"From Roof Top to River: Saving the Watershed One Drop at a Time"

Arlington Echo Storm Water Tour

In spite of many efforts to clean up the Chesapeake Bay and its tributaries, our waters continue to be polluted. There are many contributing factors to water quality, however, in Anne Arundel County; the vehicle carrying pollutants to our waterways is storm water.

Did you ever think about what happens to a raindrop that falls in the Chesapeake Bay watershed? Any rainwater in an urban or suburban area that does not evaporate or infiltrate into the ground is considered storm water. On its way to the storm drain, rain first gathers nutrients and other chemical contaminants from our air. This polluted water travels via storm drains to the nearest stream and ultimately to the Bay.

So, what can you do to save the Bay? **Infiltrate! Infiltrate! Infiltrate!** In order to have infiltration, storm water must be slowed down so that it may soak into the ground. Infiltration allows storm water to be filtered by plant roots and micro-organisms living in the soil before it is discharged into streams as cool, clean ground water.

Natural areas such as riparian forests and wetlands are nature's own infiltrators. Here at Arlington Echo, we recognize that our impervious surfaces are impacting our waterways. We have attempted to preserve our native forest and wetlands. In addition, you will notice many infiltration practices. Let's follow a drop of water from the rooftop to the Severn River. Please use the map to visit to following areas:

1. Rain Barrels
2. Bio-retention Areas - Simulated Costal Plain Bogs
3. Swales and Curb Removal
4. Green Roof
5. Pervious Pavement
6. Vernal Pool
7. Rain Garden
8. Living Shoreline

Other contributing natural areas:

- Freshwater tidal marsh
- Atlantic White Cedar Bog
- Riparian Forest

1

Rain Barrels

Echo Rain Barrels

TRANSPORT AIRBORNE AND DEPOSITED NUTRIENTS (NITROGEN AND PHOSPHORUS) TO FEED YOUR GARDEN PLANTS!

REDUCE THE HIGH ENERGY WATER FROM YOUR ROOFTOP THAT OTHERWISE CARRIES MANY CONTAMINANTS TO YOUR WATERWAYS!

Benefits You and the Environment!

CONVENIENTLY COLLECT WATER WHERE YOU CAN USE IT FOR YOUR GARDEN AND LAWNS!

CONSERVE WATER AND REDUCE WATER BILLS!

Throughout Arlington Echo we have Rain Barrels attached to the downspout of every building—adding up to 96 Barrels throughout campus. Rain Barrels gather the water that falls on the roofs and slows it down. The water from a 30 minute storm is released over 2 days.

Did You Know?

- 60 % of lawn fertilizers are washed away by surface water
- 30% of nutrient & sediment overloading in the Chesapeake Bay can be attributed to non-point pollution and human land use
- Anne Arundel County has the fourth worst air quality in the U.S., most of this pollution ends up in our runoff

So what does this have to do with rain barrels? Some people might think that rain barrels are only used for water conservation during drought periods, when in fact they are just as useful during rainy periods.

Lawn and garden watering make up nearly 40% of total household water use during the summer. For every 1000 square feet of roofline, one inch of rain equates to 632+ gallons of water. This is a large amount of free "soft water" that can be stored and used later to wash cars and windows, water plants, fill ponds, or feed a rain garden during periods of drought.

The water that falls carries pollutants that are usually directed into groundwater or allowed to flow directly into waterways around the Bay. Water that runs off the land can be loaded with nutrients, bacteria, heavy metals, and toxic chemicals. By placing a barrel at every downspout, rainwater can be collected from the roof and redistributed into a filtration area such as a rain garden or a bog that filters nitrates, phosphates, and other pollutants. The barrels collect the first flush, the most critical rain that is loaded with pollutants, and then slowly releases the water to a garden or shallow dry well area. By diverting water from storm drains, the impact of runoff into streams and the Chesapeake Bay is greatly decreased.

2 *Bio-retention Areas -Simulated Costal Plain Bogs*

A bog is one of nature's ways to filter rain- water runoff from non-point sources. If bogs are ***preserved/restored*** the overall health of the Bay will improve.

The L.A.W.S.S. of the BOG

Lack of nutrients: because of the lack of oxygen and the acidic chemistry of bogs, they lack many nutrients, such as nitrogen, that are food for plants. The lack of nutrients restricts the growth of competing plant species. Carnivorous plants such as pitcher plants, sun dews, and bladderworts obtain their nutrients from the meat (insects) they digest.

Acid: Bogs are great environments for plants to decay, which adds organic acids to the soil and water. Since this makes it so harsh for most nutrient-loving plants, bog plants have adapted to be *acidophilic*, using the natural acids as food. Examples: cranberry, Atlantic White Cedar, sphagnum moss. *Acidophilic plants* need little nutrients to survive.

Water: Bogs are wetlands! Coastal plains bogs form near the edges of still or slow- moving water, near ponds, lakes, slow streams, or springs. The water in bogs is normally clear and cool. Technically speaking, the coastal plain bogs of Anne Arundel County are called *Fens* because water passes through them rather than being contained.

Sandy soil: Maryland's bogs are unusual because they rely on a sandy soil that is part of the Magothy sand lens, which begins in Europe and continues along the Atlantic, surfacing only for 30 miles long & 10 miles wide in Anne Arundel County. Coastal plains bogs associated with this sand lens can be found from Gibson Island in Pasadena to Bowie near the Patuxent River. This sand combined with the high concentration of surface carbon from plants, provides a great filtering medium for cleaning the water associated with bogs. Leafs from acidophilic plants such as Atlantic White Cedar are slow to decay and add to this filtering mat.

Sun: Because the lack of nutrients most plant growth is restricted. Most bog plant species are low growing so they do not compete for the sun. Bog associated trees such as Atlantic White Cedars and Sweet Bay Magnolia grow on the edge of bogs allowing light to penetrate the center of bogs.

Bogs are open, ***acidic***, ***nutrient poor*** wetlands. Bogs form when a mat of ***vegetation*** (moss) develops on the edge of a pond, lake, wetlands, or slow-moving stream and grows over the surface of the water. As time passes, the dead, ***decaying*** plants make a dense, ***fibrous*** layer that is called peat. When plants die they become part of the peat layer. Most plants, that you know, cannot grow in bogs. That is because the still or slow-moving water is too acidic and does not contain nutrients, such as ***nitrogen*** that are needed for plants to grow. There are some unusual plants that can grow in bogs.

Pitcher Plants and Sun dews- carnivorous plants that attract and digest insects.

Atlantic White Cedars- rot resistant tree that needs wet soil and can grow to be 80-100 ft tall These plants are endangered in Maryland because there are only a few bogs remaining. AA County has the most bogs in Maryland but that number is less than 10.

What can be done to protect our threatened bogs?

Changes in the quality of water is one of the major threats to bogs. If a bog dries out, rare bog plants will be replaced with plants more tolerant of dry conditions. Development, with parking lots and buildings, too close to bogs changes flow patterns of water and the amount of water entering the bog. With the water comes ***sediment*** that fills in the bog, changes soil conditions and provides habitat for woody plants (trees). All these changes destroy the bog. Some pollutants, such as herbicides, can damage or kill bog plants directly or by changing the acidity or nutrient levels in the bog.

3 *Swales and Curb Removal*

By removing curbs and creating swales, water can be controlled and directed to lesson erosion and also encourage infiltration.

A swale is a slight depression that runs along the contour of the land. It can be deep or shallow, or even hidden (a ditch filled with gravel and capped with topsoil), and the dirt from digging the swale is usually used to make a berm on the downhill side. An important distinction is that a swale is not a drain. It is a water collection device. The cheapest way to store water is in the soil. And of course, by stopping the run-off, it prevents erosion as well.

How it works is this: Rain falls on your property, and instead of running straight down the slope, it runs to the swale and gathers. There it soaks in slowly.

Stones in our swales slow down the water to help reduce erosion. Plants such and moss and ferns help to absorb nutrients and water.

Our roads at Arlington Echo were once lined with wooden curbs. Rain water would then run down the hill and go directly into a storm drain that emptied into the Severn River. All the pollutants from the road would also go directly into the Severn River.

By removing curbing from our roads, the water can now sheet directly into the forest. This disperses the water and allows for the water to soak in. The forest floor is a great big sponge that can easily help infiltrate the water.

4 *Green Roof*

Green roof? Well, yes – plants growing on the top of building!

The Green Roof on the boat house is made of sedums, a plant well adapted to extreme temperature and drought. The plants help to clean and treat the water before it even reaches the ground. It even acts as insulation, helping to keep the building cool in the summer and warm in the winter.

Benefits of Green Roofs

- **Stormwater Management:** **Anne Arundel County is composed of 14% impervious surface, such as parking lots and driveways, which increases the amount of pollutants running into our waterway. Green roofs naturally filter and retain rainwater as part of a stormwater management system that includes rain barrels, rain gardens, and wetland construction. North Carolina State University data suggests that green roofs can reduce up to 50% of rainfall runoff annually.**
  Source: Hunt, William F. "Overview of Innovative Stormwater Treatment Practices: Green Roofs, Permeable Pavement, and Water Harvesting Systems/ Cisterns." Treating Rooftop Runoff [2006]: 3-14.
- **Denitrification:** **30% of harmful nitrogen in our environment is present in the air. This nitrogen in turn falls to earth in the form of acid rain, presenting a huge problem for biodiversity. In the Chesapeake, eutrophication is a process in which high amounts of nitrogen from rain and runoff have created algal blooms. When these blooms decay, they create hypoxic (little oxygen) or anoxic (no oxygen) conditions in the Bay, making it difficult for anything to live. Green roofs catch nutrients such as nitrogen and filter rainwater so it can safely travel into waterways.**
  Source: United States Environmental Protection Agency
- **Aesthetics:** **The design of our green roof is coordinated so that different varieties of *Sedum* develop into different colors, displaying the Arlington Echo logo. They are also a provocative learning tool in learning about stormwater management.**
- **Reduced roof temperature:** **Green roof plants, in the process of photosynthesis, soak up much of the light that would be absorbed into the roof, making the boathouse cooler in the summer. At the same time, the respiring green roof acts as insulation in the winter, regulating temperature in all seasons.**
- **Plant Habitat:** **Although the roof is planted with varieties of *Sedum*, a plant normally acclimated to desert environments, the roof space provides more area for plants, encouraging a greening of highly populated areas, especially cities.**

5 *Pervious Pavement*

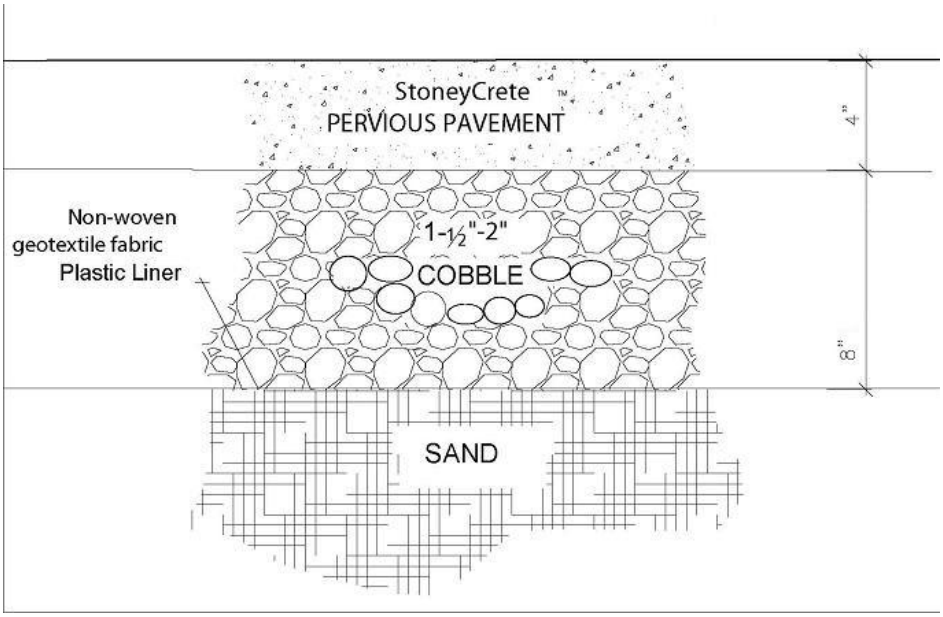
The pervious concrete is one of the many ways we treat storm water at Arlington Echo. The storm water passes through the pervious concrete, to the rain garden and overflows to the bioretention area. Every drop of storm water that we treat will help our watershed.

Pervious concrete is a certain type of asphalt in which there are multiple layers of different sized aggregate. The different sized aggregate allows for air pockets within the asphalt to promote infiltration of rainwater into the ground.

Benefits- While promoting infiltration of rainwater, the pervious pavement will slow down the rushing water and reduce run-off and erosion into nearby waterways. The rainwater being infiltrated through the pavement is then directed to bio-retention areas such as shade gardens, and bogs. The main goal of the pervious pavement is to influence a natural infiltration system into the ground rather than a rapid loss of important excess nutrients into waterways.

All of these stormwater methods allow the water to seep through the ground and into the aquifer and then enter the Bay at a cool 50 degrees; instead of a running directly from hot asphalt and other impervious areas.

Water filters through the pores in the concrete slowing down and depositing sediment and pollutants that it is carrying with it. There are 3 layers in our pervious pavement: sand, cobble and the porous cement.



6 *Vernal Pool*

A vernal pool is an area which is only wet in the Spring. It provides an ideal habitat and breeding ground for amphibians that is free from predators that were found in open water.

A vernal pool is a contained basin depression lacking a permanent above ground outlet. In the Northeast, it fills with water with the rising water table of fall and winter or with the meltwater and runoff of winter and spring snow and rain. Many vernal pools in the Northeast are covered with ice in the winter months. They contain water for a few months in the spring and early summer. By late summer, a vernal pool is generally (but not always) dry.\

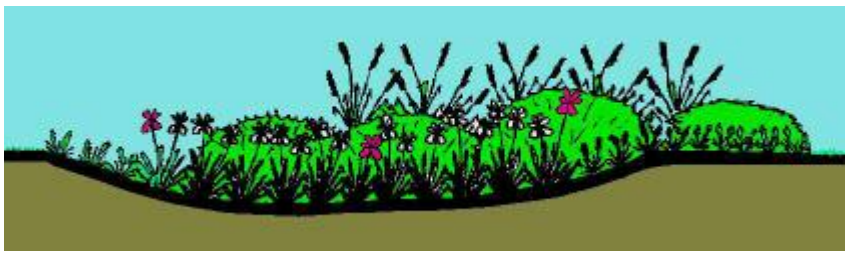
Sometimes called woodland pools, these wetlands provide a unique habitat that supports a diverse collection of organisms. Most of these organisms rely solely on this habitat for their life cycles.

A vernal pool, because of its periodic drying, does not support breeding populations of fish. Many organisms have evolved to use a temporary wetland which will dry but where they are not eaten by fish. These organisms are the "obligate" vernal pool species, so called because they **must** use a vernal pool for various parts of their life cycle. If the obligate species are using a body of water, then that water **is** a vernal pool. Some easily recognizable obligate species are the fairy shrimp, the mole salamanders and the Gray tree frog.

The mole salamanders are also upland organisms. They spend most of their lives in burrows on the forest floor. Annually, on certain rainy nights, they migrate to ancestral vernal pools to mate and lay their eggs. They soon return to the upland. The eggs develop in the pool and, by the time the pool dries, the young emerge to begin their life as a terrestrial animal. Evidence that mole salamanders breed in an area make that water body a vernal pool. Breeding evidence would be a breeding adults, egg masses or larvae.

7 *Rain Garden*

Plotting to Infiltrate? Try Rain Gardens.
Lorrie Stromme, Hennepin County Master Gardener


Courtesy of the Friends of Bassett Creek website.

What is a Rain Garden?
The term rain garden defies precise definition. Basically, a rain garden is a strategically located low area planted with native vegetation that intercepts runoff. Other terms include mini-wetland, storm water garden, water quality garden, stormwater marsh, backyard wetland, low swale, wetland biofilter, or bioretention pond. The variables include dimensions, design, engineering components, and plant selection.

Rain gardens are designed to direct polluted runoff into a low, vegetated area, where the pollutants can be captured and filtered. The features of a rain garden aid in this biofiltration process: a shallow basin depth, gentle side slopes, soil that allows infiltration, and vegetation that traps sediment and sediment-polluting runoff. Vegetation shields the soil surface from raindrop impact while the root mass holds the soil particles in place. Improved water quality results from the nutrient removal process as the water and pollutants come into contact with roots and microbes in the soil. Plants, trees, and groundcover absorb up to 14 times more rainwater than a grass lawn.

The design of a rain garden can be varied to accommodate soils, watershed hydrology, existing drainage patterns, aesthetics, microclimate, and purpose.

A rain garden should be placed near impervious surfaces so that rainwater and snowmelt will drain into the dip or depression. Locate the garden strategically near impervious surfaces, such as alleys, sidewalks, driveways, and under downspouts or gutters, to capture the rain as close as possible to the point where it falls. Rain gardens planted between two residential properties can channel runoff to front or back yard gardens, while simultaneously acting as a living fence between neighbors. In one instance, a rain garden located under a downspout to capture roof runoff captured approximately 14,000 gallons of water per year. Gardens should not be located over gas or water services.

Rain gardens and planted infiltration trenches have also been incorporated into parking lot designs. Look for areas where there is no curb and the drainage goes into a planted area!

You need plant species that can tolerate the extremes of wet soils and very dry periods are preferred for rain gardens. Native plants have several advantages. They are best adapted to the local climate and, once established, seldom need watering or fertilizing. Many are deep rooted, which enables them to tolerate drought. Native plants are attractive to diverse native butterflies and provide habitats for wildlife, especially birds. Natives are low maintenance, but they still require care, occasional weeding, and control of debilitating diseases and insect pests.

8 *Living Shoreline*

This living shoreline project is one component of a larger effort to reduce shoreline erosion and sedimentation while creating critical habitat for a wide variety estuarine species.

One of the most significant problems facing landowners along Maryland's coastal environment is shore erosion – a natural, yet unrelenting process. Through the years, landowners have tried many tactics to protect their property including informal dumping of recycled concrete materials and old tires to more traditional erosion control techniques such as groins, bulkheading and riprap revetments. Unfortunately, these approaches have a number of problems, ranging from obvious visual impacts to the elimination of valuable fringing wetlands and sand beaches that help improve water quality and support wildlife.

However, in recent years landowners have increasingly turned to a "living shorelines" approach to control erosion and provide critical habitat through strategic placement of marsh plants, stone, and sand. During the mid 1980s "soft" shoreline stabilization alternatives were referred to as "nonstructural shore erosion control" which incorporated many elements of today's "living shorelines" techniques. Some emerging practices place even greater emphasis on habitat creation and less on erosion control. Living shoreline treatments are designed with the intention of maintaining or minimally disrupting normal coastal processes, such as sediment movement along the shoreline and protection and restoration of wetlands. (Jefferson Patterson – web page)

This project created approximately 6,000 square feet of tidal wetlands and 250 linear feet of shoreline stabilization at Arlington Echo Outdoor Education Center on the Severn River. The current shoreline has 250 linear feet of deteriorating pressure treated wood bulkhead. By removing the existing bulkhead, and stabilizing an area 25 feet from the shoreline a wetland was created. Toe boulders were placed below the mean low water elevation and biologs were planted to create a natural looking marsh. Planting wetland grasses further stabilized the area. The shoreline was planted with native shrubs. This project improved water quality, provides fish and wildlife habitat and functions as a demonstration site for waterfront landowners.