Jordan Cove

URBAN WATERSHED PROJECT

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Background

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.

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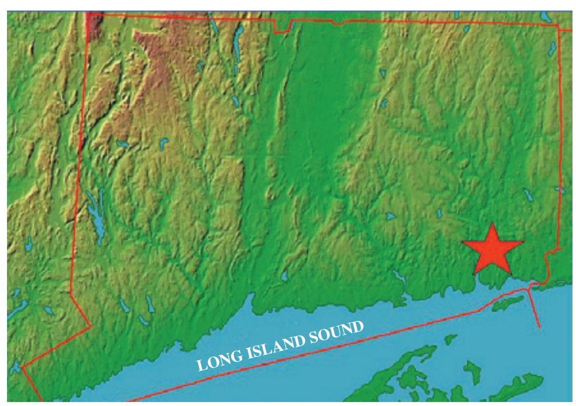


Project Overview

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.
2. Demonstrate residential Best Management Practices (BMPs).
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

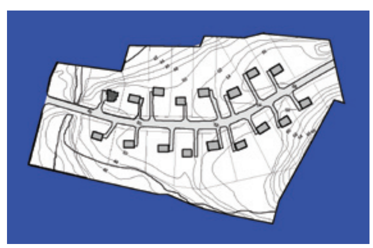
PROJECT DESIGN WAS BASED ON A PAIRED WATERSHED APPROACH; ONE WATERSHED SERVED AS A CONTROL WHILE THE OTHER IS CALLED A TREATMENT WATERSHED.

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.

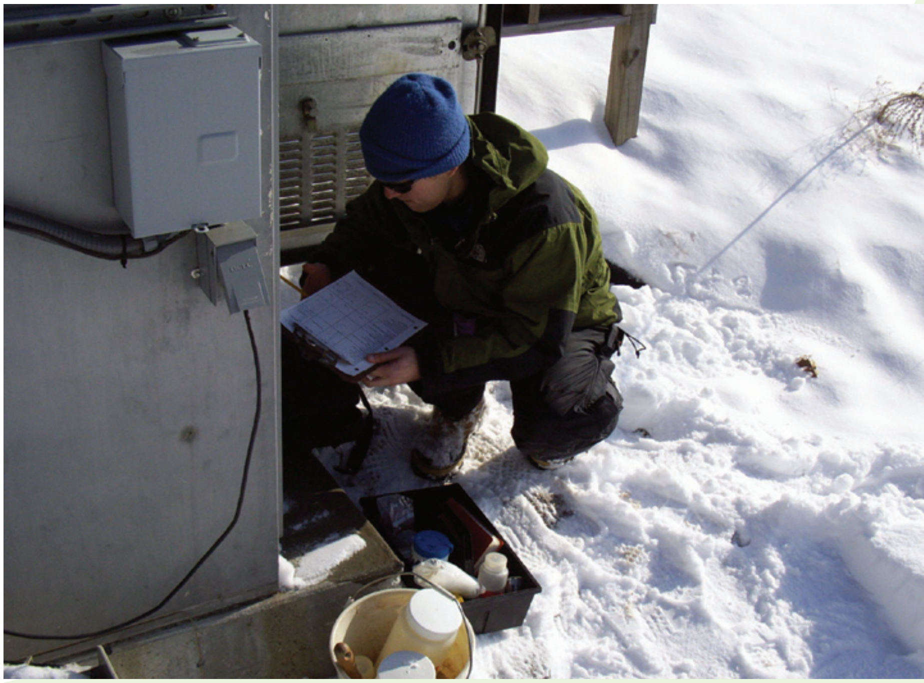


BMP WATERSHED (TREATMENT)

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:

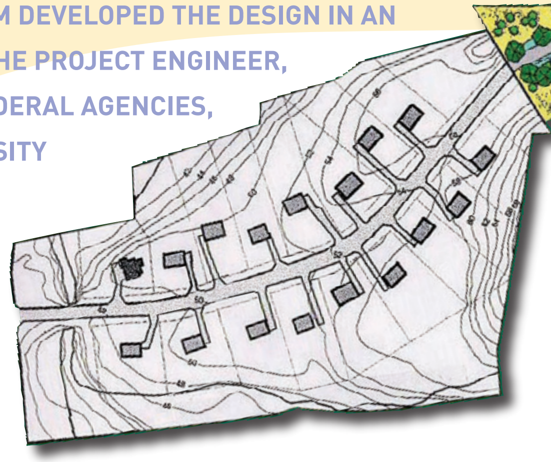
- Suspended solids cloud water and can harm fish habitat.
- Phosphorus and nitrogen stimulate excessive growth of algae; heavy metals can be toxic to aquatic life.
- Bacteria are indicators of potentially harmful pathogens.
- Biochemical oxygen demand can use up oxygen in lakes and rivers.

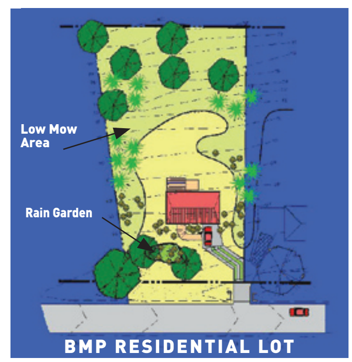
PROJECT SCHEDULE

Period	Traditional Watershed	BMP Watershed
Calibration Period	1996 - 1998	1996 - 1999
Construction Period	1998 - 2003	1999 - 2002
Post-construction Period	2003-2005	2002-2005

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.





BMP RESIDENTIAL LOT

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 anaylsis. Calibration was conducted prior to construction.

TECHNICAL MODIFICATIONS OF EXISTING DEVELOPMENT STANDARDS

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

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.

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.

RAIN GARDENS • OPEN SPACE • SWALES • EDUCATION

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

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

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.

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.

DRIVEWAYS • ROAD • CUL -DE-SAC • PETS

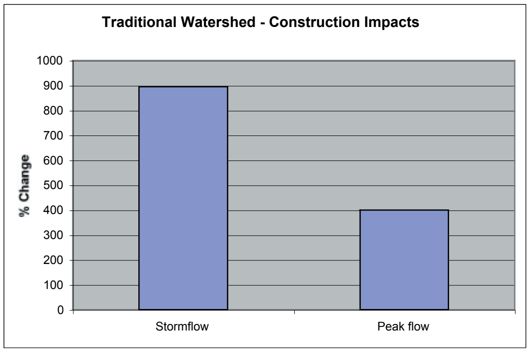
Education
Education programs focused on lawn fertilization and maintenance.

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.

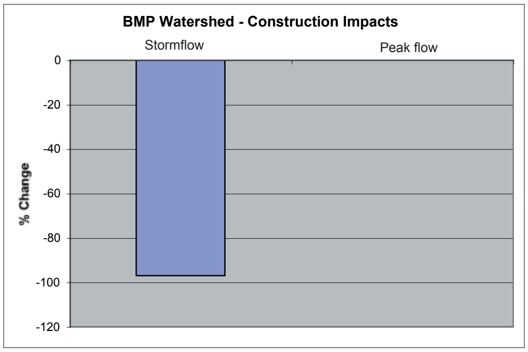
★ Monitoring Locations



RUNOFF

Traditional Watershed

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



% change from level expected by calibration.

BMP Watershed

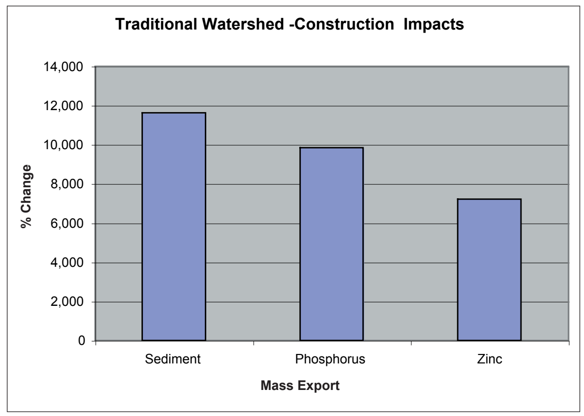
- Runoff volume did not increase from the BMP Watershed because of a berm, swales, pavers, temporary retention basins, and bioretention.

Results: Construction

WATER QUALITY

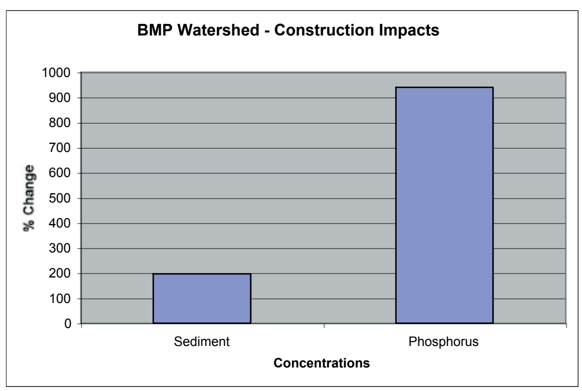
Traditional Watershed

- 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.



% change from level expected by calibration.

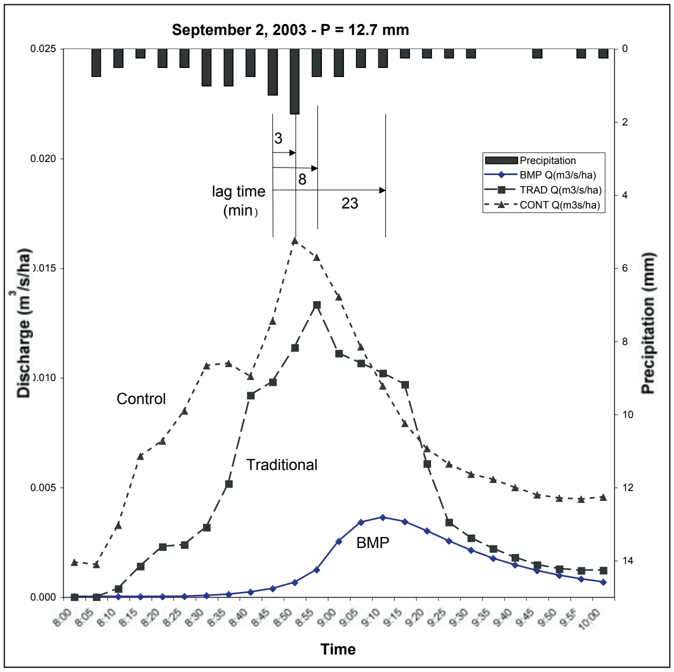
Concentration - the amount of a substance in a liter of water.

Mass Export - the total mass leaving the site calculated by multiplying the concentration times the runoff amount.

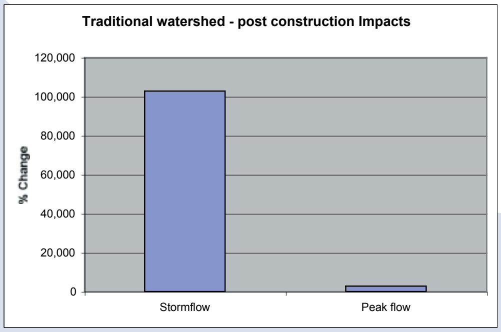
Results: Post-construction

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

Aerial photo taken April 2004.



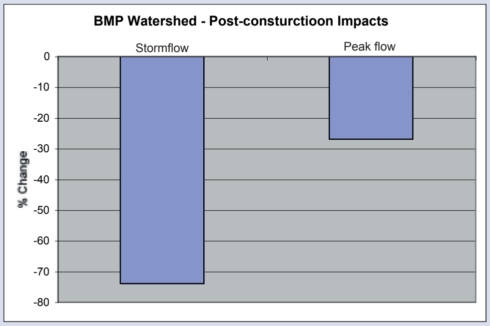
Runoff during this storm in 2003 showed a much lower peak and volume of runoff from the BMP watershed than from the others. The peak was delayed 15 minutes after the peak from the traditional watershed.



RUNOFF

Traditional Watershed

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



% change from level expected by calibration.

BMP Watershed

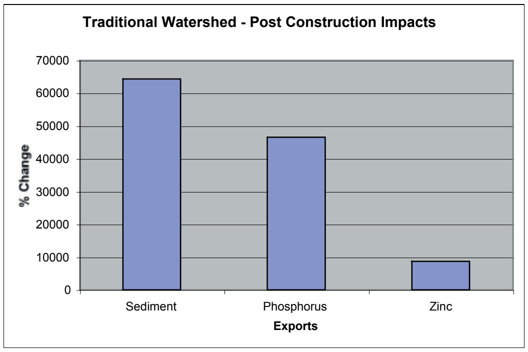
- Runoff volume and peak did not increase from the BMP Watershed because of swales, pavers, and bioretention.
- This is the goal of Low Impact Development.

Results: Post-construction

WATER QUALITY

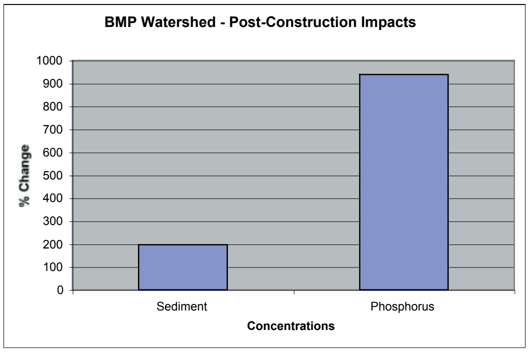
Traditional Watershed

- 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.



% change from level expected by calibration.

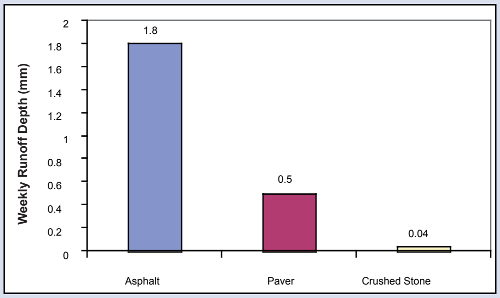
DRIVEWAY STUDY

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

asphalt

paver

crushed stone



Runoff from the asphalt driveway was most, followed by the concrete paver driveway, and then the crushed stone driveway.

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.

Want to learn more?

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Jordan Cove Urban Watershed Project

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.

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