# Rain Gardens, Stormwater, and the Scituate Reservoir

July 6, 2015

North Scituate Library

Scituate, RI

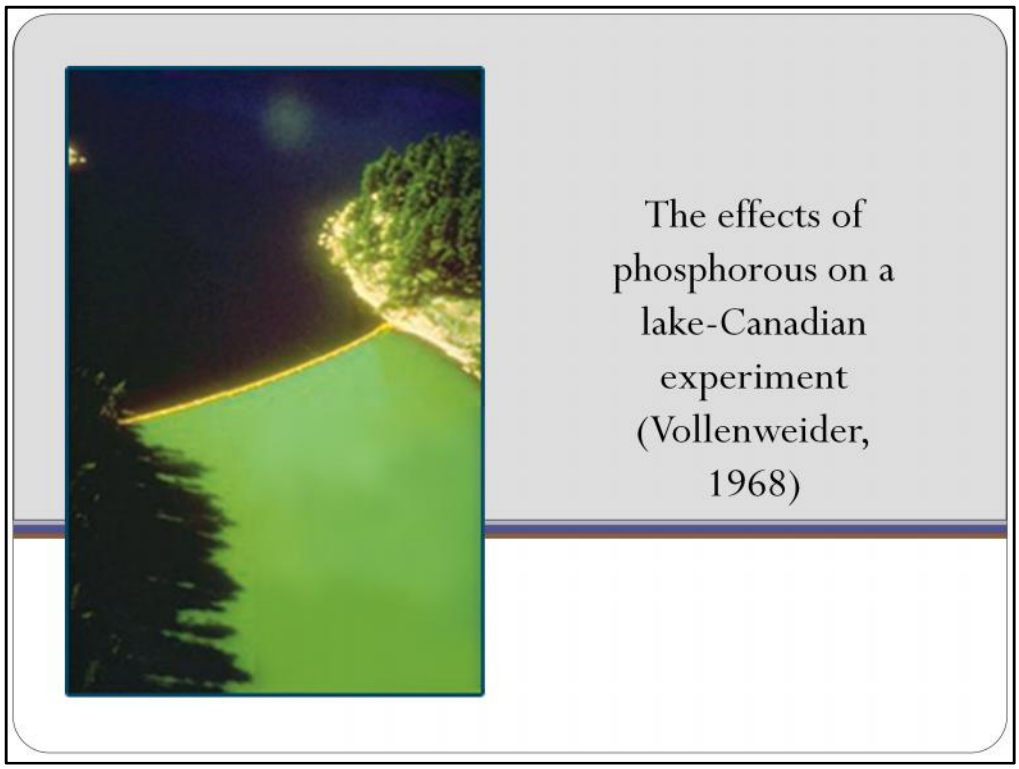
Funded by RIDEM with an EPA grant under Section 319 of the Clean Water Act


Tonight's Agenda
• What is stormwater?
• Stormwater and Regulating Reservoir
• The North Scituate Stormwater Project
• Our rain gardens
• Neighborhood tour!


Thank you!


Stormwater is all of the water that is not absorbed into the ground when it rains. Some may run into a storm drain, which will usually take it to a nearby river, lake or stream (even in the Scituate Reservoir watershed). Anything that is on the ground can be picked up by stormwater and carried to its ultimate destination


Some of the most common types of pollution carried by stormwater are nutrients (from fertilizer, animal waste, and even from the atmosphere), bacteria (from animal waste), sediment (from construction, winter road salting, or uncovered fields), and hydrocarbons (oil and gasoline leaking from vehicles).

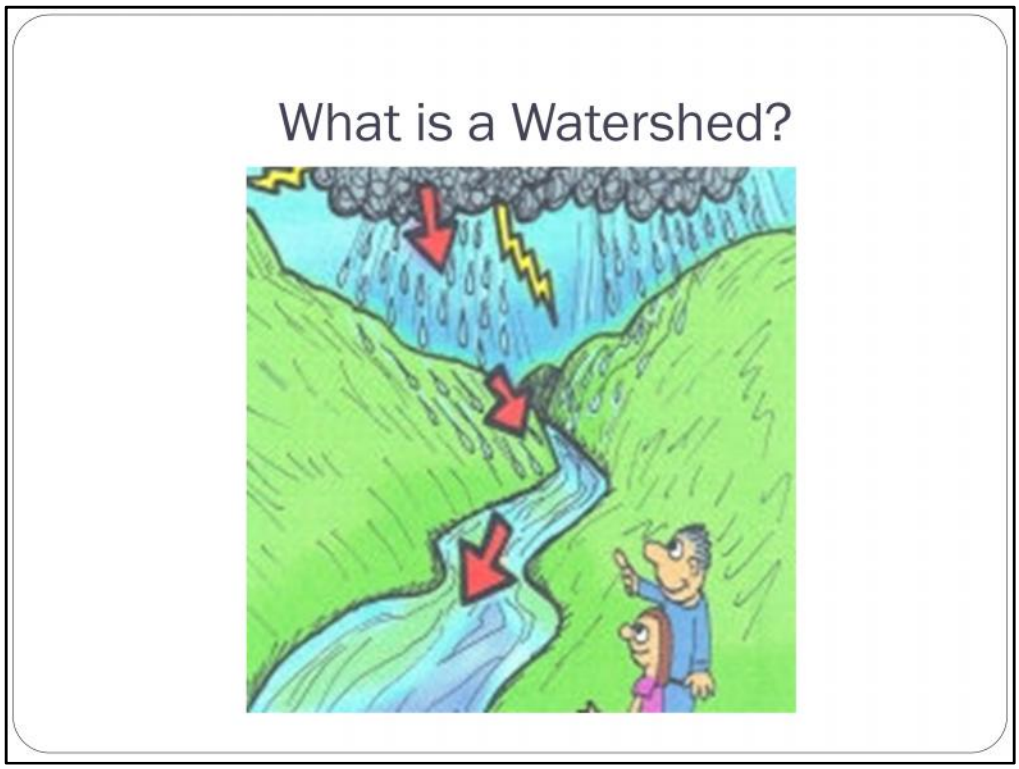



Of all of the types of pollution that can affect a waterbody, the effects of phosphorus, a nutrient that is present in animal waste and many fertilizers, are often the most noticeable. When too much phosphorus ends up in our water, it acts as a fertilizer for algae and aquatic plants. As the algae and plants grow, they use up a lot of the oxygen that is dissolved in the water, making it difficult for fish and other aquatic animals to survive. When you see a lake that looks very green and murky, too much phosphorus from stormwater is probably the culprit. The picture you see here is from a famous experiment that was conducted in Canada in the late-1960s. The green portion of the lake was given phosphorus inputs, while the top half was not. The difference that the phosphorus made is clear to see. Phosphorus is considered a "limiting nutrient" for algae growth in fresh water-this means that as much algae will grow as phosphorus allows.

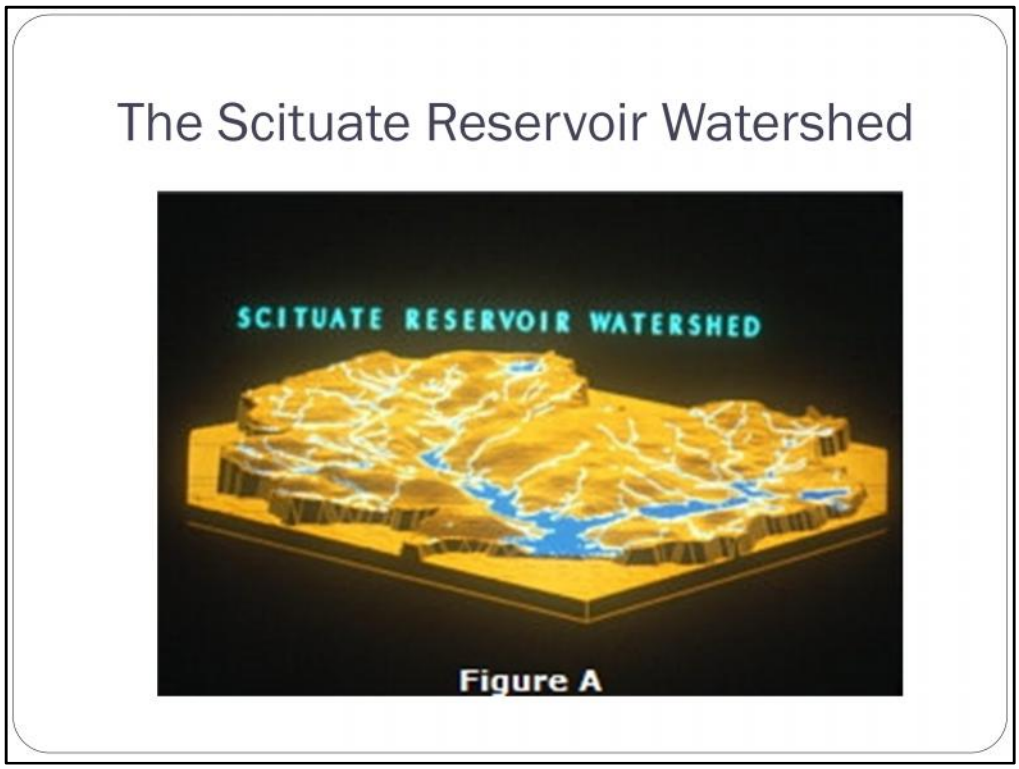

One type of algae that can become especially prevalent when phosphorus levels are high is blue-green algae, or cyanobacteria. It is natural for there to be some of this type of algae in lakes and reservoirs, but when high phosphorus levels cause too much of it to grow it will lead to algae "blooms" like you see here in the summer and fall. Sometimes, for reasons scientists are still struggling to understand, these blooms can release toxins that cause serious illness to people and pets. Blooms like these can cause freshwater beach closures, and a recent bloom in Lake Erie where toxins were released last summer caused a temporary shutdown of Toledo, Ohio's drinking water supply.


Many waterbodies that have high phosphorus levels also have high bacteria levels. When lakes and reservoirs are tested for bacteria, they are actually just being tested for an "indicator bacteria," or a type of bacteria that is naturally present in the intestines of many different animals including dogs, livestock, geese, and even people. Most commonly, fresh water is tested for E. Coli, which despite it's negative reputation is usually harmless. When E. Coli is found in water, however, it indicates that animal waste is reaching the water, and it could carry with it harmful pathogens such as Giardia or Salmonella. Some pollution sources, like dog waste and backed up septic systems, are high in both E. Coli and bacteria.

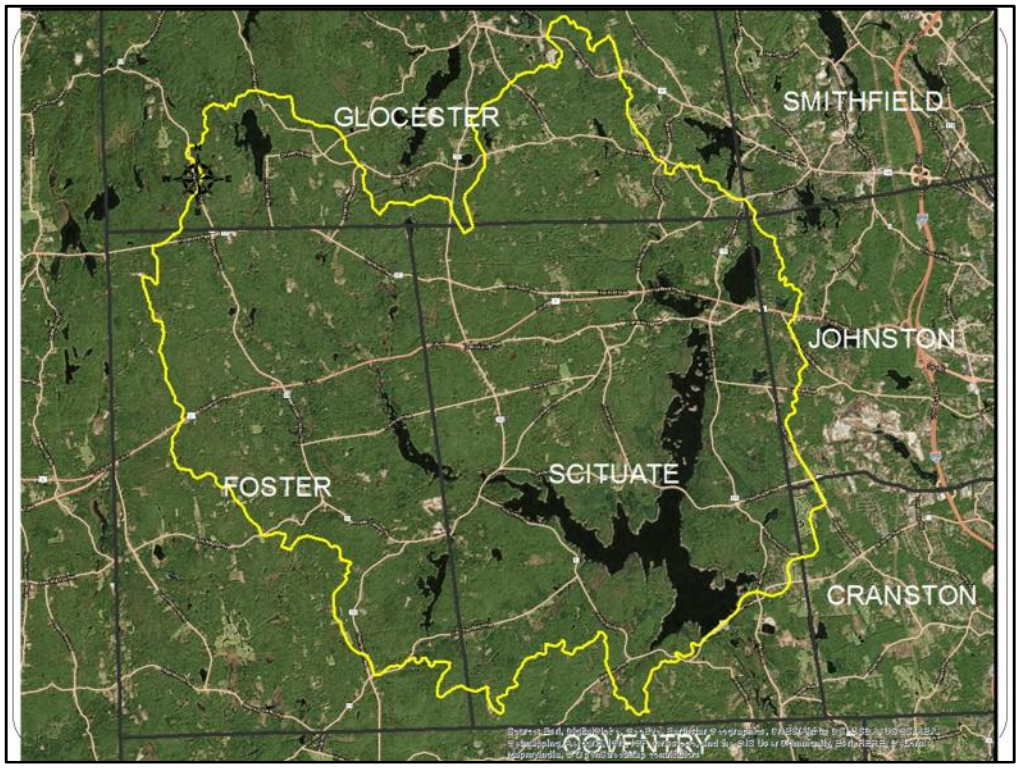
# Stormwater In The Scituate Reservoir Watershed




A watershed is all of the hills and valleys that bring water down to a given lake, valley, stream, or reservoir. Water can reach the bottom of a watershed by running over hills, flowing through storm drains, or even travelling underground.




This picture will give you an idea of the scope of the hills and valleys that bring water down to the Scituate Reservoir, which provides drinking water for over 60% of Rhode Islanders. The watershed actually provides water for an even greater percentage when you consider that the private well water that watershed residents drink comes from the watershed as well.

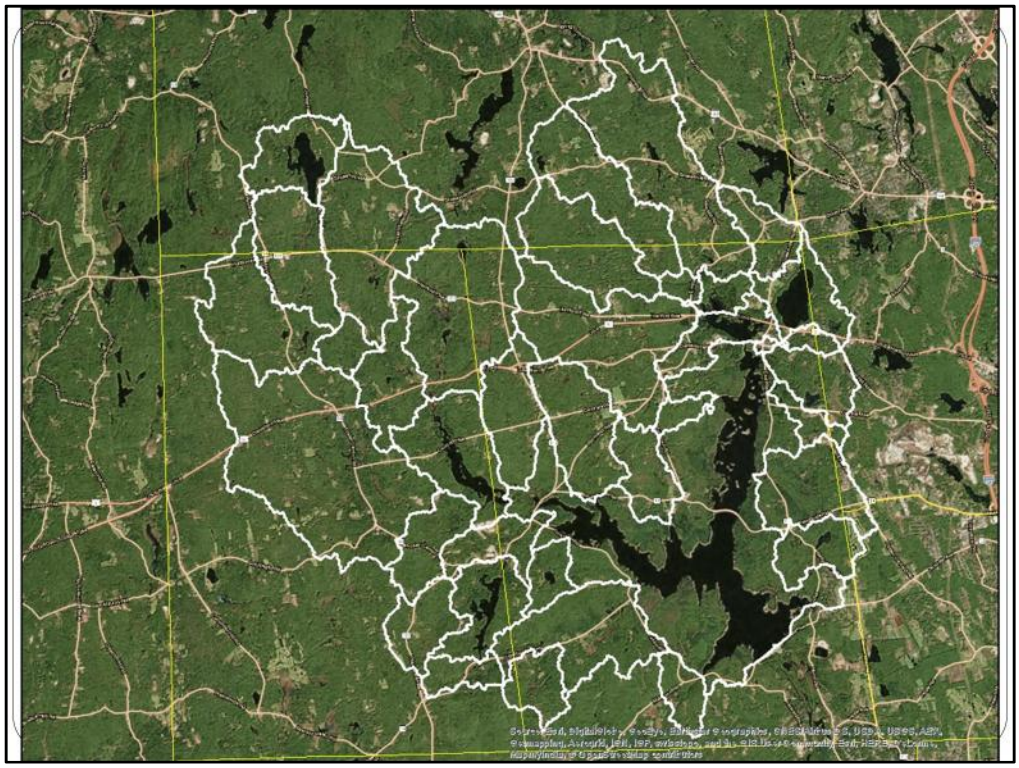



This picture shows the towns in the Scituate Reservoir watershed. The watershed includes large parts of Scituate, Foster, and Glocester as well as smaller parts of Johnston, Cranston, and Smithfield.

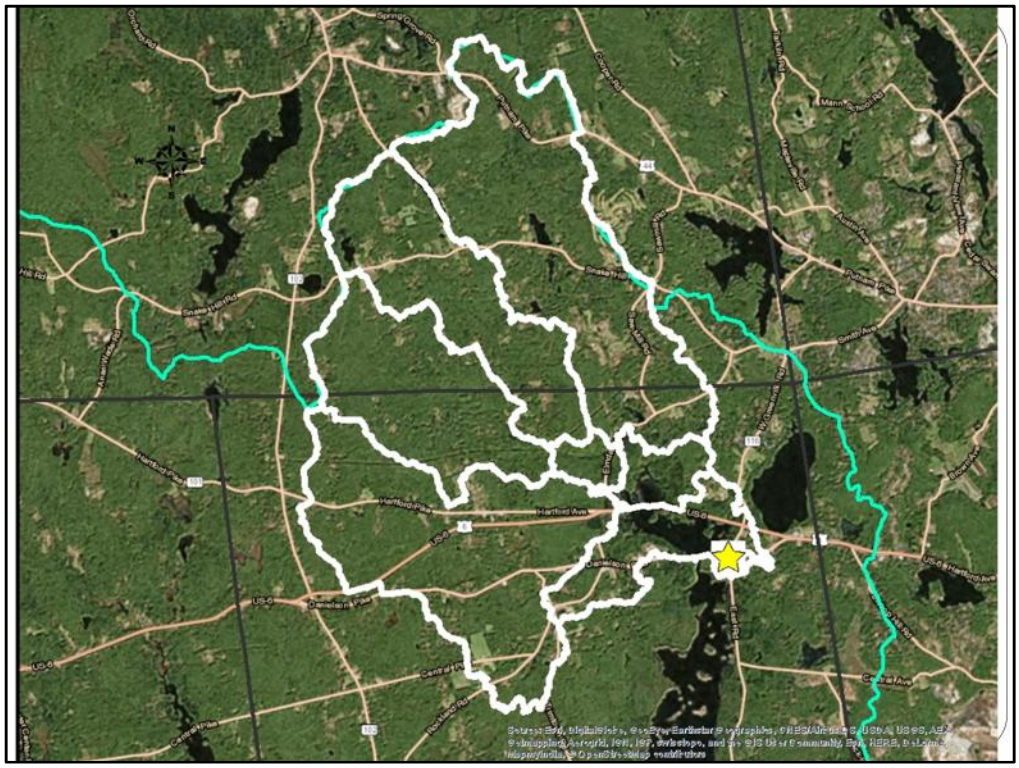
Geographic data for this and subsequent maps:
***Title:*** Town lines; s44btl88
***Originators:*** RIGIS
USGS
***Publisher:*** RIGIS
***Publication place:*** Providence, Rhode Island
***Publication date:*** 19880601
***Data type:*** vector digital data
***Data location:*** http://www.edc.uri.edu/rigis/data/boundaries.html

Scituate Reservoir Watershed and Sub-Watershed Boundaries Provided by Providence Water

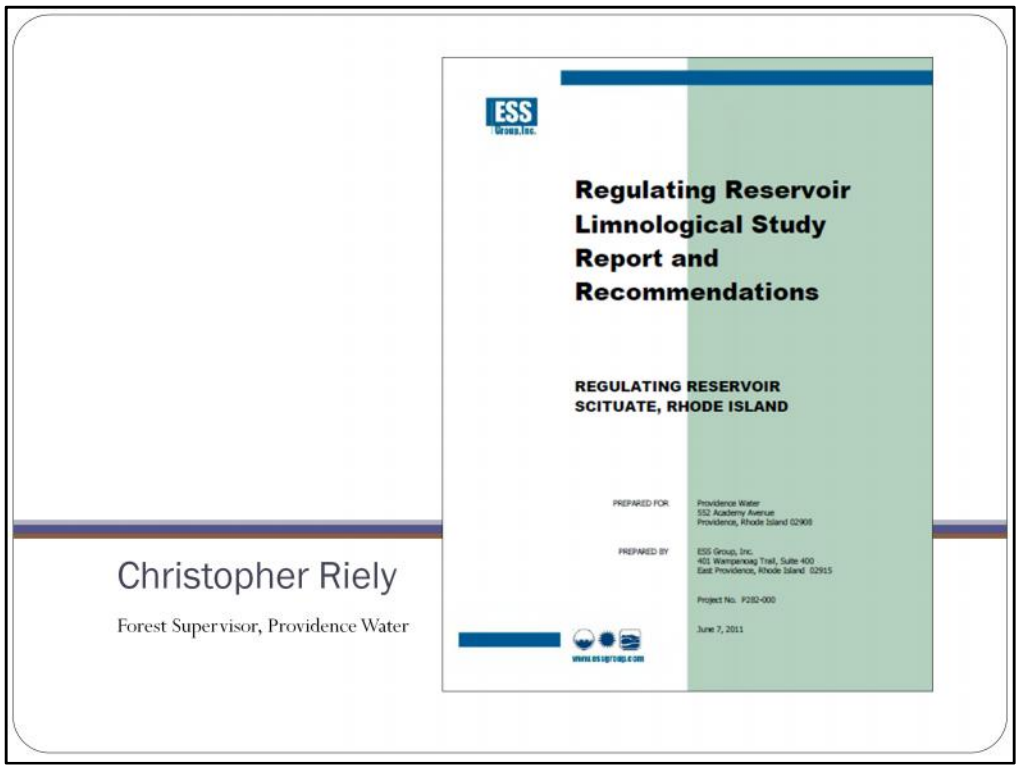

The main Scituate Reservoir has four smaller tributary reservoirs that feed into it- Regulating, Moswansicut, Barden, and Westconnaug. Ponaganset Reservoir is farther away the main reservoir, but because it is part of the Scituate Reservoir watershed and its water could eventually feed into the Reservoir system, it is managed by Providence Water there are certain restrictions on recreation there (i.e. electric motor boats only). In recent years, Providence Water has been commissioning studies to evaluate the health of each of these smaller reservoirs. This will help determine where in the watershed both land management and education events will be most productive.



In reality, the Scituate Reservoir watershed can be divided into many smaller watersheds. The goal of the limnological (lake science) assessments is to determine which areas of the watershed need a little more help to keep water clean. Currently, the Scituate Reservoir's water is of a very high quality! In 2009, a study found it to be the second cleanest drinking water in the country. However, development pressure is increasing throughout RI, and the Scituate Reservoir watershed is no exception. Wherever more houses, buildings, and roads are built, there will be more stormwater with the potential to bring pollution to the reservoir.



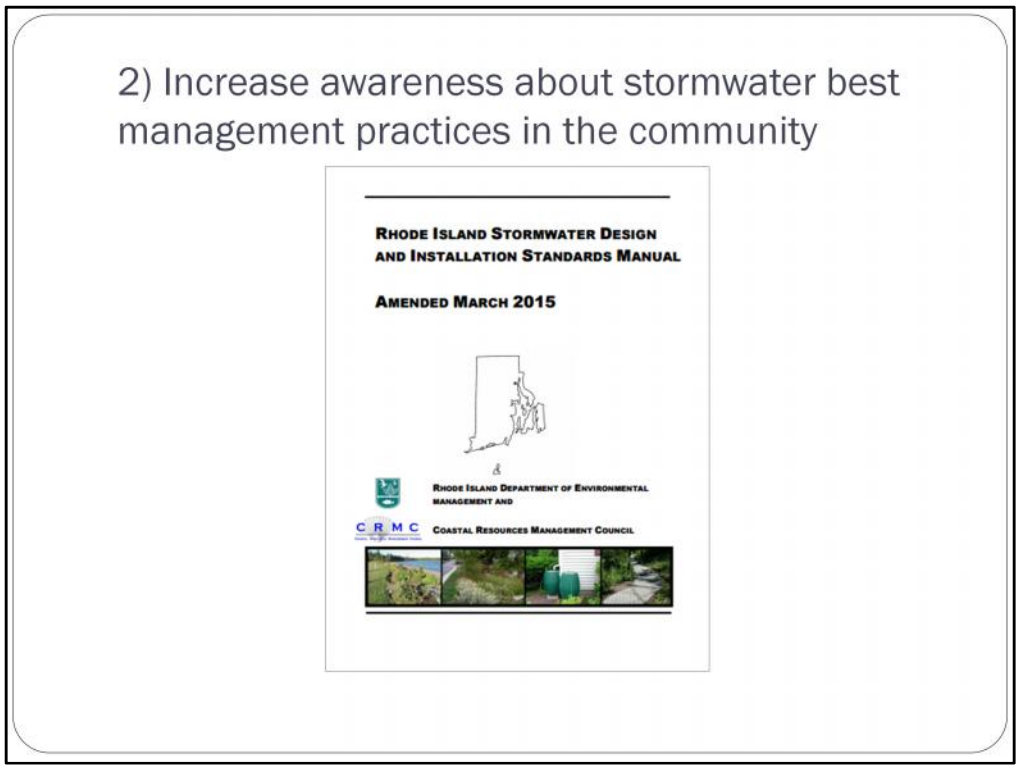
This picture shows the sub-watershed that leads into Regulating Reservoir, with a star on North Scituate Village.  Regulating has a relatively large drainage basin for its size, and it also includes many of the more densely-settled parts of the Scituate Reservoir watershed. As you can see, it can even be split up into ever smaller sub-watersheds.



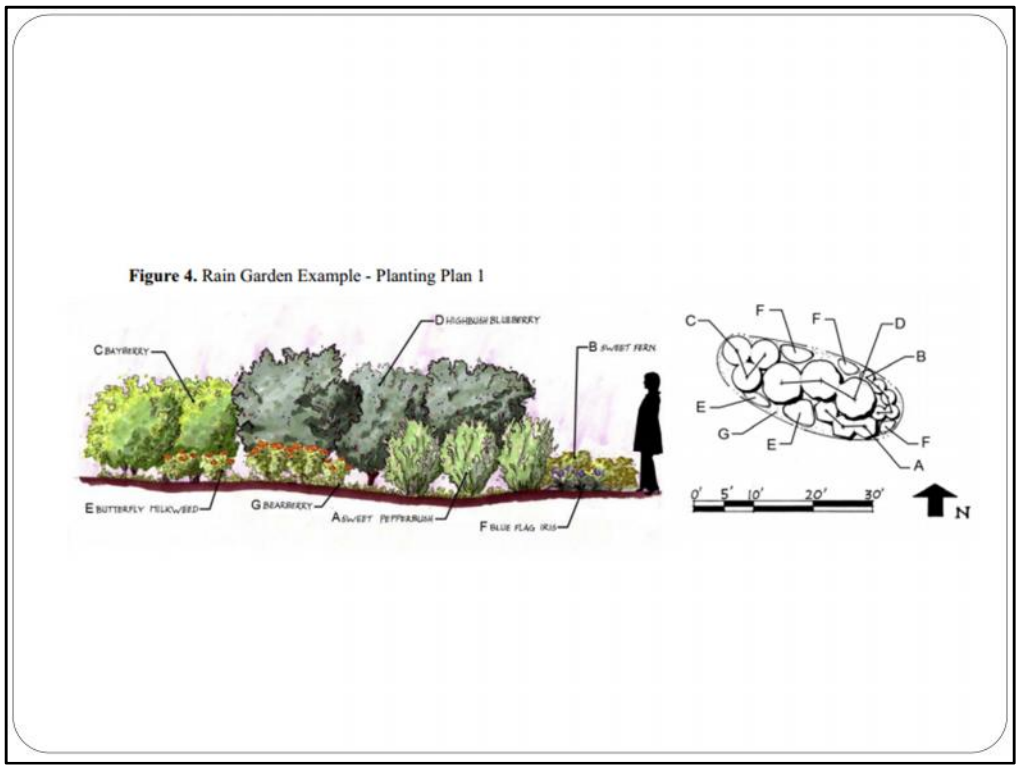

In 2011, Providence Water contracted with consultants from ESS Group to study the health of this waterbody. The consultants found that high levels of phosphorus and bacteria pollution were entering Regulating Reservoir, and that much of this pollution was entering from outfalls near Silk Lane in North Scituate Village.


The results of the limnological assesment led to the formation of the North Scituate Village Stormwater Project, which begin in 2013. The goals of the project are twofold:

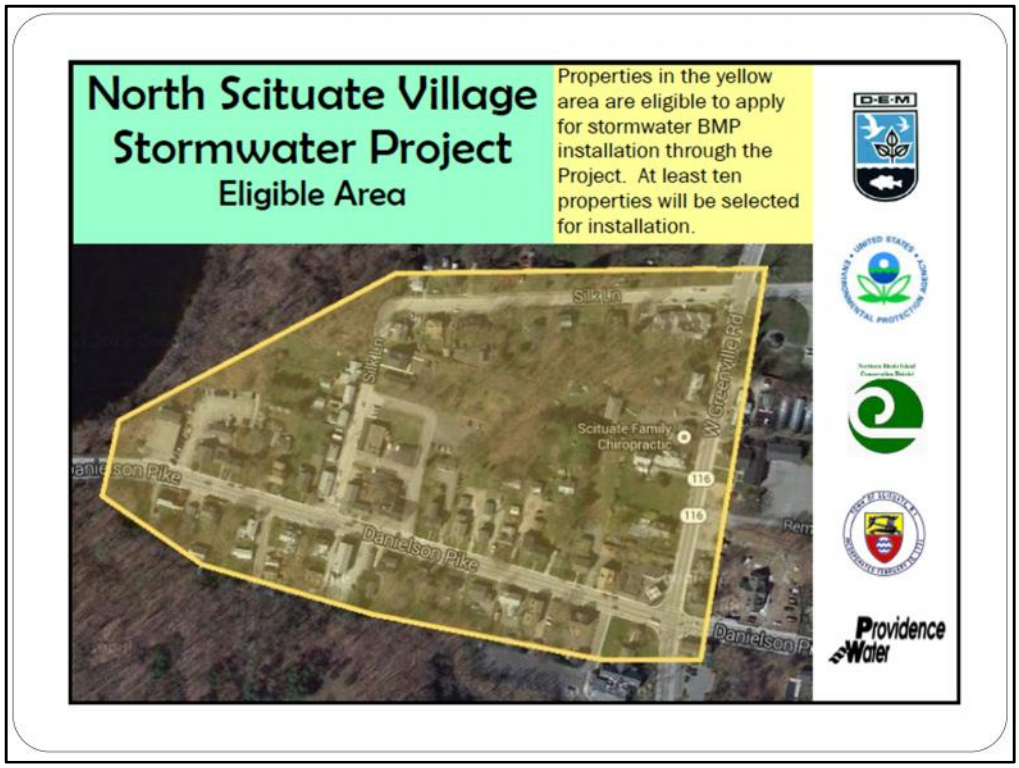

1) Install stormwater best management practices in North Scituate Village. Best management practices are the variety of features that can be constructed to help manage stormwater naturally-by helping it to soak into the ground-instead of allowing it to run through storm drain systems and into Regulating Reservoir. Rain gardens are just one of the many types of best management practices that are being installed as part of this project. In addition, the Town of Scituate will be installing at least one LARGE best management practice, designed to manage parking lot runoff from the municipal parking lot on Silk Lane, later this summer, and NRICD will be installing a tree filter system near the Gazebo this fall. Some other best management practices, including dry wells and infiltration trenches to absorb driveway runoff, are quite small and blend right into the landscape.




2) Increase awareness about stormwater best management practices in the community. RI has created some great new stormwater management regulations that require contractors working on new construction or reconstruction, of anything from a small single-family home to a large retail development, to include a plan to infiltrate some stormwater before it leaves the property. Though existing homeowners are not required to add a best management practice, the document that provides guidance for single-family homes is a great starting point for anyone who is thinking about adding a rain garden or other practice to their home. You have a copy of it in your folder.




The document includes guidance such as sample rain garden planting plans, as well as guidance on sizing and placement of rain gardens, which we'll discuss in a bit.




Our goal beginning the project was to install as many as 10 best management practices, primarily rain gardens, in the project area shown here. We installed 5 rain gardens in 2014, and expect to install between 1 and 3 more this year before the project funding expires on September 30. All rain gardens were installed, free of charge, on private property. Additionally, maintenance is being performed and funded for three years by NRICD, paid for under our agreement with Providence Water. We notified property owners in the area about the project using a combination of direct mailings, workshop invitations, and canvassing, with an emphasis on properties that seemed to have a lot of stormwater draining in the street, and we were thrilled to find several great property owners willing to participate.

Base Imagery: Google Maps, 2014

How do rain gardens work?


Rain gardens work by keeping stormwater on your property to the greatest extent possible. When water is absorbed into a rain garden, it does not have the chance to pick up pollution on the street. Even if stormwater is clean, keeping it on your property will do a lot to help protect waterbodies like the Scituate Reservoir.

Rain gardens accept drainage from a hard, or impervious surface. Some rain gardens receive water from a downspout, which may or may not be buried, and others are designed to accept water that runs off from a road or driveway. We have both kinds of rain gardens here in North Scituate Village. Water that enters a rain garden from a downspout is likely to be very clean, and allowing it to infiltrate into the rain garden will simply prevent it from becoming polluted. Water that enters from a road my have some pollutants in it, some of which can be removed as water filters through the garden.

**Tables 7. and 8**. Rain Garden Sizing Guidance

| Rain Garden Surface Area in Sandy Soils (Sands, Loamy Sands and Sandy Loams) (square feet) | | | |
|---|---|---|---|
| **Drainage Area (Square feet)** | **for 4 inch deep garden** | **for 6 inch deep garden** | **for 8 inch deep garden** |
| 100 | 19 | 15 | 8 |
| 200 | 38 | 30 | 16 |
| 300 | 57 | 45 | 24 |
| 400 | 76 | 60 | 32 |
| 500 | 95 | 75 | 40 |
| 600 | 114 | 90 | 48 |
| 700 | 133 | 105 | 56 |
| 800 | 152 | 120 | 64 |
| 900 | 171 | 135 | 72 |
| 1000 | 190 | 150 | 80 |

| Rain Garden Surface Area in Silty Soils (Loams and Silt Loams) (square feet) | | | |
|---|---|---|---|
| **Drainage Area (Square feet)** | **for 4 inch deep garden** | **for 6 inch deep garden** | **for 8 inch deep garden** |
| 100 | 34 | 25 | 16 |
| 200 | 68 | 50 | 32 |
| 300 | 102 | 75 | 48 |
| 400 | 136 | 100 | 64 |
| 500 | 170 | 125 | 80 |
| 600 | 204 | 150 | 96 |
| 700 | 238 | 175 | 112 |
| 800 | 272 | 200 | 128 |
| 900 | 306 | 225 | 144 |
| 1000 | 340 | 250 | 160 |

*In lieu of a soil texture determination, use the calculated surface areas for silty soils

No matter how they receive water, rain gardens must be large enough to accept all of the water from the drainage area that feeds into them. DEM requirements shown here guide designers to make rain gardens large enough to infiltrate all of the runoff from a 1-inch rainstorm without allowing water to pond in the garden for more than 12 hours. To be safe, since large, powerful storms seem to be increasing, our designer made the gardens installed as part of our project significantly larger than the minimum requirements.

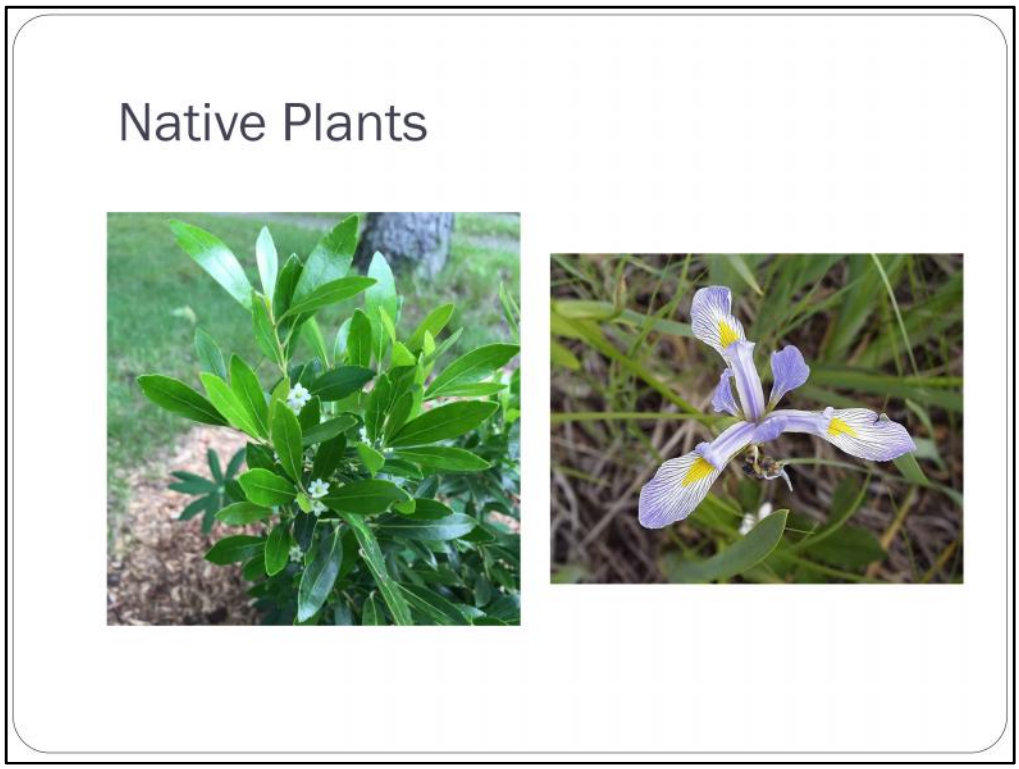
**Table 1.** Minimum Setback Distances for Rain Gardens, Infiltration Trenches, Dry Wells and Permeable Pavement Practices on Single-Family Residential Lots

| Landscape Feature | Required Setback (ft) for Infiltration Trenches and Dry Wells | Required Setback (ft) for Rain Gardens and Permeable Paving Practices |
|---|---|---|
| Public Drinking Water Supply Well – Drilled (rock), Driven, or Dug | 200 | 200 |
| Public Drinking Water Supply Well – Gravel Packed, Gravel Developed | 400 | 400 |
| Private Drinking Water Wells | 50 | 25 |
| Surface Water Drinking Water Supply Impoundment with Supply Intake | 100 | 100 |
| Tributaries that Discharge to the Surface Drinking Water Supply Impoundment | 50 | 50 |
| All Other Surface Waters | 50 | 50 |
| Up-gradient from Natural slopes > %15 | 25 | 25 |
| Down-gradient from Building Structures | 10 | 10 |
| Up-gradient from Building Structures | 10 | 10 |
| Onsite Wastewater Treatment Systems (OWTS) | 15 | 15 |
| Coastal features, coastal buffer zones, regulated freshwater wetlands | As applicable | |

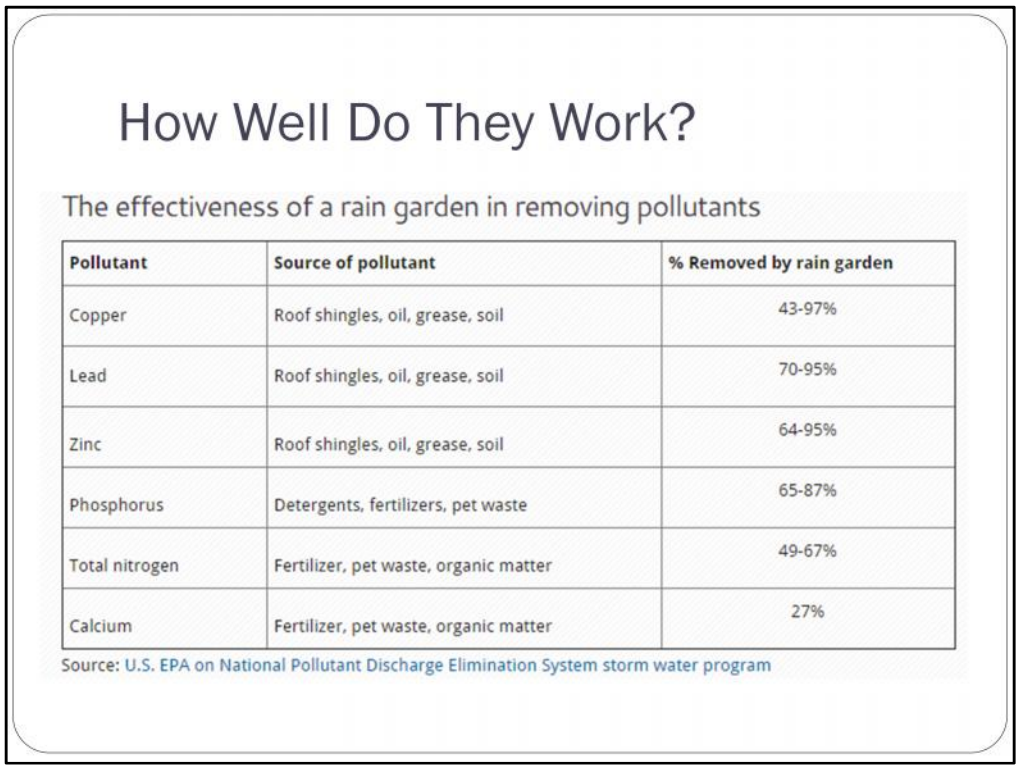
The RIDEM regulations also specify various setbacks, or how far away from various features a rain garden needs to be. Some important setbacks for homeowners to notice are that rain gardens must be 10 feet away from a building's foundation, 15 feet from any part of the septic system and 25 feet from a private well. These setbacks are more cautious than what is required in some states, but they protect against things like water backing up towards a house or accidentally digging into a septic leachfield during construction.


How large a rain garden needs to be is also a function of the soil where it is being placed. In North Scituate Village, the soil is what we refer to as “well drained,” meaning that water absorbs quickly after a rainstorm. The only addition we made to the native soil in the area, therefore, was adding compost to the first 8” of soil depth to help the plants grow and help the soil retain water slightly better. In other areas of the country where there is a lot of clay in the soil, some gardens have an added layer of gravel or even an underdrain to make sure that the gardens drain properly. DEM gives size guidelines for several different soil types, and recommends that if a homeowner isn’t sure, they make the garden large enough for soil that drains slowly.


Mulch is another important addition to any rain garden. In addition to looking nice, it serves several important functions. 1, it keeps soil cool in the summer and warm in the winter for plants. 2, it helps hold moisture in for the plants. 3, it slows or prevents weed growth. 4, if a garden is accepting runoff from a road (as opposed to roof runoff, which will be very clean), mulch does a very good job absorbing oil and gasoline, and hosting bacteria that will eventually break them down into less harmful forms. Our garden designer requested the use of shredded mulch, like can commonly be purchased at garden centers. Other garden designs sometimes call for hard wood mulch, which can be tougher to source.




All of our gardens are planted with either species that are native to RI, or varietals of species that are native to RI in cases where the pure species was not available. Native plants work especially well in rain gardens because they are hearty and do not require frequent inputs of fertilizer. They are also well adapted to survive RI's frequently erratic weather. Fortunately, there are native plants available to fill almost any aesthetic niche, and more and more garden centers are starting to carry them. As a bonus, native plants help to support native bees and butterflies, many of which have seen population declines in recent years.



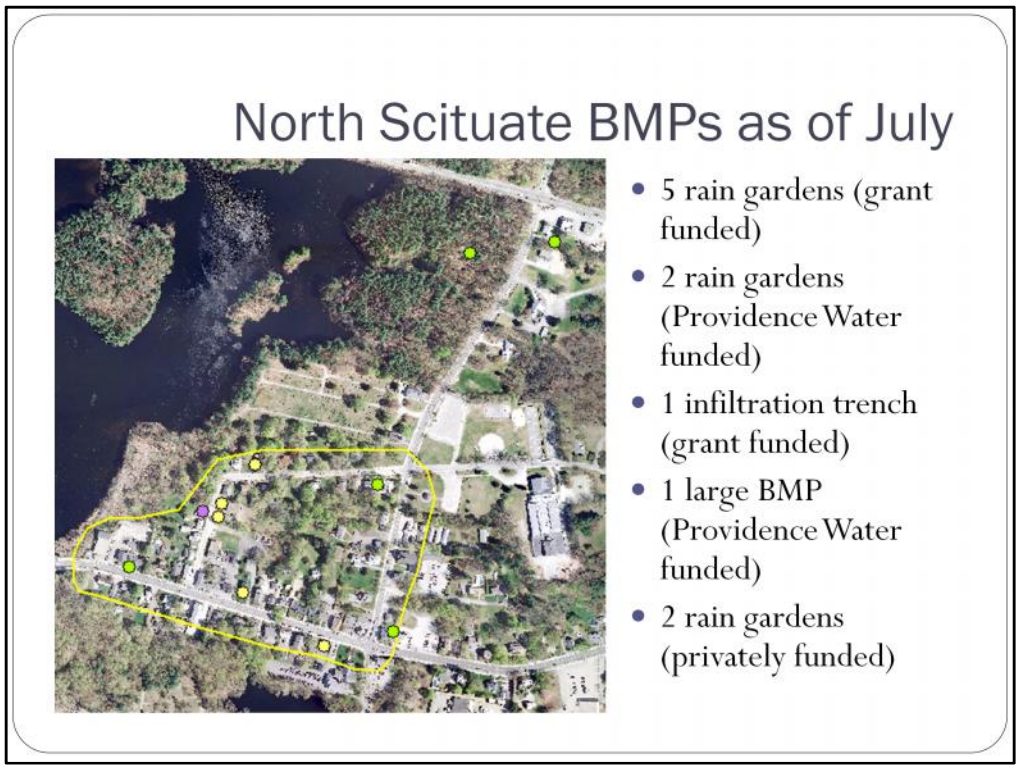
## How Well Do They Work?

The effectiveness of a rain garden in removing pollutants

| Pollutant | Source of pollutant | % Removed by rain garden |
|---|---|---|
| Copper | Roof shingles, oil, grease, soil | 43-97% |
| Lead | Roof shingles, oil, grease, soil | 70-95% |
| Zinc | Roof shingles, oil, grease, soil | 64-95% |
| Phosphorus | Detergents, fertilizers, pet waste | 65-87% |
| Total nitrogen | Fertilizer, pet waste, organic matter | 49-67% |
| Calcium | Fertilizer, pet waste, organic matter | 27% |

Source: U.S. EPA on National Pollutant Discharge Elimination System storm water program

In cases where a rain garden is collecting runoff that is already polluted, it does a very good job of removing pollutants. Proper design is important to ensure that rain gardens function as designed-water is channeled into them appropriately, the soil mixture is such that water is absorbed quickly, and plants continue to grow and thrive.




The North Scituate Stormwater Project has given the village of North Scituate the opportunity to become a leader in stormwater management in Rhode Island. There are not many places in RI where so many different types of stormwater management have been implemented in a very small area. In addition to the 5 rain gardens installed as part of our grant, 2 additional gardens (paid for by PW) have been added at Town Hall and the Village Tavern. The library and Dexter Credit Union both installed rain gardens independently. There is also an infiltration trench currently being installed on Silk lane, and a large stormwater management structure at the corner of routes 6 and 116 in North Scituate that was installed by Providence Water. Our grant funding period ends on September 30, and it is our hope to install at least one more rain garden before that time as well as other smaller projects that we are currently working on. The Town of Scituate will also be adding another large best management practice to the project area, which is outlined here in yellow.