- There were no differences in car washing practices among the three watersheds.
- There were no differences in pet waste handling among the three watersheds.
- More BMP residents composted leaf wastes.
- More BMP residents mowed their own lawns.
Conclusions:

• Low impact development can maintain pre-development peak runoff and volume of runoff levels. Pollutant export is generally not increased, except for phosphorus and sediment.

• Traditional development increases runoff by two orders of magnitude. Pollutant export is also increased.

This project is partially funded by the CT DEP through a US EPA, nonpoint source (NPS) grant under section 319 Clean Water Act.