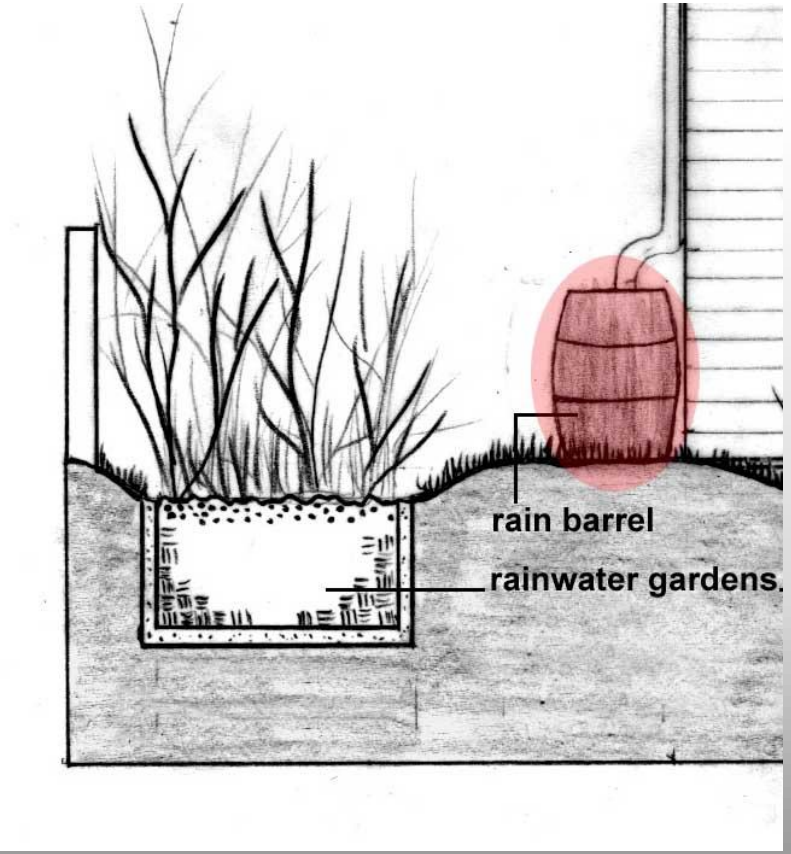
Comprehensive Environmental Inc.

Restoring Water Quality and the Hydrologic Cycle: How Residents Can Help

Stormwater Awareness Series
Arlington, MA
June 10, 2014



Source: "Greenscapes: Beautiful landscapes that protect our water "
www.greenscapes.org

Overview

I. Stormwater Impacts

II. Measures to Address Stormwater Problems

III. Spy Pond Project

IV. What Can You Do to Help?

V. Summary

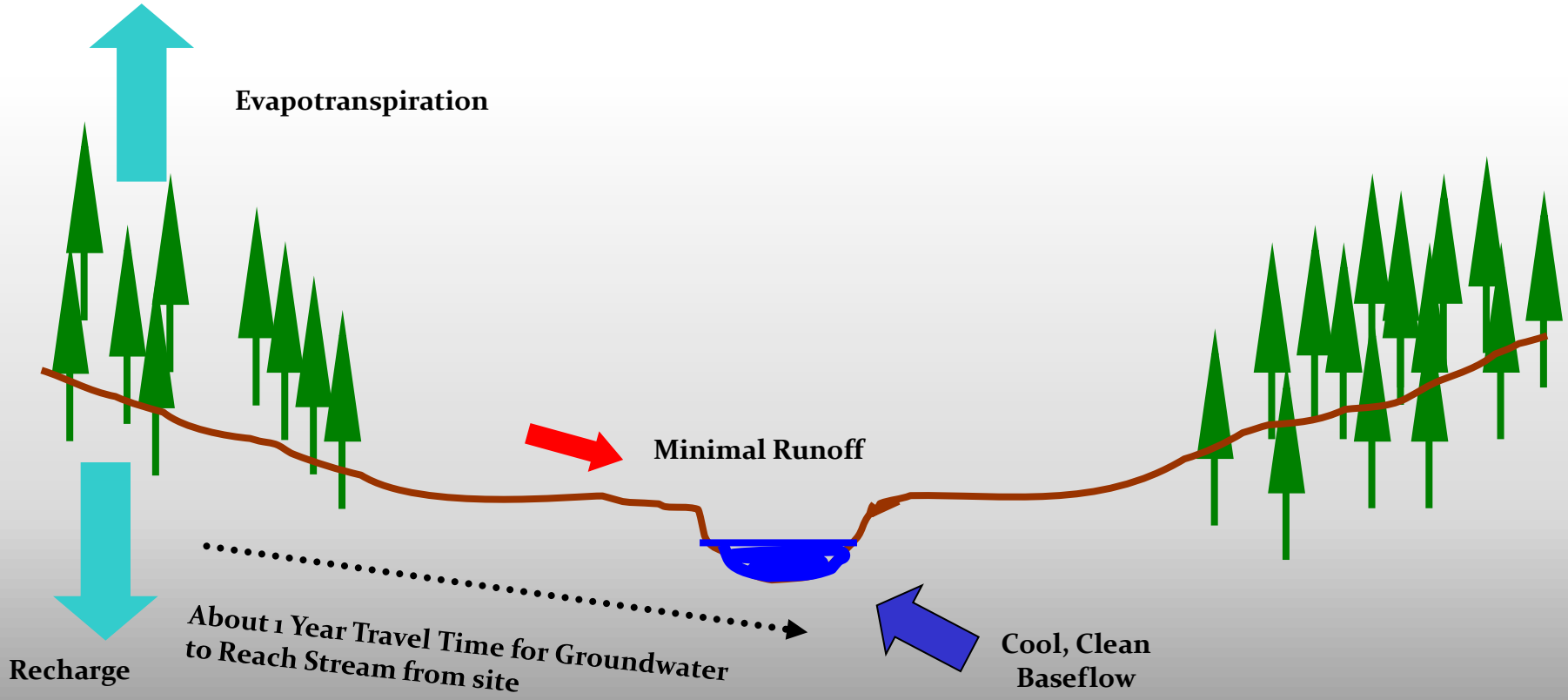
I. Stormwater Impacts

What is Stormwater Runoff?

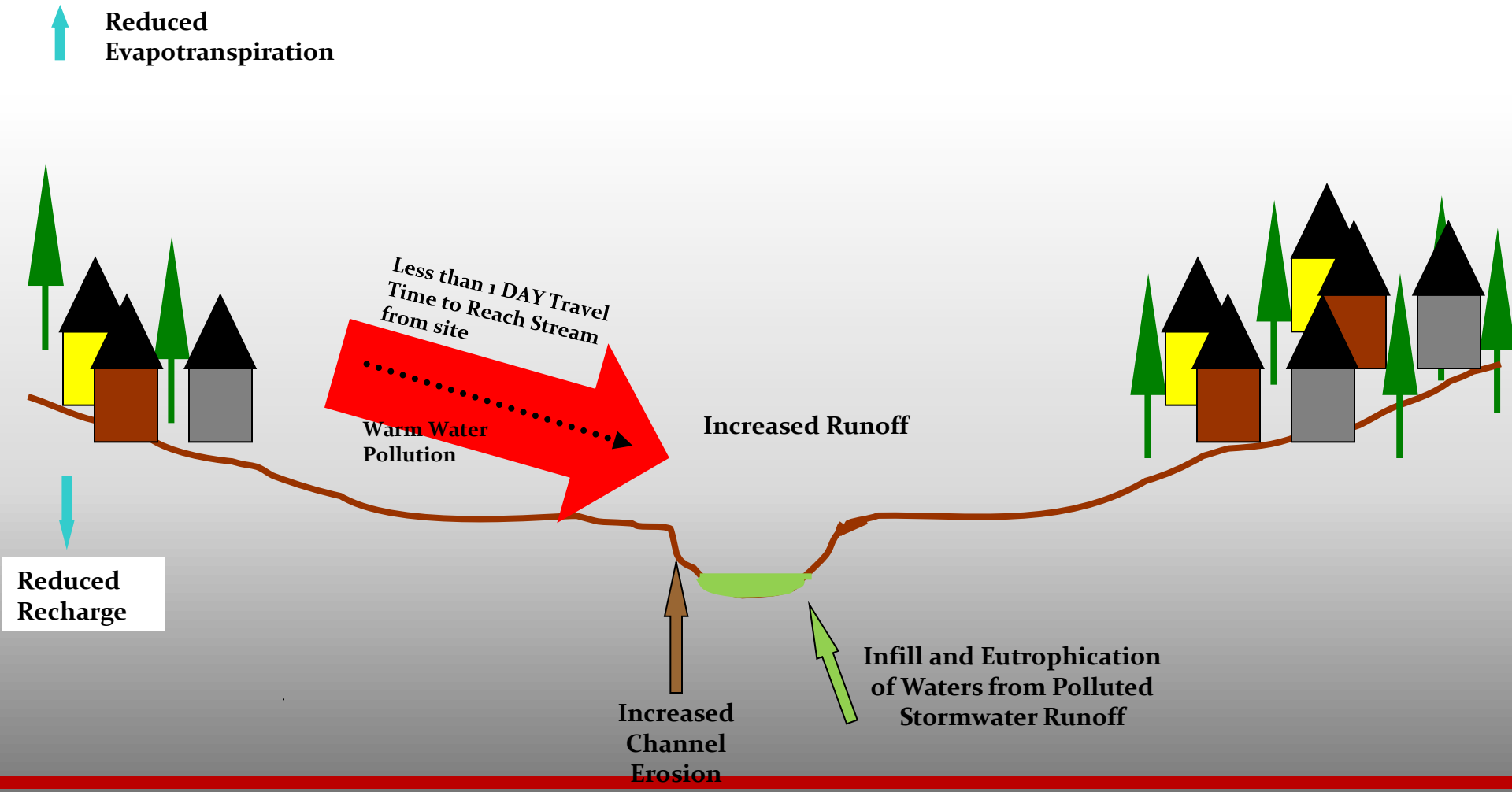
- Rain or melted snow that “runs off” across the land instead of seeping into the ground
- Flows directly into surface waters or into stormwater drainage without treatment
- most significant source of water pollution

http://www.apcc.org/stormwatermanagement/index.html

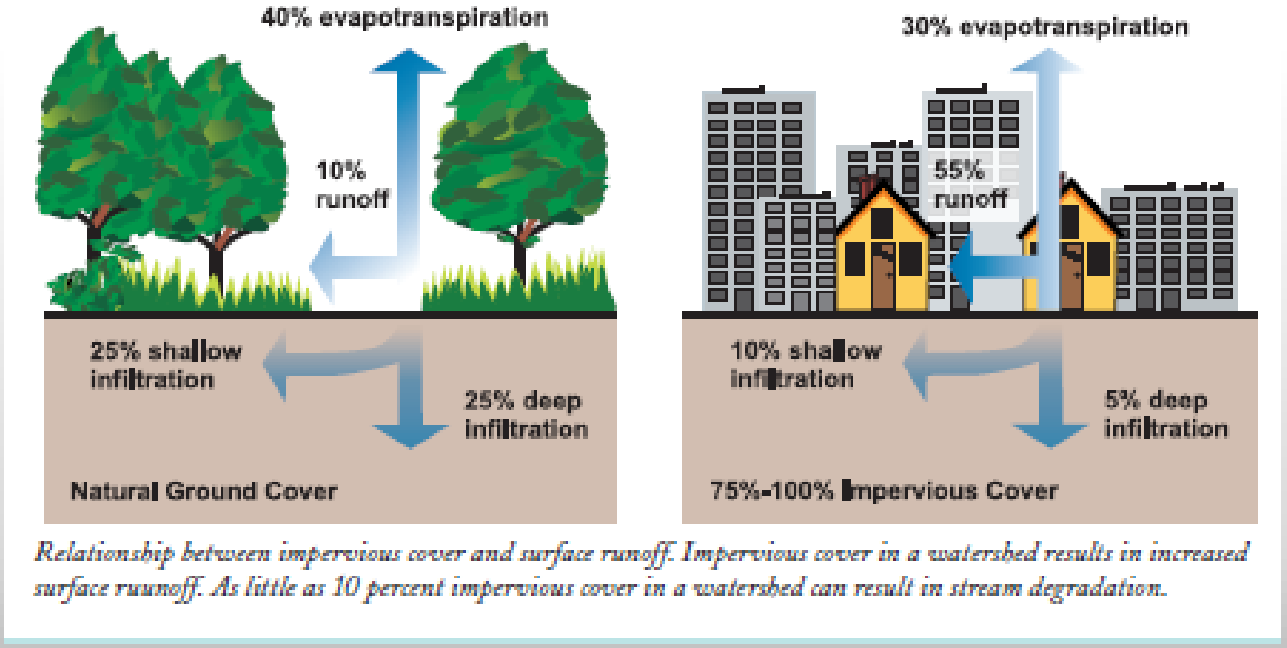
Pre-development "Before"



Post-development "After"



Urban Areas Pre/Post Development



Relationship between impervious cover and surface runoff. Impervious cover in a watershed results in increased surface ruunoff. As little as 10 percent impervious cover in a watershed can result in stream degradation.

Source: EPA "Protecting Water Quality from Urban Runoff"

❖Typical city block generates more than 5X more runoff than a woodland area of the same size

Issues with Stormwater Runoff

- Flooding
- Erosion
- Increased turbidity
- Water pollution
- Habitat destruction
- Combined sewer overflows/infrastructure damage

Source: EPA “Soak up the Rain?”

Typical Stormwater Pollutants

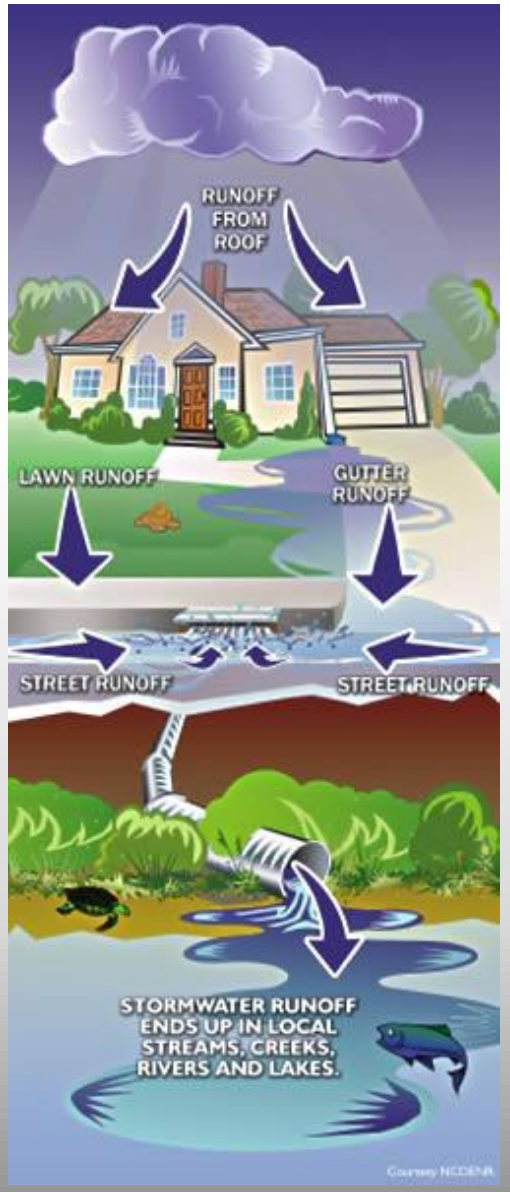
- Sediment
- Nutrients
- Bacteria
- Chlorides
- Toxic Contaminants
- Thermal Pollution


Source: Maine DEP


Source: CEI

Common Residential Pollution Sources

- **Lawn Care-** nutrients & sediment
- **Septic Systems-** nutrients & bacteria
- **Auto Care-** toxic contaminants
- **Pet Waste-** bacteria



Stormwater Runoff
(Photo Credit: North Carolina Dept. of Environmental and Natural Resources)

II. Measures to Address Stormwater Problems

Low Impact Development (LID)

- Mimic or restore natural watershed functions through small-scale treatment at the source of runoff
- Disconnect impervious surfaces
- Capture and infiltrate runoff from roofs, driveways, parking lots, lawns, etc.

Benefits of LID

- Reduces volume of stormwater created
  -reduces flooding and infrastructure damage
  -reduces erosion
  -reduces pollution and thermal impacts to surface waters
- Increase curb appeal (incorporate into landscape)
- Increase wildlife habitat
- Replenishes groundwater and stream baseflow

Best Management Practices (BMPs)

- Infiltration Basin
- Infiltration Trench
- Leaching Catch Basin/Dry well
- Porous Pavement
- Pavement Disconnection
- Wet Basin
- Bioretention
- Pocket Wetland
- Gravel Wetland
- Tree Box Filter
- Sand/Organic Filter
- Various Pre-treatment measures

Infiltration Basin

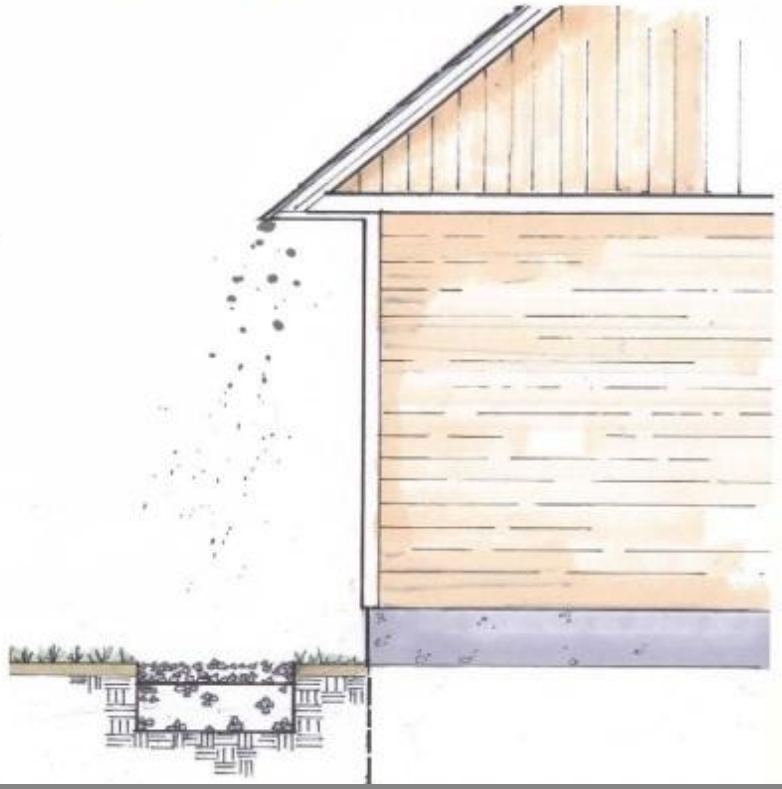
EPA: NPDES Menu of BMPs

Infiltration Trench

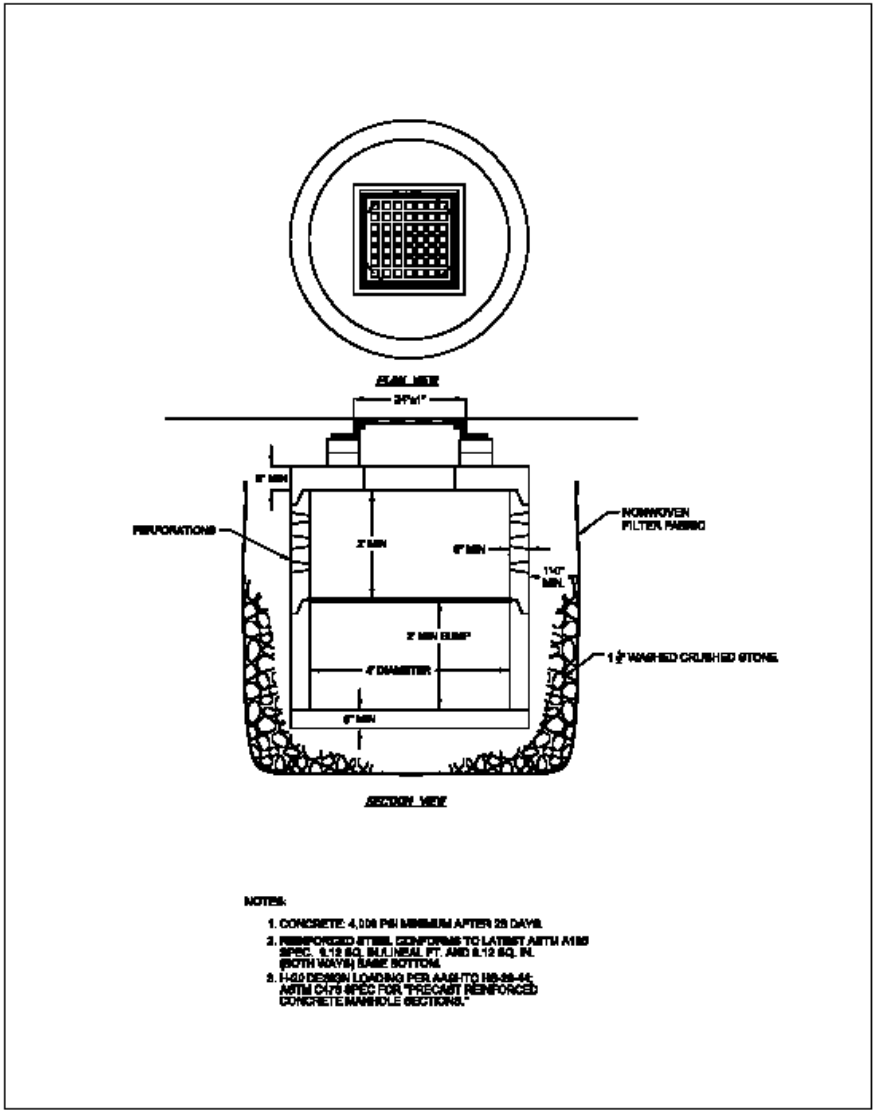
New Hampshire Homeowner's Guide to Stormwater Management Do-It-Yourself Stormwater Solutions

Dripline Infiltration Trench

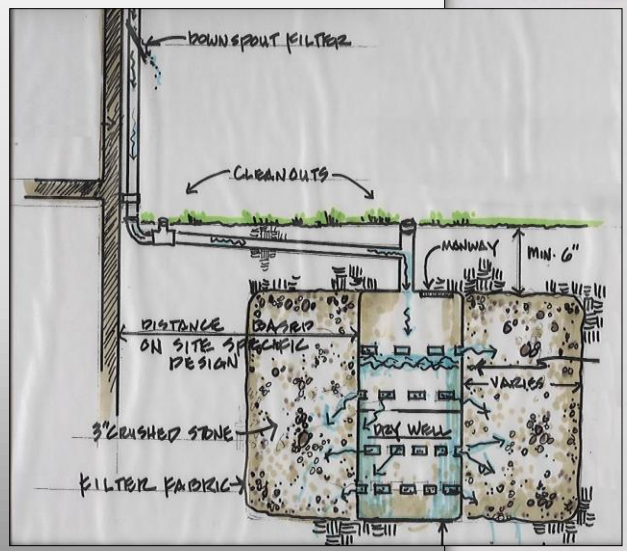
A dripline infiltration trench collects and infiltrates stormwater from your roof until it soaks into the ground. It helps control stormwater from running off your property.



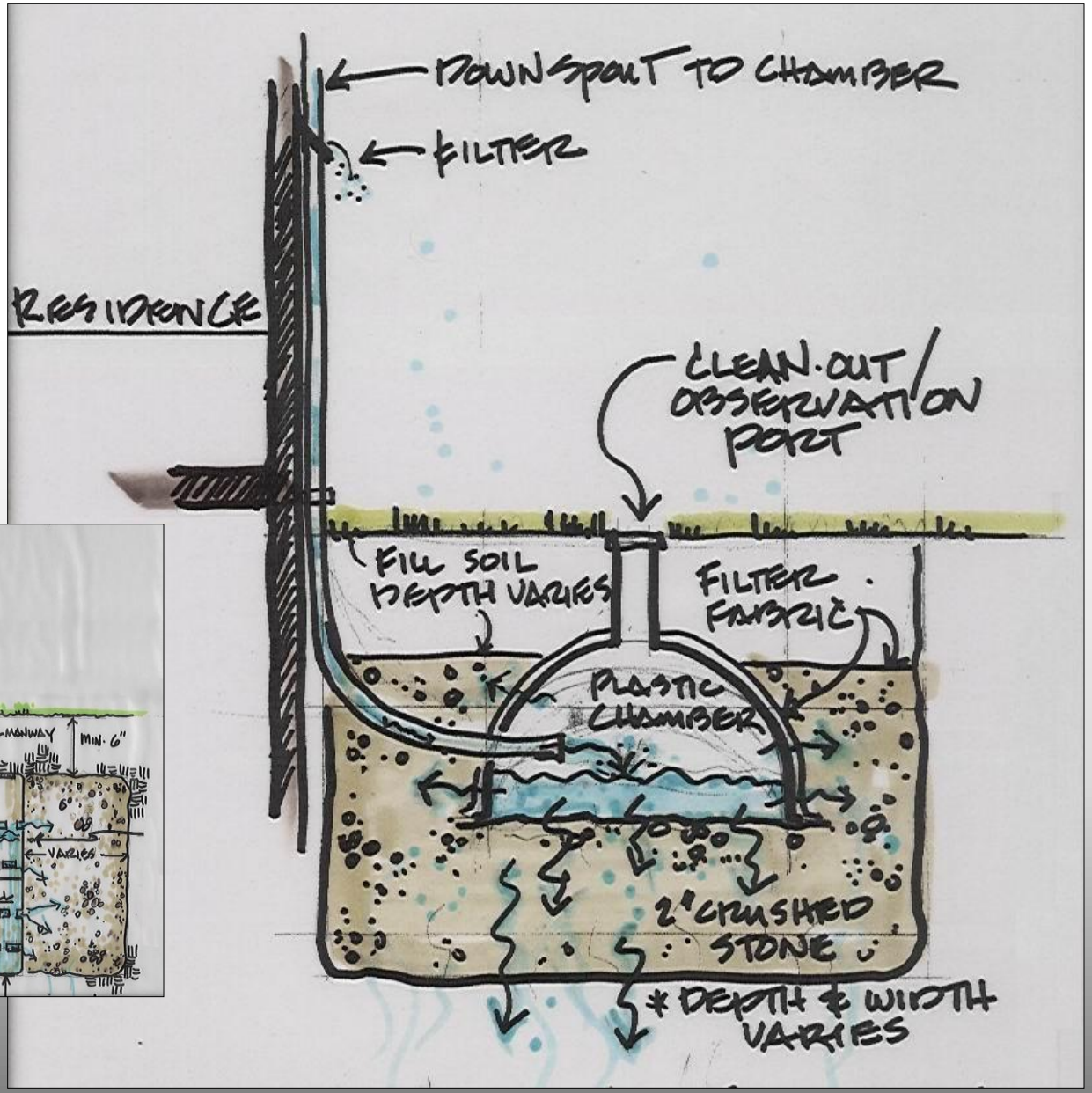
Leaching Catch Basin



Dry Well



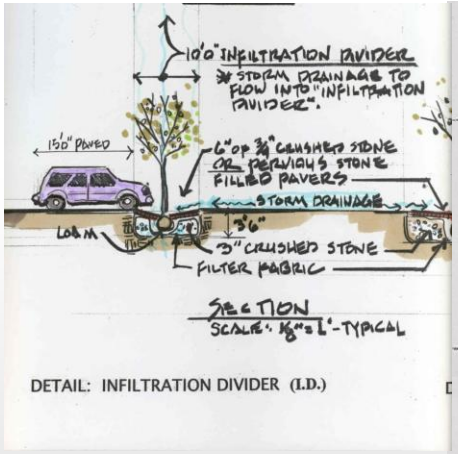
Source: CEI

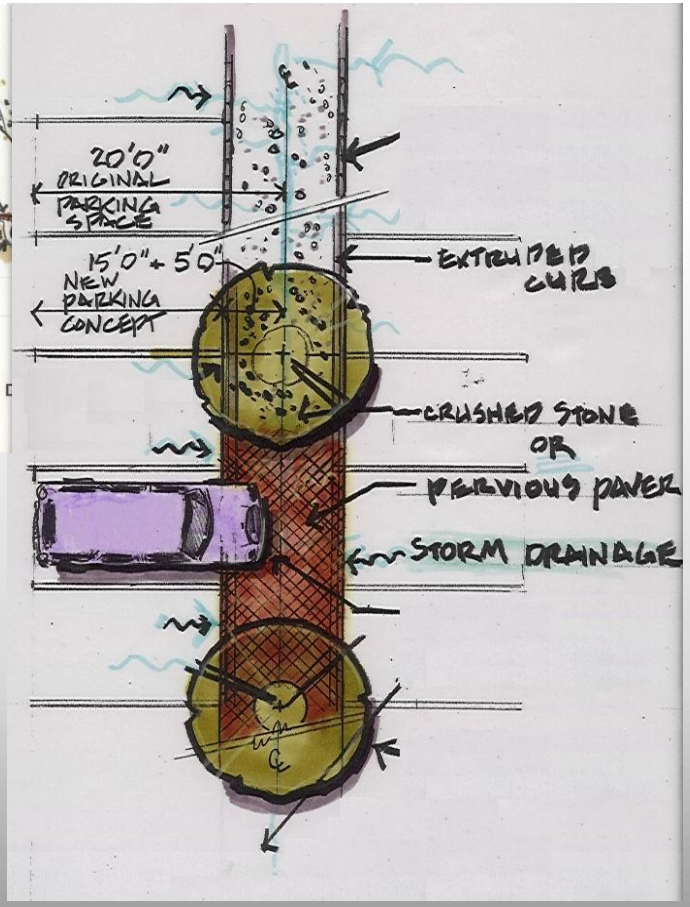


Raingarden

Bioretention

Pavement Disconnection

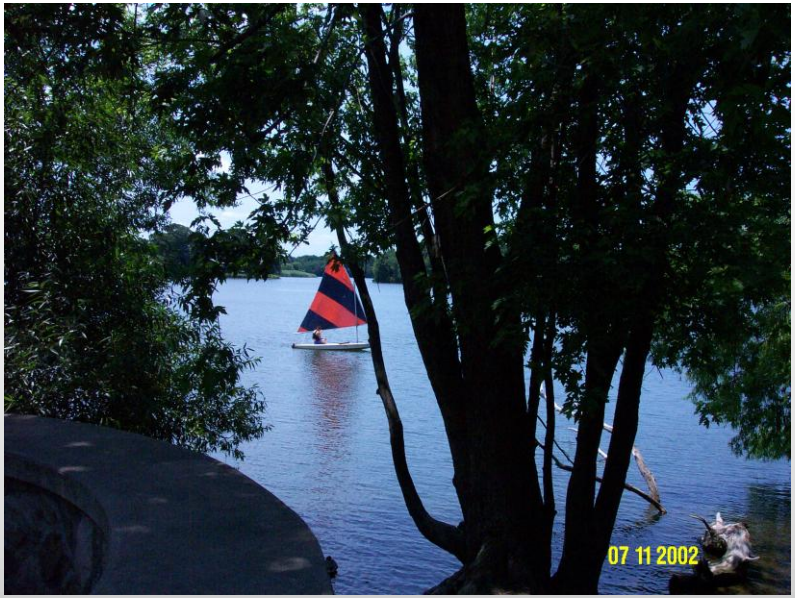




III. Case Study: Spy Pond Project

Spy Pond Description

- 102 acre kettle pond
- Shallow with average depth of 14 ft & maximum depth of 36 ft
- Fed by groundwater & stormwater runoff from 700 acre watershed area
- Uses include boating and fishing



Water Quality Issues

- 1871 – pond abandoned as water supply due to degrading water quality
- Sewage break overflows into pond in 1970s
- Bottom sediments >20 feet deep
- Impairments include chlordane, DDT, excess algal growth, low DO & phosphorus
- Stormwater & internal recycling are primary sources of phosphorus

Arlington Strikes Back

- Obtained $475,000 in grant funds to reduce phosphorus inputs
- Improvements made between 2002 and 2006
- Project partners:
  - Comprehensive Environmental Inc. – Engineering Design
  - Tufts University – Monitoring
  - Spy Pond Committee – Public Outreach

Public Outreach

- Mark all catch basins within watershed
- Distribute door hangers

Catch Basin Cleaning

- Increase cleaning frequency in select areas

Source: http://seabreezepropertyservices.com/property-services/municipal/

In-Lake Controls

- Chemical applications
  - Weed control
  - Internal recycling of phosphorus

Stormwater Controls

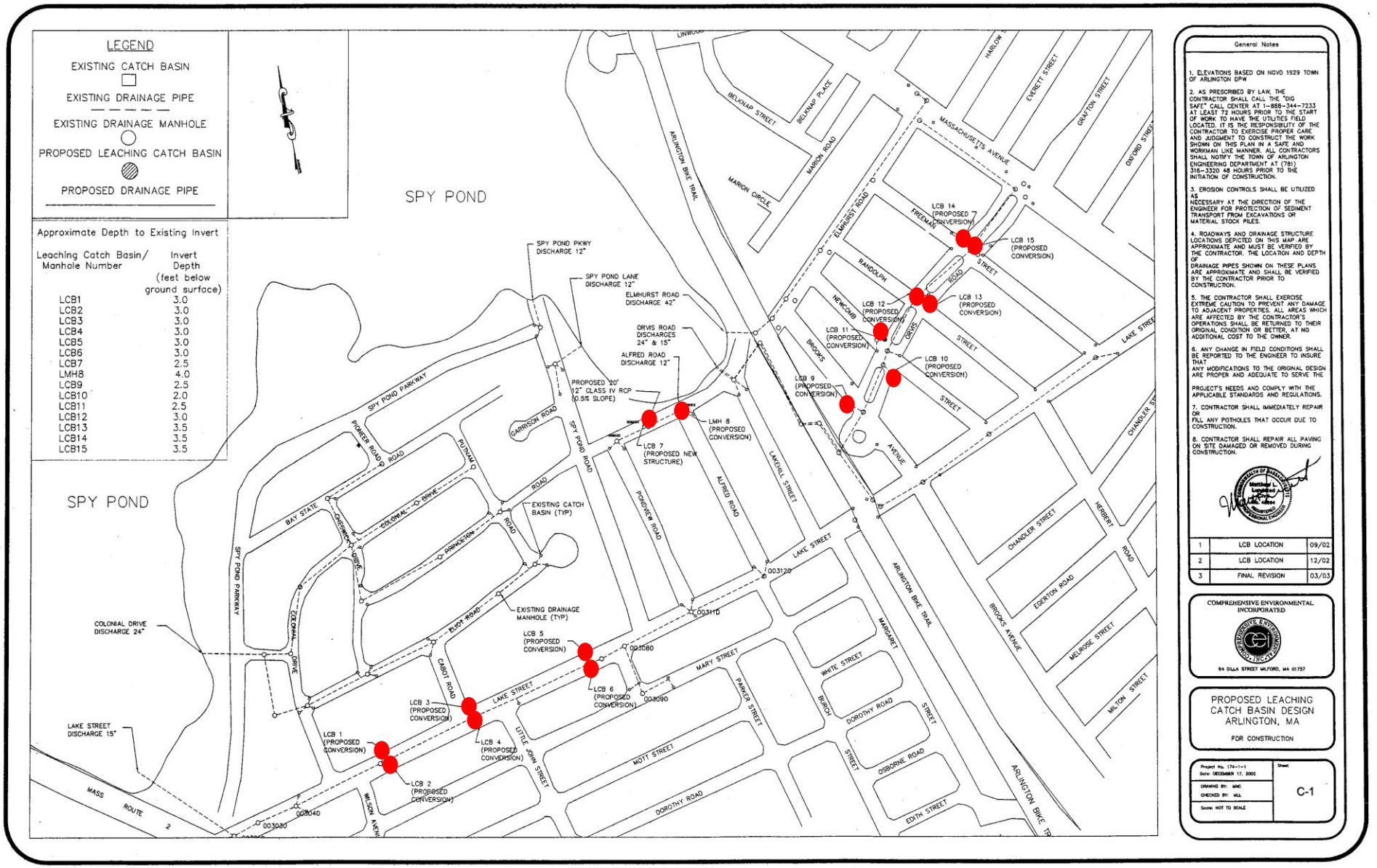
- Design standards
- Leaching catch basins (LCBs)
- Baffle tanks

Stormwater Design Standards

- Incorporate infiltration & LID requirements into Arlington's development standards
- Targets new and re-development

Leaching Structures

- 15 LCBs focused on south side of pond
- Disconnect impervious surfaces
- Infiltrates smaller storms
- Larger storms overflow to pond



General Notes

1. ELEVATIONS BASED ON NGVD 1929 TOWN OF ARLINGTON DPW

2. AS PRESCRIBED BY LAW, THE CONTRACTOR SHALL CALL THE "DIG SAFE" CALL CENTER AT 1-888-344-7233 AT LEAST 72 HOURS PRIOR TO THE START OF WORK TO HAVE THE UTILITIES FIELD LOCATED. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO EXERCISE PROPER CARE AND JUDGMENT TO CONSTRUCT THE WORK SHOWN ON THIS PLAN IN A SAFE AND WORKMAN LIKE MANNER. ALL CONTRACTORS SHALL NOTIFY THE TOWN OF ARLINGTON ENGINEERING DEPARTMENT AT (781) 316-3320 48 HOURS PRIOR TO THE INITIATION OF CONSTRUCTION.

3. EROSION CONTROLS SHALL BE UTILIZED AS NECESSARY AT THE DIRECTION OF THE ENGINEER FOR PROTECTION OF SEDIMENT TRANSPORT FROM EXCAVATIONS OR MATERIAL STOCK PILES.

4. ROADWAYS AND DRAINAGE STRUCTURE LOCATIONS DEPICTED ON THIS MAP ARE APPROXIMATE AND MUST BE VERIFIED BY THE CONTRACTOR. THE LOCATION AND DEPTH OF DRAINAGE PIPES SHOWN ON THESE PLANS ARE APPROXIMATE AND SHALL BE VERIFIED BY THE CONTRACTOR PRIOR TO CONSTRUCTION.

5. THE CONTRACTOR SHALL EXERCISE EXTREME CAUTION TO PREVENT ANY DAMAGE TO ADJACENT PROPERTIES. ALL AREAS WHICH ARE AFFECTED BY THE CONTRACTOR'S OPERATIONS SHALL BE RETURNED TO THEIR ORIGINAL CONDITION OR BETTER, AT NO ADDITIONAL COST TO THE OWNER.

6. ANY CHANGE IN FIELD CONDITIONS SHALL BE REPORTED TO THE ENGINEER TO INSURE THAT ANY MODIFICATIONS TO THE ORIGINAL DESIGN ARE PROPER AND ADEQUATE TO SERVE THE PROJECT'S NEEDS AND COMPLY WITH THE APPLICABLE STANDARDS AND REGULATIONS.

7. CONTRACTOR SHALL IMMEDIATELY REPAIR OR FILL ANY POTHOLES THAT OCCUR DUE TO CONSTRUCTION.

8. CONTRACTOR SHALL REPAIR ALL PAVING ON SITE DAMAGED OR REMOVED DURING CONSTRUCTION.

1	LCB LOCATION	09/02
2	LCB LOCATION	12/02
3	FINAL REVISION	03/03

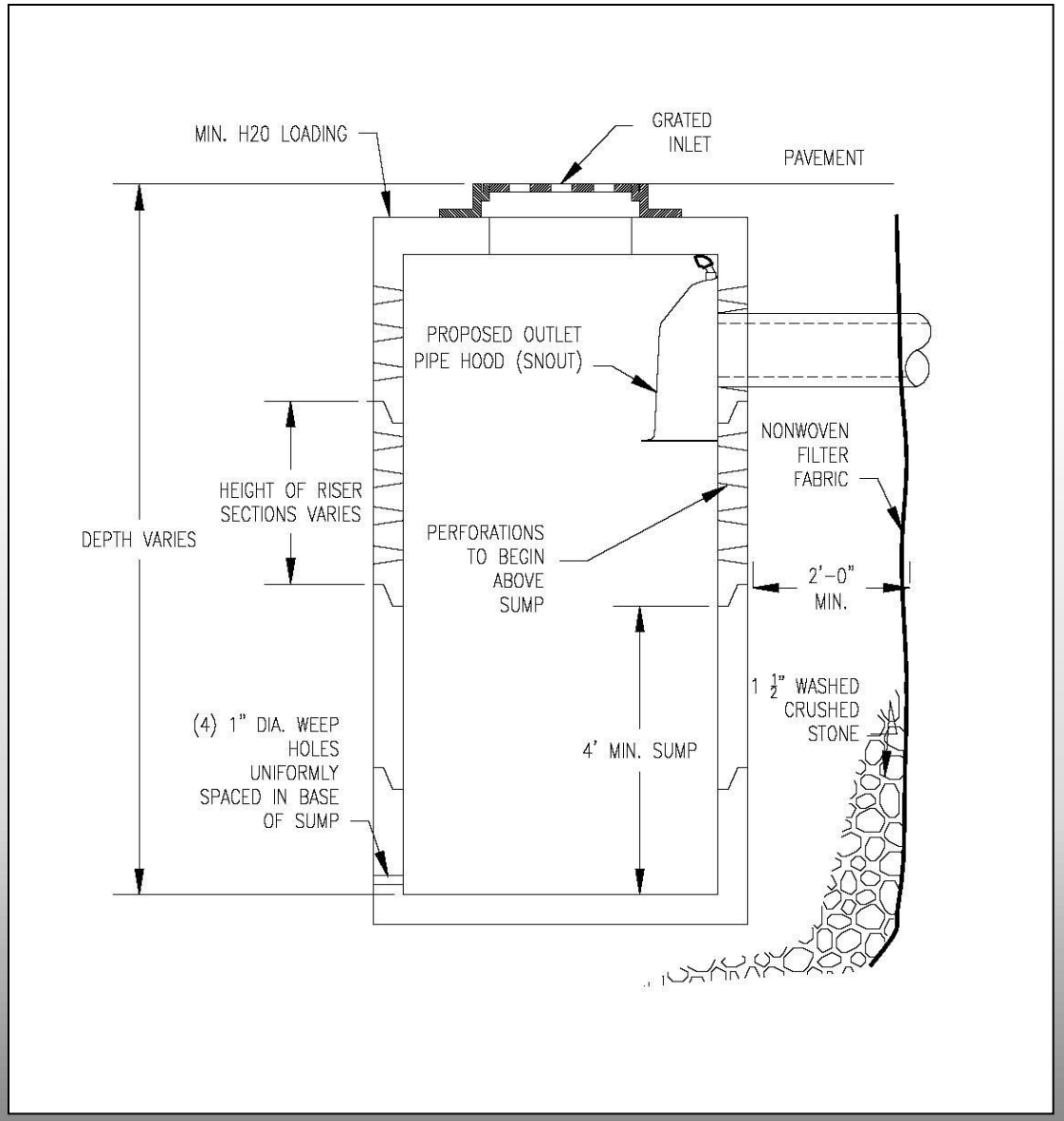
COMPREHENSIVE ENVIRONMENTAL INCORPORATED
84 DILLA STREET MILFORD, MA 01757

PROPOSED LEACHING CATCH BASIN DESIGN
ARLINGTON, MA
FOR CONSTRUCTION

Project No. 174-1-1
Date: DECEMBER 17, 2002
DRAWING BY: MMC
CHECKED BY: WLL
Scale: NOT TO SCALE
Sheet C-1

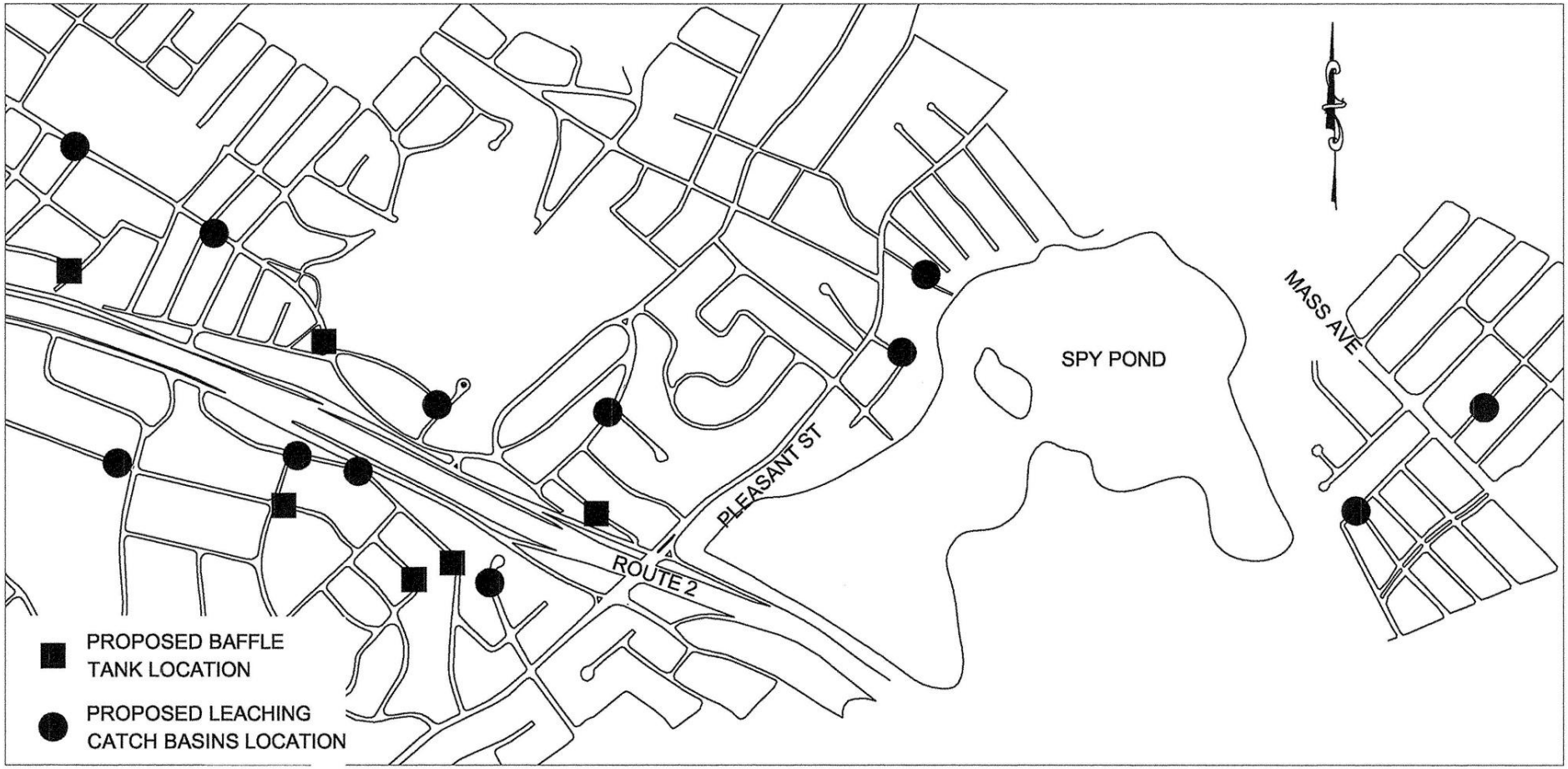
Client Focused, Responsive, Quality Service • Experienced, Knowledgeable Technical Staff • Innovative, Cost Effective Designs

Typical Leaching Catch Basin




KOMATSU
NE

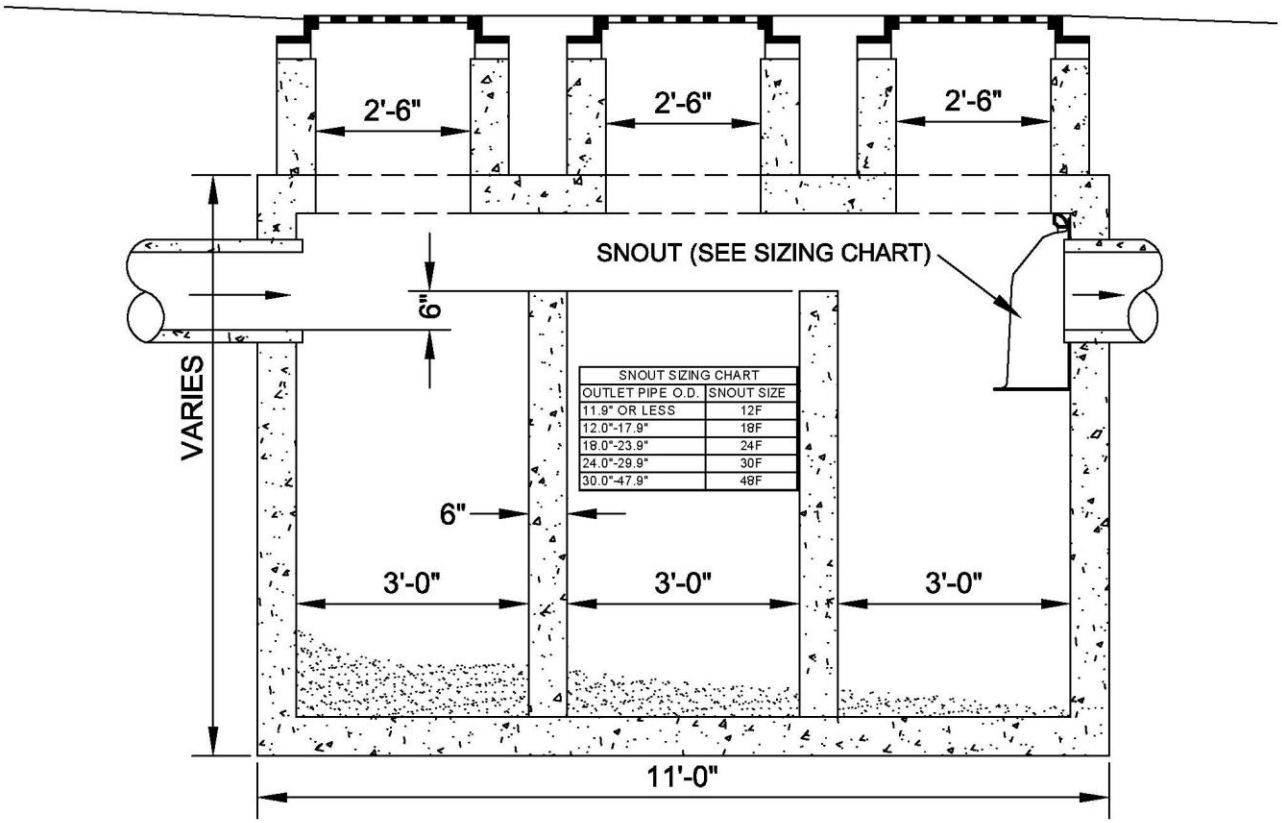
Additional LCBs and Baffle Tanks for Northwest Side of Pond



Baffle Tanks

- Baffle tanks used where infiltration not feasible
  - Steep slopes
  - Ledge
- Removes sediment & phosphorus

Baffle Tanks



TYPICAL BAFFLE TANK

NOT TO SCALE

Ongoing Work

- Arlington is implementing town-wide stormwater best management practices (BMPs) under its Stormwater Program
  - Public education & outreach
  - Illicit discharge detection and elimination
  - Regulatory controls for development
  - Goodhousekeeping practices
- Spy Pond Committee continues outreach and pond improvements

IV. What can YOU do to help?

Good Housekeeping/Pollution Prevention

- Store and dispose of chemicals properly
- Pick up after pets
- Check cars for leaks and recycle used antifreeze and motor oil
- Use car wash facilities that don't generate runoff
- Have septic systems professionally inspected every 3-5 yrs
- Use fertilizers sparingly
- Sweep driveways, sidewalks and roads
- Reuse yard waste for compost pile

Disconnect Impervious Areas

- Roof leaders/drains
- Walkways
- Driveways

What Does a Connected Roof Leader Look Like?

- Direct connection to stormdrain pipes
- Flow directly to driveway
- Flow to steep lawn

http://ianrpubs.unl.edu/epublic/pages/publicationD.jsp?publicationId=1547

Why Target Roof Leaders?

- Ordinances address stormwater runoff from new and re-development projects
  - New subdivisions
  - New site plan reviews
  - Redevelopment of existing commercial & industrial properties
- Existing residential development not addressed through regulations

Benefits of Disconnecting Roof Leaders

- Increase recharge
  -cooler, cleaner baseflow
- Reduce pollutant loads to surface waters
  - healthier water bodies for habitat, less treatment of water supplies
- Reduce erosion and sedimentation
  - less stormwater runoff
- Reduce flooding and infrastructure damage
  - saves $$

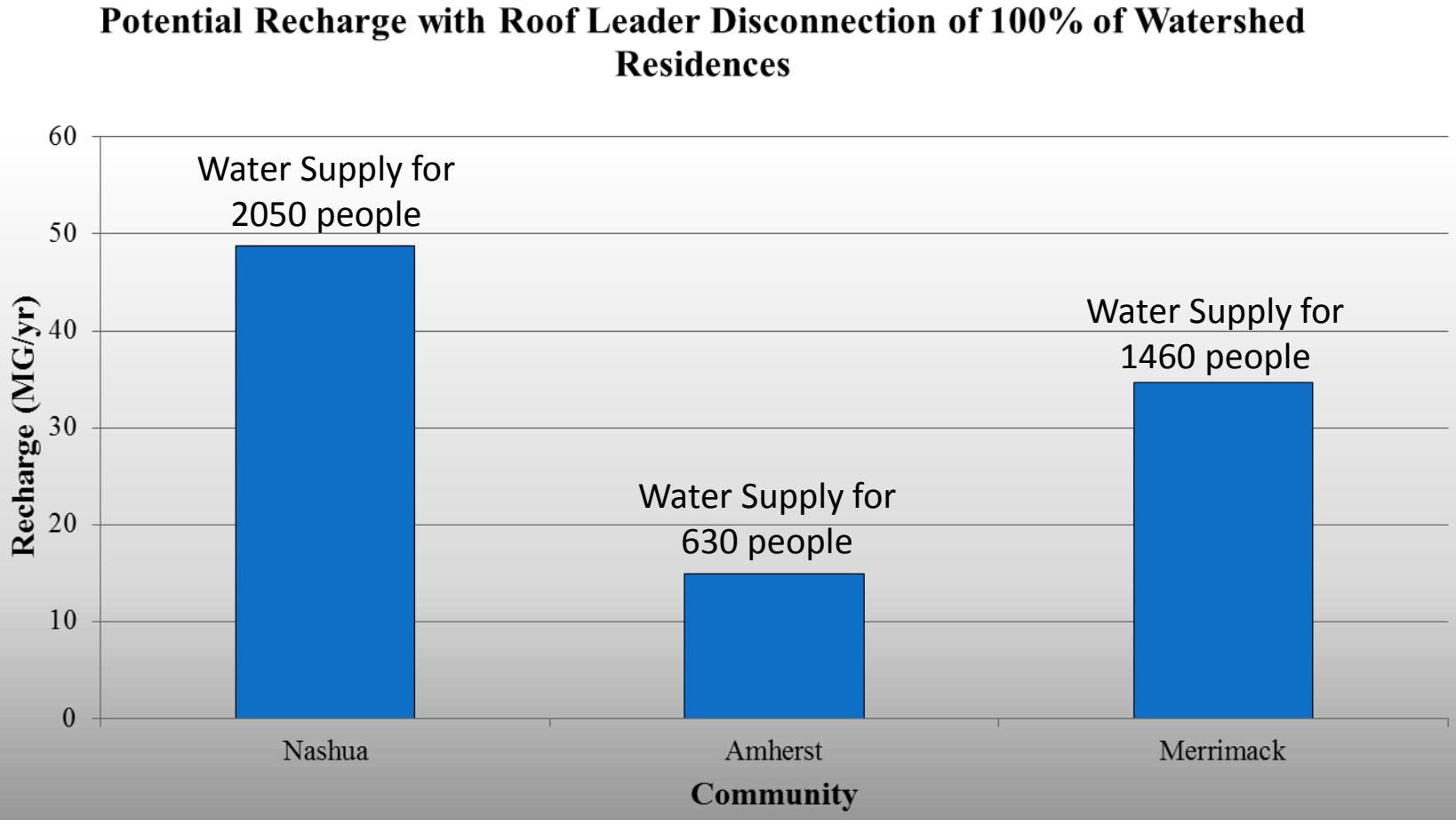
Example of Benefits: Pennichuck Brook Watershed

Example Benefits

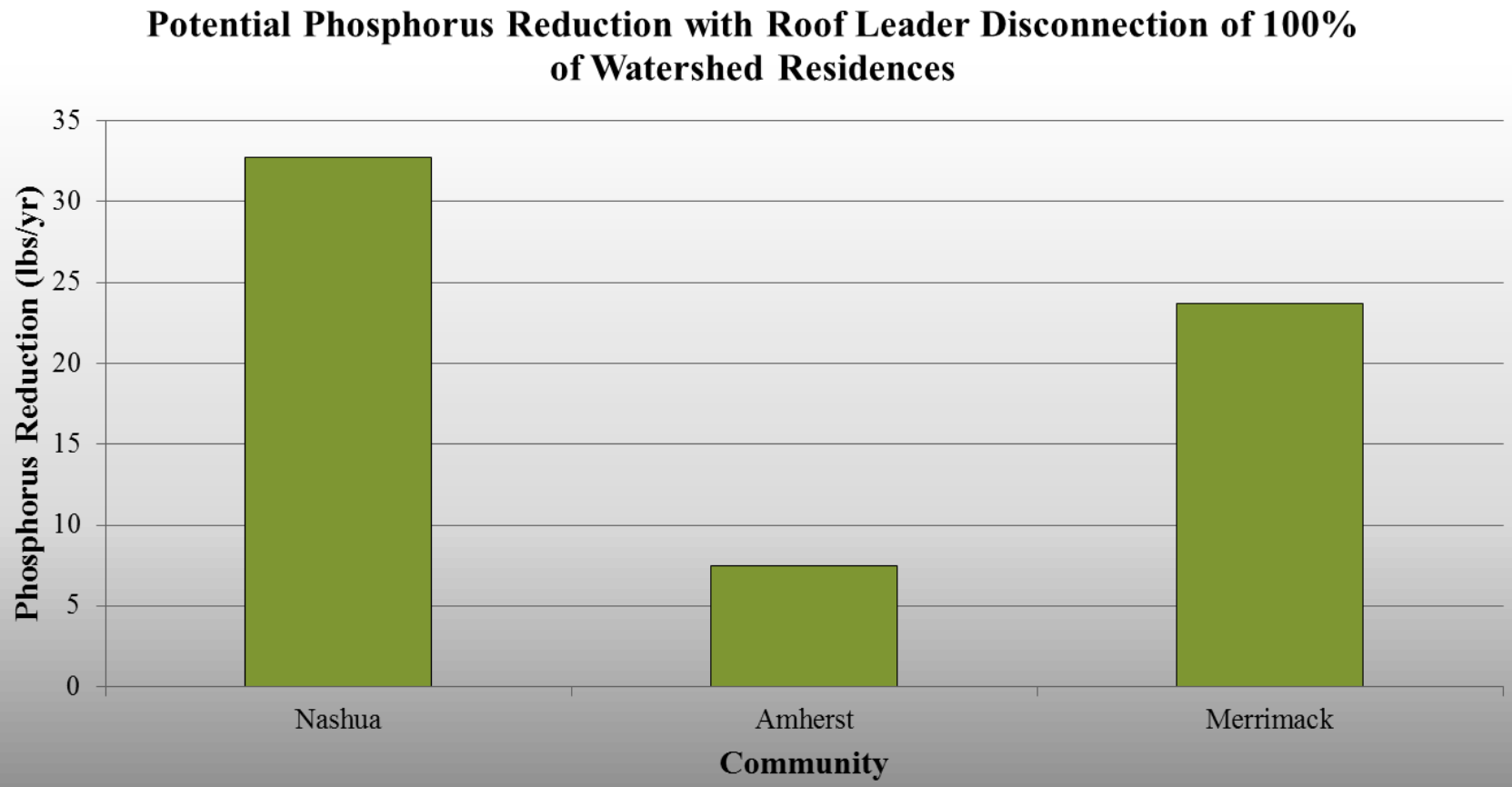
Reviewed Disconnection benefits in 3 communities within Pennichuck Brook Watershed:

- **Nashua, NH**: 642 single family homes, 270 multi-family
- **Amherst, NH**: 374 single family
- **Merrimack, NH**: 769 single family, 16 multi-family

Quantitative Benefits – Recharge Volumes



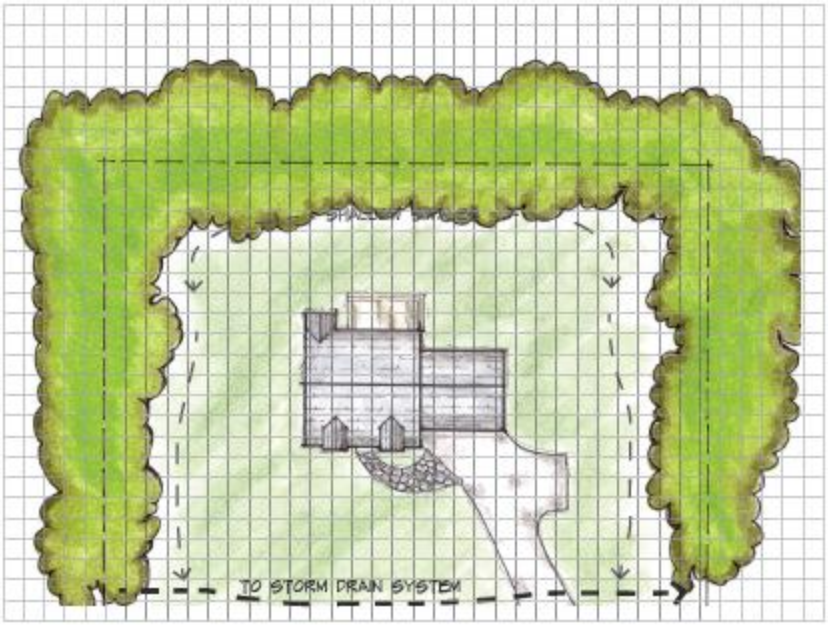
Quantitative Benefits – Phosphorus Reduction



Steps for Disconnecting Impervious Area: Estimating Your Stormwater Footprint

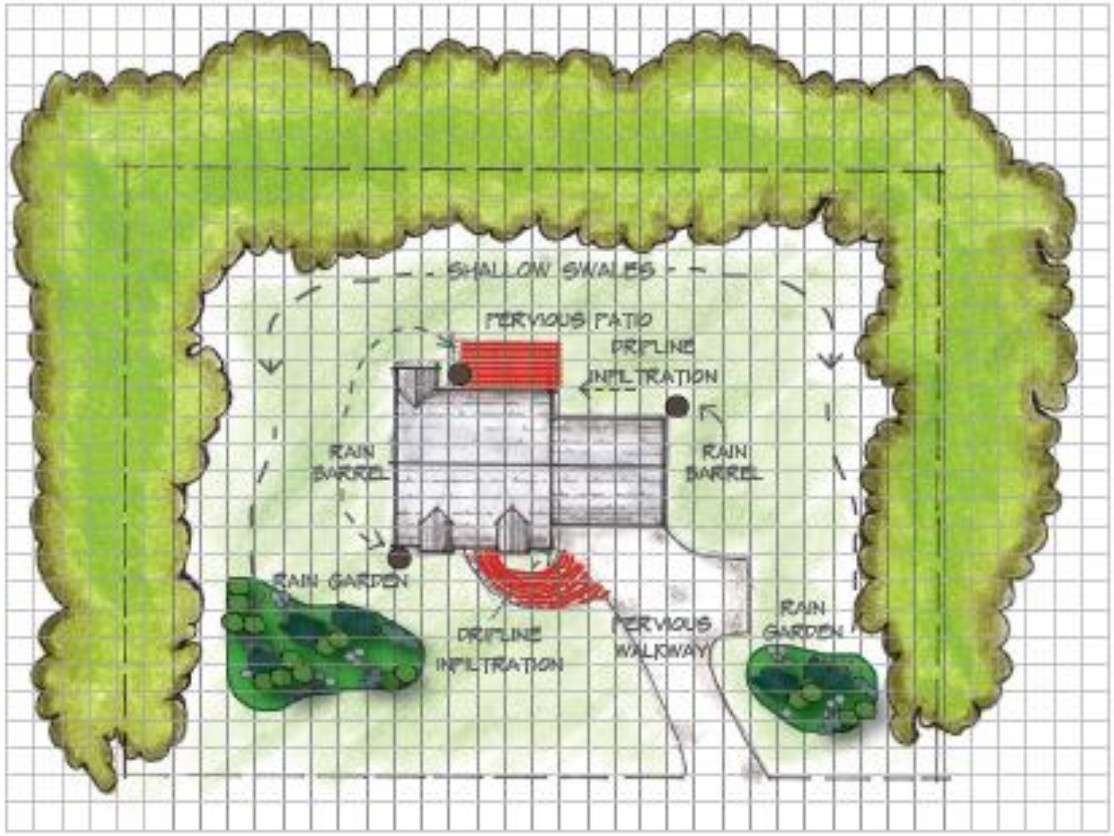
Map Property

- Property boundaries
- Building
- Driveway
- Septic
- Use assessor map, Google Earth



Map Proposed Additions

- Patios
- Decks
- Improvements



Calculate Areas

- Lot Size and land cover types
- Impervious Areas
  - Roofed Areas: house, garage, shed
  - Other impervious surfaces: driveways, walkways, decks, patios, etc.
- Lawn and landscaped areas
- Forested or natural areas

Identify Vulnerable Areas and Treatment Practices

- Roof Downspouts
- Steep slopes and other vulnerable areas
- Streams and ponds
- Stormwater treatment practices
  - Vegetated buffer areas
  - Roof dripline infiltration
  - Raingardens

Identify Where Stormwater Flows

- Identify high points
- Observe the direction of flow
- Identify low spots where water puddles

Example Map of Drainage Areas

Estimate How much Stormwater Your Property Creates

$$\text{IMPERVIOUS AREA}_1 + \text{IMPERVIOUS AREA}_2 + \ldots = \text{IMPERVIOUS AREA}_{total}$$

$$(\text{IMPERVIOUS AREA}_{total}\ ft^2) \times (1\ inch / 12) = \text{STORMWATER VOLUME}\ (ft^3)$$

Example: During a rain storm that produces 1-inch of rain, a typical 2400 ft^{2*} house with a two car garage would create…

$$(3{,}730\ ft^2) \times (1\ inch/12) = 311\ ft^3$$

That is equal to 2,326 gallons or about 55 bath tubs filled to the brim!

* House is assumed to be 2-story with ~1200 ft^2 of roof area, 800 ft^2 of garage roof, and 1730 ft^2 of other hard surfaces including driveway, walkways and patios.

Choose Stormwater Treatment Practices

Assess:

- Water table
- Soil type
- Where stormwater drains

Install:

- Dripline/Driveway infiltration trench
- Dry well
- Infiltration steps
- Pervious walkways and patios
- Rain barrel/garden
- Vegetated swale
- Water bar

Common BMP Options for Rerouting Roof Leaders

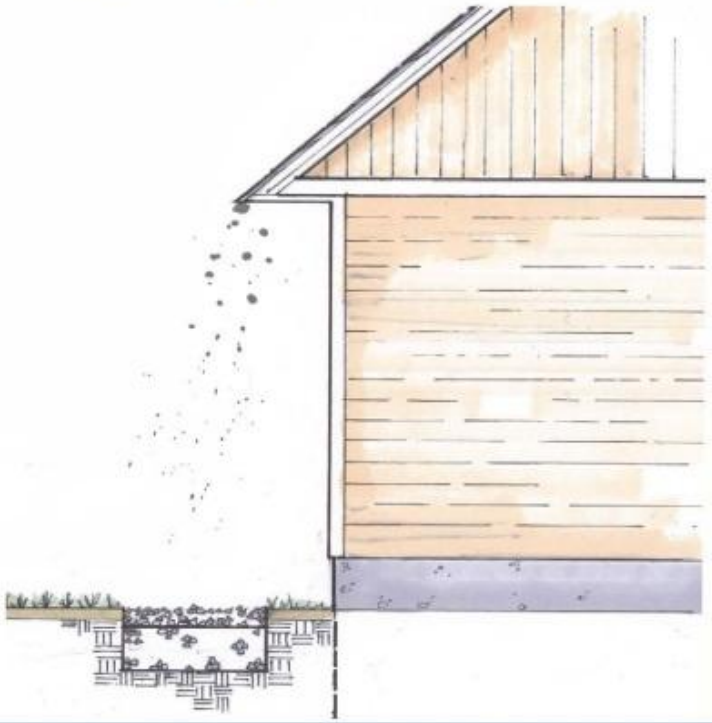
- **Dripline Infiltration Trench**
- **Drywells**
- **Rainbarrels/Cisterns**

Dripline Infiltration Trench

New Hampshire Homeowner's Guide to Stormwater Management Do-It-Yourself Stormwater Solutions

Dripline Infiltration Trench

A dripline infiltration trench collects and infiltrates stormwater from your roof until it soaks into the ground. It helps control stormwater from running off your property.



Dripline Infiltration Trench

Sizing and Design

STEP 1. Measure the distance from the side of your house to the edge of your roof line. If you cannot reach the roof line, align your body under the edge of your roof line and measure the distance from your body to the house. This is your reference line.

STEP 2. Mark the reference line on the ground along the perimeter of your house where you will be installing the dripline trench.

STEP 3. Measure 12" from the reference line away from your house and mark this along the perimeter. This the outside boundary line for excavation

STEP 4. Measure 6" from the reference in toward your house and mark this along the perimeter. This is the inside boundary line for excavation.

EQUIPMENT & MATERIALS

- Measuring tape
- Shovel
- Crushed stone ($^1/_2$" to $1^1/_2$" diameter)
- Non-woven geotextile fabric (or landscape weed fabric for smaller projects)

OPTIONAL

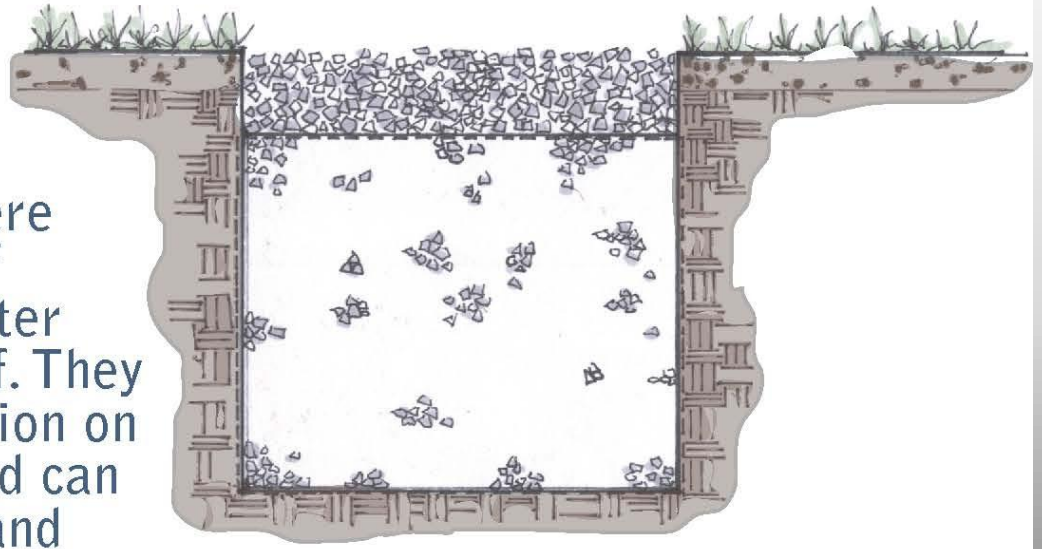
- Perforated PVC or other plastic piping
- String or spray paint

Dry Well

New Hampshire Homeowner's Guide to Stormwater Management Do-It-Yourself Stormwater Solutions

Dry Well

Dry wells collect and infiltrate roof runoff at gutter downspouts, roof valleys, and other places where large amounts of concentrated water flow off of a roof. They help reduce erosion on your property and can reduce ponding and sitting water.



Dry Well

Sizing and Design

STEP 1. Determine the best placement for your dry well. This is usually where large amounts of concentrated runoff flow, such as off of a roof valley or at the end of your roof gutter downspout. It is best to observe runoff during a rain storm.

STEP 2. Follow the steps to **Estimate How Much Stormwater Your Property Creates** (page 14) to determine how large to make your dry well. A typical dry well measures about 3′ x 3′ x 3′.

STEP 3. Clearly mark the boundary of your dry well to identify where you will dig.

Installation

STEP 1. Dig down 3′ within the dry well boundary you marked in step 3 above.

EQUIPMENT & MATERIALS

- Measuring tape
- Shovel
- Crushed stone ($^1/_2$″ to $1^1/_2$″ diameter)
- Non-woven geotextile fabric (or landscape weed fabric for smaller projects)

OPTIONAL

- Perforated PVC or other plastic piping
- Splash guard
- Gutter downspout extension

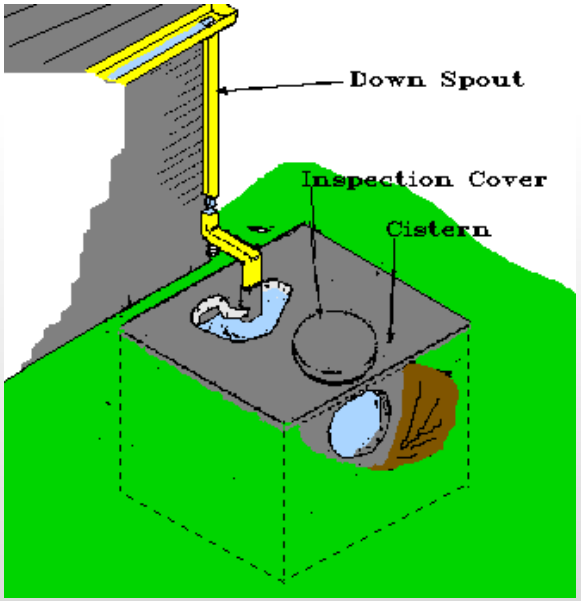
Rainbarrels

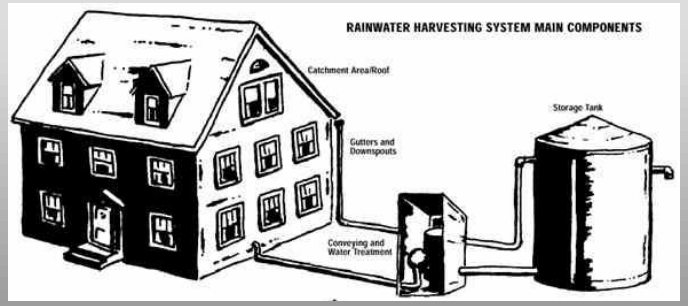
Source: CEI

Source: New England Rainbarrel

Source: New England Rainbarrel

Cisterns





Source: LID Center

Other Options and Disconnection Opportunities

- **Landscaped raingardens –** roof leaders, sidewalks and driveways
- **Filter strips –** roof leaders, sidewalks and driveways
- **Porous paving materials –** sidewalks and driveways

Raingardens

Easy Shrub Garden

Sunny Garden

Butterfly Garden

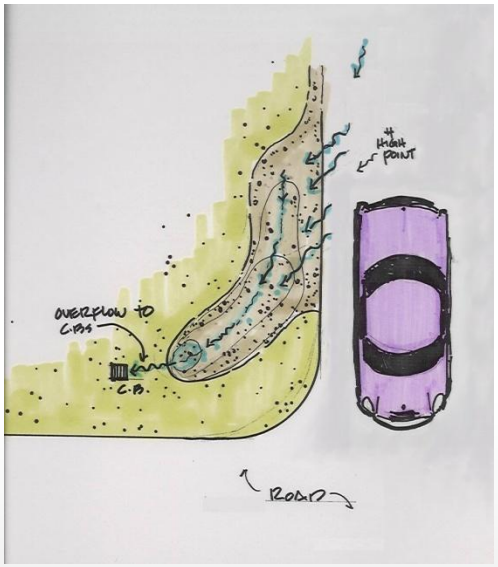
Shady Garden

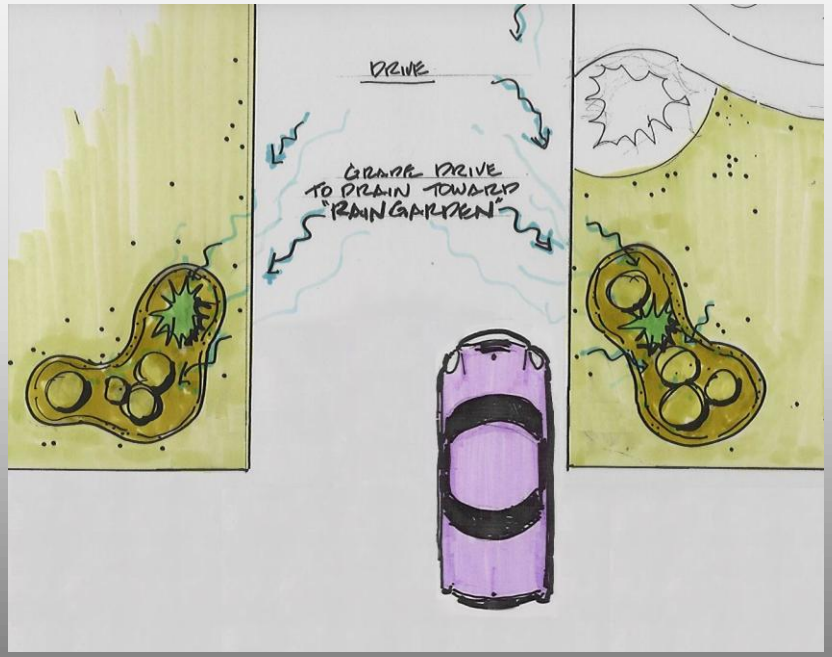
Sunny Border Garden

Daylily Garden

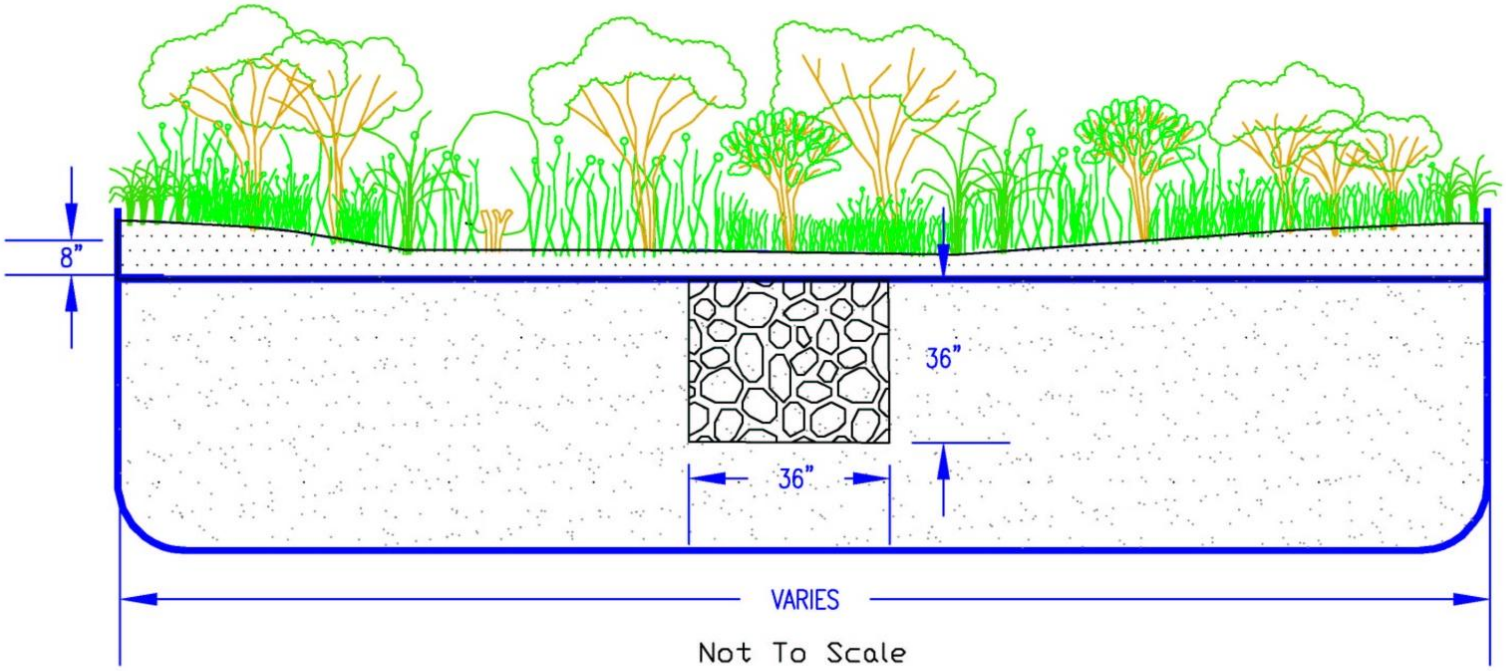
Prairie Garden


GRADE TO DRAIN
ROAD


HIGH POINT
OVERFLOW TO C.B.S
C.B.
ROAD


DRIVE
GRADE DRIVE TO DRAIN TOWARD "RAINGARDEN"

Typical Raingarden Detail



Typical Rain Garden

Plant Selection

- Plants that can tolerate being wet and also survive dryer periods
- Native plants recommended
- Select plants appropriate for sun/shade at site

Materials

- Shovels, rakes, backhoe optional
- Stone or PVC piping
- Filter fabric/burlap/grain bags
- Stakes/tape measure
- Compost
- Mulch
- Plants
- Typical gardening supplies for planting

Filter Strips

Porous Pavement

- Porous Concrete/Asphalt
- Reinforced Gravel Paving
- Reinforced Grass Paving
- Interlocking Concrete Blocks or Plastic Cells (filled with gravel, soil and or grass)

Porous asphalt

Source: UCONN NEMO

Calculate Drainage Area to Each BMP

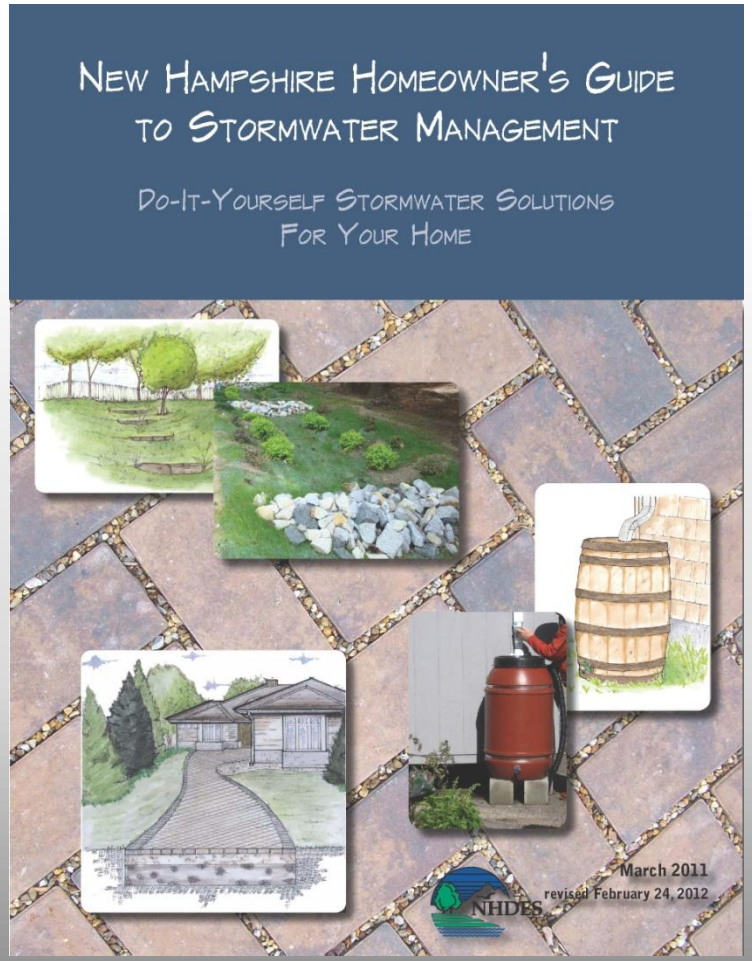
- Use to:
  - Size BMPs
  - Quantify benefits

Table 1. Summary of example drainage areas to each stormwater treatment practice.

Drainage Area	Stormwater Treatment Practice	Land Use Type	Approx. area (ft^2)
1	rain barrel	impervious roof	312
2	rain barrel	impervious roof	304
3	rain barrel	impervious roof	203
4	dripline infiltration trench	impervious roof	709
5	pervious pavers	other hard surface	240
6	pervious pavers	other hard surface	150
7	rain garden	lawn/landscape	2464
8	rain garden	lawn/landscape	2814

Tools for Calculations

- BMP Sizing
  - NHDES, NH Homeowner's Guide to Stormwater Management
- Stormwater Footprint, Impacts and Benefits
  - NHDES Residential Loading Model, online resource
  - Step-by-step instructions to install do-it-yourself stormwater treatment practices



Maintenance/Cost $$$

Depends on:

- Size
- Materials
- Type of plants, etc…

Maintain:

- Frequently inspect
- Upkeep plants
- Replenish mulch
- Replace other material

Typical BMP Costs

- Raingardens - $150-$600
- Rainbarrels - $80-$120
- Cisterns – variable
  - Galvanized Steel $225 for 200 gal.
  - Polyethylene $165 for 165 gal.
  - Fiberglass $660 for 350 gal.
- Dry Wells – vary based on size

Source: LID Center/SmartStorm

V. Summary

Summary: What You Can Do

- Review your home's drainage
- Disconnect roof leaders
- Build your own raingarden
- Add native vegetation to your landscape
- Reduce your lawn size
- Work on preventing runoff from leaving your property

Source: City of Portland, OR

Source: City of Maplewood, MN