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The Homeowner's Guide to Stormwater

How to develop and implement a stormwater management plan for your property

Photo by Tetra Tech

Purpose of this Guide

If you are simply looking for a way to help protect or improve your watershed or you are doing a small home improvement project that creates new impervious area and you need to manage the stormwater that is generated*, this guide is for you. It will help you better understand:

- what is stormwater, why stormwater runoff can be a problem, and what you can do about it;
- how much stormwater runoff is generated by impervious areas on your property;
- how stormwater flows across and leaves your property; and
- how you can reduce the amount of stormwater runoff leaving your property.

This guide will help you create your own stormwater management plan and select simple stormwater solutions to be implemented on your property.

** Check with your local municipality to find out more about what permits may be required for any building projects.*

Disclaimer

The practices described in the guide are provided exclusively for general educational and informational purposes. The guide is intended to help property owners evaluate and assess current runoff pathways on their properties and identify practices to better manage stormwater. The guide outlines several practices to choose from that are fairly simple to plan and construct.

All efforts have been made to ensure the material in this guide is accurate and up to date. However, the Little Conestoga Partnership and its partner organizations cannot be held responsible for any circumstances resulting from its use, unavailability, or possible inaccuracy.

This guide is not intended to be a substitute for professional design and implementation services. This guide provides you with general information on an "as is" basis. You acknowledge that you assume the entire risk of loss in using this guide and the information provided herein, including without limitation any loss incurred by any end user. You further acknowledge that the management of stormwater is a complex and site specific issue and that the general information contained in this guide may not be sufficient to assess any and all particular site conditions. Any stormwater management practice should be installed with the consultation of an experienced professional who can address specific site conditions.

The Little Conestoga Partnership and its partner organizations make no representations and specifically disclaim all liabilities and warranties, express, implied, or statutory, regarding the accuracy, timeliness, or completeness for any particular purpose of any material contained on this site.

The information presented in this guide does not in any way replace or supersede any municipal, county, state, or federal requirements or regulations related to stormwater management. You should check with all appropriate regulatory authorities before relying upon this guide to plan or implement any and all stormwater management practices on your property.

Lawn Care Practice 6. Maximize use of slow release N fertilizer.

Less nutrient loss occurs when slow release fertilizer products are used during the growing season, compared to water soluble formulations. Slow release fertilizer is typically shown on fertilizer products as water insoluble nitrogen (WIN), and can range from 20 to 50% of the total nitrogen product. You can shop for the fertilizer product with the greatest percentage of WIN. Avoid using in late fall as they may release nitrogen when the grass is dormant or frozen.

Lawn Care Practice 7. Set Mower height at 3 inches or taller.

Maintaining taller grass produces a deeper and more extensive root system, increasing nutrient uptake and reducing runoff. The deeper roots also capture moisture during times of drought, suppress weeds and increase turf density.

Lawn Care Practice 8. Immediately sweep off any fertilizer that lands on a paved surface.

Rotary spreaders are the most common method to apply fertilizers and can broadcast fertilizer granules near the edge of the lawn, street or driveway, where they can be subsequently washed off in a rain storm. Sweep up wayward granules before they have a chance to get into gutters and storm sewers. If you use a rotary spreader, purchase one with a deflector shield to prevent spraying fertilizer on the street, driveway or sidewalks.

Lawn Care Practice 9. Do not apply fertilizer within 15 to 20 feet of a stream, pond or other water body and consider managing this zone as a perennial planting, meadow, grass buffer or forest buffer.

The risk of runoff is greatest from lawn areas adjacent to water features such as streams, shorelines, sinkholes and drainage ditches. Consider establishing a riparian buffer of shrubs, trees or perennials along streams and other water courses.

Lawn Care Practice 10. Employ stormwater practices to increase soil porosity and infiltration capability, especially along portions of the lawn that are used to convey or treat stormwater runoff.

A well maintained lawn, with a dense healthy cover of turf grass significantly slows and absorbs stormwater runoff. However, you should consider installing stormwater best management practices where runoff is causing problems. Rain gardens, rain barrels, and bioswales help lawns infiltrate excess stormwater.

Second, take a "reduced rate and monitor" approach. For this approach, follow the nitrogen application rates on the fertilizer bag label and reduce them by one-third to a half, and monitor the results. If lawn quality starts to fall below acceptable levels, re-apply at the reduced rates.

Third, fertilize as the Penn State Extension recommended rate (3.0 to 3.5 pounds per 1,000 square feet of nitrogen per season), but split into 3 or 4 small doses during the growing season (for example, early spring, late spring, late summer and mid-fall). This will get you to an accepted application rate of less than a pound of nitrogen per 1000 square feet for each individual application.

Most bagged fertilizers in Pennsylvania have already removed phosphorus from their products, except for "starter fertilizers" used to establish grass seed in new lawns. If your soil tests show a phosphorus deficiency, ask your lawn care professional for recommendations on how to provide the phosphorus your lawn needs.

Lawn Care Practice 4. Retain clippings and mulched leaves on the lawn and keep them out of streets and storm drains.

Use a mulching mower to return grass clippings and leaves to your lawn. Lawn clippings are an important nutrient source for lawns, as well as an important source of organic matter which enhances stormwater infiltration, soil health and water retention. Nitrogen fertilization can be reduced without decreasing turf grass quality when clippings are left to decompose and return to the lawn.

Lawn clippings are high in nutrients and should be treated as if they were a fertilizer. You should keep lawn clippings and leaves on your lawn, and out of the gutter, street or storm drain system, regardless of whether you fertilize or not. In addition, the amount of nutrients supplied by lawn clippings and mulched leaves should be accounted for when assessing fertilizer needs.

Lawn Care Practice 5. Do not apply fertilizers before spring green up or after the grass becomes dormant.

The risk of pollution by leaching or surface runoff is greatest during the seasons of the year when the grass is dormant. Avoid applying fertilizer in the late fall or winter. In spring, wait until the grass begins to green.

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Section 1: Introduction

What is Stormwater Runoff?

Photo by Matt Royer, Penn State

Stormwater runoff is precipitation (rain or snowmelt) that flows across the land. Stormwater may infiltrate into soil, discharge directly into streams, water bodies, or drain inlets, or evaporate back into the atmosphere.

In the natural environment, most precipitation is absorbed by trees and plants or permeates into the ground, which results in stable stream flows and good water quality.

Photo by Matt Kofroth, LCCD

Things are different in the built environment. Rain that falls on a roof, driveway, patio or lawn runs off the surface more rapidly, picking up pollutants as it goes. This stormwater runoff flows into streams or storm drains that discharge into waterways like the Little Conestoga Creek, the Susquehanna River and eventually the Chesapeake Bay.

Photo by Kristen Kyler, Penn State

Why Can Stormwater Runoff Be a Problem?

Poorly managed stormwater runoff can cause a host of problems. These include:

- **Flooding.** As stormwater runs off roofs, driveways and lawns, large volumes quickly reach streams, causing them to rise quickly and flood, instead of a natural slow and steady water rise. When more impervious surfaces exist, flooding occurs more rapidly and can be more severe, resulting in damage to property and people.
- **Pollution.** Stormwater running over roofs, driveways, roads and lawns will pick up pollutants such as oil, fertilizers, pesticides, dirt/sediment, trash, and animal waste. These pollutants "hitch a ride" with the stormwater and flow untreated into local streams, polluting our waters.
- **Stream Bank Erosion.** When stormwater flows into streams at unnaturally high volumes and speeds, the power of these flows can cause severe stream bank erosion. Eroding banks can eat away at streamside property, create dangerous situations, and damage natural habitat for fish and other aquatic life. This erosion is another source of sediment pollution in streams.

Photo by Matt Kofroth, LCCD

Here are the EPA Expert Panel's recommendations for growing and maintaining a Bay-friendly lawn:

Lawn Care Practice 1. Consult with the local extension service office, certified plan writer or applicator to get technical assistance to develop an effective urban nutrient management plan for the property, based on a soil test analysis.

The precise lawn care prescription should be based on site-specific recommendations that take into account soil properties, the type of grass species, the age of the lawn, and other factors. Professional expertise is essential to develop an effective plan. Look for professionals who are Pennsylvania Certified Horticulturists or Landscape Industry Certified.

Lawn Care Practice 2. Maintain a dense vegetative cover of turf grass to reduce runoff, prevent erosion, and retain nutrients.

Dense vegetative cover helps to reduce surface runoff which can be responsible for significant pollution from the lawn, regardless of whether it is fertilized or not.

If your lawn does not have a dense turf grass cover, identify the factors responsible for the poor turf cover, and implement practices to improve it (e.g., tilling, soil amendments, fertilization or conservation landscaping).

Lawn Care Practice 3. Per the plan developed by your local extension agent or your lawn care professional, follow one of three fertilizer application strategies: (1) choose not to fertilize; (2) reduce rate and monitor; or (3) apply less than a pound of nitrogen per 1000 square feet per each individual application.

In order to reduce nutrient runoff from fertilizing your lawn, employ one of three fertilizer application strategies, depending upon the condition of your lawn and your needs and preferences.

First, elect not to fertilize at all. Some lawns, due to their age or natural soil fertility may be able to maintain a healthy, dense cover without additional fertilization. (However, if your lawn is thin, is weed infested or has bare spots, you should consider fertilizing to restore a thick turf grass cover, using one of the other two strategies.)

If installing these stormwater practices is not something you want to tackle, you can take your plan to a landscape professional with experience in designing and implementing these types of stormwater practices. You may want to do some of the work yourself and enlist the help of a professional to do the other part. The choice is up to you.

Please note that this guide focuses on six practices that are fairly simple to plan and construct. There are many other, more complex stormwater best management practices that may be applicable to your property and that you may want to consider. These include bioswales, underground cisterns, drywells, pervious pavement, infiltration trenches and many more. If you are interested in seeing if any of these types of practices are a good fit for your property, you should consult an experienced professional to plan, design and implement them.

Section 5: Healthy Lawn Care Practices

The practices described in this guide are alternatives to maintaining a lawn and go a long way to protecting our streams and the Chesapeake Bay. Yet lawns remain a significant component of the residential landscape, and are important to homeowners for many uses. By properly managing this resource, we can significantly improve water quality in the Bay.

A recent report by the Chesapeake Bay Program of EPA compiled much of the research about lawns and their contribution to pollution in stormwater runoff. Their overall conclusion is that maintaining a dense, vegetative cover of turf grass reduces runoff, prevents erosion and retains nutrients in the turf grass (see "Expert Panel Report"). http://chesapeakestormwater.net/wp-content/plugins/download-monitor/download.php?id=279.

In fact, recent estimates indicate that lawns and turf grass are now the largest "crop" in the Chesapeake Bay watershed, covering more than 3.8 million acres and eclipsing pasture, hay/alfalfa and row crops like corn, soybean and wheat. See Chesapeake Stormwater Network, Technical Bulletin No. 8: The Clipping Point.

- **Threats to Human Health.** Stormwater runoff can carry many toxic pollutants, such as toxic metals, organic compounds, bacteria, and viruses. Polluted stormwater can contaminate drinking water supplies and hamper recreational opportunities as well as threaten fish and other aquatic life.

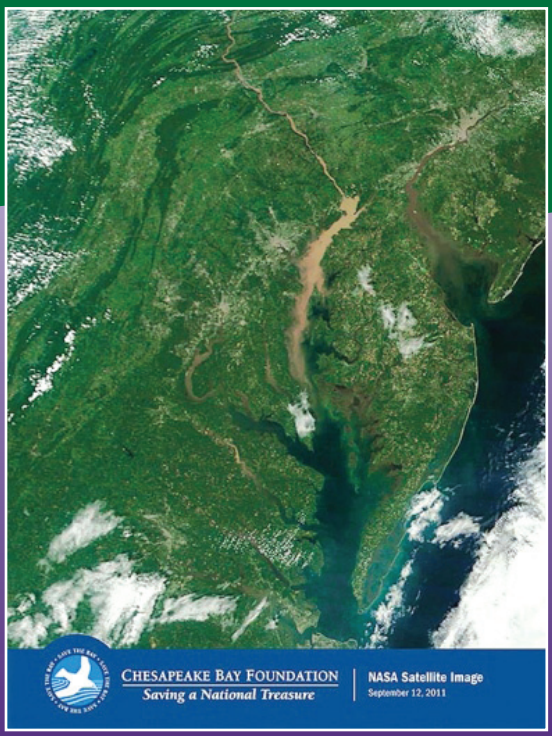
What Can I Do to Help?

As a homeowner, you can help avoid the problems associated with stormwater runoff by:

- reducing impervious areas so that the rain soaks into the ground
- planting native trees and plants which help infiltrate stormwater and increase evaporation and transpiration
- following the lawn care practices described in this guide
- managing stormwater on-site with rain gardens, rain barrels and similar practices
- doing many small things, you have a big impact on improving stormwater management

permeable pavers

Photos by Matt Kofroth, LCCD



Managing stormwater on your property will not only help protect local streams, but will also help clean up downstream waterways including the Chesapeake Bay.

"As of 2011, 17.5 million people were estimated to live in the Bay watershed, up from 17.4 million in 2010. Experts predict the watershed's population will increase to more than 20 million by 2030." *(Chesapeake Bay Program)*

Section 2: Assessing Stormwater on Your Property

In order to better manage stormwater on your property you should first understand how stormwater is generated and flows on your property. Follow these simple steps to figure out where stormwater is generated, how it flows, and approximately how much stormwater comes from your property.

1. Walk your property and map your boundaries and basic features.

Step 1: Draw your property boundaries.

Draw the boundaries of your lot. If you are not sure of your boundaries, you may be able to look this up on your property tax assessment, deed to your house, or at your county's tax office.

Map created by Kara Kalupson, LCCD

Step 2: Draw buildings and other features of your property.

Draw and label the buildings and other features of your property. These include:

Map created by Kara Kalupson, LCCD

- **Impervious areas.** These are hard surfaces on your property that prevent stormwater from soaking into the ground. They include buildings, driveways, parking areas, walkways, decks, patios, or other hard surfaces.
- **Lawn and landscaped areas.** These include any areas with grass or landscaping that you regularly maintain.
- **Natural vegetation.** These are areas of woods, meadow, or other naturally vegetated areas that are allowed to grow natural on your property.
- **Water features.** These could be streams, wetlands, ponds or swimming pools.

You can determine the approximate size of each area by using a tape measure and calculating the square footage of each. Depending on the overall size of your property, you may want to calculate these areas in square feet or convert to acres (1 acre = 43,560 square feet). If your property has no natural vegetation, such as woods or meadows, or water features on it, you can simply subtract the impervious areas from your total lot size to get your total lawn and landscaped area.

Section 4: Implementing Your Stormwater Plan

Congratulations! Your stormwater management plan is complete! You have taken an important step in managing stormwater on your property to help clean up your local stream and the Chesapeake Bay.

Now you are ready to start implementing your plan. If you are a do-it-yourselfer, there are several online resources that provide detailed design and implementation guidance for the six practices discussed in this guide. *Note: Please refer to the disclaimer at the beginning of this guide.*

The Chesapeake Stormwater Network (www.chesapeakestormwater.net) is in the process of developing a homeowner rain garden guide that will provide excellent step-by-step guidance on designing, constructing and maintaining rain gardens and other practices. Refer to the Chesapeake Stormwater Network's website often for updates as this guide is finalized.

In the meantime, here are some other online guides you can reference:

RAIN GARDENS

Rain Gardens: A How-To Manual for Homeowners (University of Wisconsin Extension)
http://learningstore.uwex.edu/assets/pdfs/GWQ037.pdf

Rain Gardens in Connecticut: A Design Guide for Homeowners (UConn Cooperative Extension System)
http://nemo.uconn.edu/publications/rain_garden_broch.pdf

Rain Garden Templates for the Chesapeake Bay Watershed (Low Impact Development Center)
http://www.lowimpactdevelopment.org/raingarden_design/templates.htm

RIPARIAN BUFFERS

Riparian Forest Buffer Guidance (PA Department of Environmental Protection)
http://www.elibrary.dep.state.pa.us/dsweb/Get/Document-82308/394-5600-001.pdf

TREE PLANTING

Planting and After Care of Community Trees (Penn State Extension)
http://pubs.cas.psu.edu/freepubs/pdfs/uh143.pdf

PATrees.org: The Free Resource Guide
http://www.patrees.org

Pervious Paver

NATIVE MEADOWS

Meadows and Prairies: Wildlife-Friendly Alternatives to Lawn (Penn State Extension)
http://pubs.cas.psu.edu/FreePubs/pdfs/uh117.pdf

PERVIOUS PAVERS

New Hampshire Homeowner's Guide to Stormwater Management Do-It-Yourself Stormwater Solutions: Pervious Walkways & Patios (NH Department of Environmental Sciences)
http://des.nh.gov/organization/divisions/water/stormwater/documents/perv-walkw-patios-fs.pdf

RAIN BARRELS AND CISTERNS

Rain Barrel Installation Instructions (Rutgers Cooperative Extension)
http://water.rutgers.edu/Stormwater_Management/rainbarrelbrochure.pdf

Build Your Own Rain Barrel (Chesapeake Bay Foundation) http://www.cbf.org/Document.Doc?id=30

Rainwater Harvesting: Guidance for Homeowners (North Carolina Cooperative Extension)
http://www.ces.ncsu.edu/depts/agecon/WECO/documents/WaterHarvestHome2008.pdf

Use this summary chart to help you select one or more stormwater practices that are right for your property.

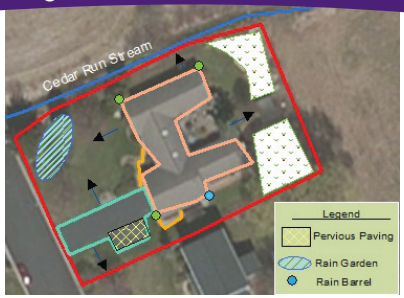
	Rain Garden	Riparian Buffer	Tree Planting	Native Meadow	Pervious Pavers	Rain Barrel/ Cistern
Space Required	Minimum Size: 50 – 200 ft^2 surface area 5 – 10 ft wide 10 – 20 ft long 3 – 8 inches deep	The wider the better for water quality benefits. Lot size and configuration will impact buffer width	Consider space needed for canopy spread	Not a factor	As needed to accommodate walkway, patio, or driveway	Not a factor
Slopes	Not usually a limitation, but a design consideration. Locate down slope of building foundations	Not usually a limitation, but a design consideration	Not usually a limitation, but a design consideration	5% or less	Not a factor	Not a factor
Depth to Water Table	1 – 4 ft clearance	Not a factor if correct species are planted			1 – 4 ft clearance	Not a factor
Depth to Bedrock	1 – 4 ft clearance	1 – 4 ft clearance	1 – 4 ft clearance	Not a factor	1 – 4 ft clearance	Not a factor
Building Foundations	Minimum 10 ft down slope from building foundations				Not a factor	Not a factor
Maintenance All practices should be inspected seasonally and after major storm events.	Low: Weeding and watering in first 2 years. Some thinning in later years.	Low to Moderate: Maintain tree tubes or cages. Spray and mow between trees for first 4-5 years. Control invasive plants. Water as needed.	Low to Moderate: Maintain tree tubes or cages. Spray and mow between trees for first 4-5 years. Control invasive plants. Water as needed.	Low to Moderate: Mow twice annually for first two years. Control invasive plants.	Moderate to High: Grass between pavers may have to be mowed. Inspect for signs of clogging. Pressure wash and replace pea stone as needed.	Low: Clean screen/ filter regularly. Clean gutters twice annually. Monitor during severe storms for overflow. Empty before winter months.

Chart adapted from the New Hampshire Homeowner's Guide to Stormwater Management Do-It-Yourself Stormwater Solutions. NH Department of Environmental Services (March 2011, revised February 2012).

Please remember to call PA ONE CALL before digging underground so you know where your underground utilities are located (ie electrical, sanitary sewer, water, etc.).

4. List and map your chosen stormwater best management practices.

Now that you've chosen stormwater management practices for your property, list them on the stormwater management plan template provided in Appendix A. Draw them on your property map. Again, you can either hand draw them on the graph paper provided in Appendix A, or continue to follow the Computer Mapping Tutorial in Appendix B to map your chosen stormwater practices on your computer generated property map.



Map created by Kara Kalupson, LCCD

Photo by Matt Royer, Penn State

2. Assess and map your stormwater flow.

The next step is to show how and where runoff flows on your property and identify any problems it may be causing. Common stormwater problems may include large puddles ("ponding"), damp basements, soil erosion, and collapsing stream banks. The ideal time to assess stormwater flow would be during or immediately after a rain storm. Look for and map the following:

- **Roof downspouts.** Indicate the location of roof downspouts and the direction stormwater flows from the downspouts.
- **Stormwater flow paths.** Using arrows, show the direction of stormwater flow off of impervious surfaces. If you have any areas where stormwater collects, such as drainage swales or ditches, show this and label them as such.
- **Areas of ponding.** Indicate locations of standing water or ponding on the map.
- **Gullies or ditches from soil erosion.** Indicate any areas of soil erosion which have resulted in gullies or ditches. This may appear within existing drainage swales or channels, and would be good to note on your assessment.

Map created by Kara Kalupson, LCCD

If you have multiple downspouts, drainage channels, ponding areas etc., organize your map and assessment plan by numbering them.

Photo by Matt Kofroth, LCCD

3. Estimate how much stormwater is generated on your property.

Photo by Margaret Kyler

The amount of stormwater runoff generated from your property depends on how long and how hard it rains, the slope of your property, the type and quality of the soils, the amount of impervious surface on your property, and other factors. Nevertheless, there is a simple calculation you can use to estimate how much stormwater runoff your property generates during a typical rainstorm.

The majority of annual rainfall in south-central Pennsylvania comes in the form of small storms of one inch or less. These small storms carry most of the pollutants that impact water quality, and thus the stormwater generated by your property for the one inch storm is a good measure of typical stormwater runoff. Use the following chart to determine how much stormwater is generated by the impervious area on your property:

Square Feet of Impervious Area	Gallons of Runoff to be Managed
500 or less	less than 312
501 – 1,000	312 – 624
1,001 – 2,000	624 – 1,246
2,001 – 3,000	1,246 – 1,869
3,001 – 4,000	1,869 – 2,492
4,001 – 5,000	2,492 – 3,115
5,001 – 10,000	3,115 – 6,231
10,001 – 20,000	6,231 – 12,462
20,001 – 43,000	12,462 – 26,793

The above numbers were calculated using the following formula:

(Total square feet of impervious area) x 0.0833 x 7.48 = _____ gallons of runoff

Use this formula if you want a more accurate calculation of the runoff generated from your impervious area.

0.0833 is to covert feet to inches • 7.48 = number of gallons per cubic foot

3. Choose where to locate the stormwater best management practices on your property.

Now that you know about your property and the type of practices you would like to install, it's time to choose the right location for the practices. Some considerations in your planning are:

- **Ponding Water.** Many stormwater practices encourage water to infiltrate into the soil (such as rain gardens and pervious pavers). Where water ponds on your property, water is unable to infiltrate. Areas that are often saturated are not appropriate places to put these practices.

(Note- if you have an on-lot sanitary septic disposal system and an area is permanently wet near this system, the septic system may be failing. The disposal system should be evaluated and fixed before any other practices are installed.)

- **Depth to bedrock.** You do not want to construct infiltration practices where bedrock is visible or is close to the surface.
- **Proximity to foundations.** You should also avoid constructing infiltration practices within 10 feet of building foundations.
- **Location of underground utilities.** Do not construct infiltration practices near septic systems or drinking water wells. Also avoid any utilities like electric, cable, water, sewer, and gas lines. (make sure to use the PAONE-CALL system to locate underground utilities)
- **Slope.** Depending on the practice, a steeper slope may prohibit siting, or it may be something that needs to be taken into account during the design stage. Consult the chart on the next page for guidance.
- **Soil percolation.** Since rain gardens and pervious pavers are designed to infiltrate stormwater into the ground, the soil in the location of the rain garden or pervious pavers must be able to drain. When considering these practices, you should conduct a simple percolation test where you would like to locate them:
  - Dig a 1 foot deep hole and fill with water.
  - Allow the water to moisten soil and drain completely. If water is still in the hole after 24 hours, choose a different location.
  - Fill the hole with water a second time and place a ruler in the hole. Note the water level and time.
  - After 15 minutes, re-measure the water level. Multiply the change in water level by 4 to get the number of inches of infiltration per hour.

Photos by Kristen Kyler, Penn State

2. Factors to consider when choosing stormwater best management practices for your property.

Photo by Dick Brown

Here are some considerations that might help you decide which practices you would like to install on your property.

- If you would like to enhance your landscaping with flowers and other attractive plants consider a rain garden or a native meadow.
- If you want to reduce the amount of time it takes to mow the lawn, a rain garden or native meadow would help accomplish this goal.

Photo by Matt Kofroth, LCCD

- If you would like to see more butterflies, a rain garden or native meadow can provide excellent butterfly habitat.
- If you have outdoor water needs (water for a vegetable garden, to water your lawn, or to wash your car) consider a rain barrel.
- If you don't have very much yard to work with, a rain barrel is probably the best choice.
- If your driveway needs repaved, consider using pervious pavers instead of traditional pavement.
- If you would like to give your patio a new look, consider pervious pavers.

Photo by Andrew Gavin, SRBC 1

- If you would like to restore forested conditions on a portion of your property, consider tree planting (or forested riparian buffer if the area to be reforested is along a stream).
- If a stream is running through your property, installing a riparian buffer would be very beneficial.
- If you want to cut down on air conditioning costs during the summer, consider planting some trees on your property.

Section 3: Developing Your Stormwater Management Plan

Now that you know what areas of your property generate stormwater when it rains, how the runoff flows, and what areas generate the most amount of runoff, you can start thinking about adding stormwater management practices to your property to better manage runoff.

1. Types of stormwater best management practices.

Many management practices exist for handling stormwater runoff. This guide suggests six of the simpler, easier to implement practices. Each practice is introduced briefly in this section so you can consider which ones are right for you.

Rain Garden

A depressed garden that uses mulch, soil, and deep-rooted native plants to capture, absorb, and infiltrate stormwater.

Photo by Matt Kofroth, LCCD

Benefits
- Manages stormwater and filters pollutants
- Wildlife habitat
- Little maintenance
- Adds beauty

Negatives
- Plants can take 2-3 years to establish
- More maintenance required in first few years

Cost
$$

Maintenance
- Low once plants established
- Weeding and watering in first two years.
- Some thinning in later years

Aesthetic appeal
- Ranges from medium to high
- Can customize based on plant selection.

Implementation Considerations
- Construct downslope of runoff to be captured
- Plant in spring or fall
- Locate at least 10 feet from building foundations

Riparian Buffer

Planting native trees and shrubs along streams and wetlands to restore the streamside area to forested conditions. These "riparian buffers" filter runoff and have numerous water quality benefits.

Photo by Matt Kofroth, LCCD

Benefits
- Increases infiltration and groundwater recharge
- Improves water quality
- Controls erosion & sedimentation
- Provides wildlife habitat

Negatives
- Not as effective on steep slopes
- More difficult to implement than some other practices

Cost
$

Maintenance
- Low once native plants are established
- Weeding and watering in first two years
- Some plant thinning in later years
- Regularly remove debris and excessive sediment accumulation

Aesthetic appeal
- Ranges from medium to high
- Higher aesthetic appeal than conventional stormwater conveyances

Implementation Considerations
- Plant in spring or fall
- Locate at least 10 feet from building foundations

Tree Planting

Planting native trees and shrubs to restore a portion of your property to forested conditions.

Photo by Matt Royer, Penn State

Benefits

- Increases infiltration and evapotranspiration of storm-water
- Filters pollutants
- Requires little maintenance
- Provides wildlife habitat
- Large canopy of native trees maximizes benefits

Negatives

- Takes many years before trees grow to provide maximum benefit
- Regular maintenance is required where invasive plant species exist
- Must guard against deer browsing and vole damage

Cost

$/$$

- Varies, depending on species, size, and type of tree planted

Maintenance

- Maintain tree tube/stakes or cages
- Spray and mow between trees at least twice a year during first 4 to 5 years

Aesthetic appeal

- High aesthetic appeal, as trees add interest, structure, color, and wildlife to property

Implementation Considerations

- Plant in spring or fall
- Watering may be necessary after planting during dry weather (25 gallons/week)

"A Wharton School of Business study found that new tree plantings in a Philadelphia neighborhood increased surrounding property values by approximately 10%."

(Wachter 2004)

Native Meadow

An area planted with native grasses and wildflowers and maintained as a natural area. "No mow" areas can also develop into meadow areas.

Photo by Dick Brown

Benefits

- Increases infiltration and evapotranspiration of stormwater
- Filters pollutants
- Requires little maintenance
- Provides wildlife habitat

Negatives

- Site preparation (including turf grass removal) is required before planting
- Meadows may conflict with local weed ordinances

Cost

$

- Native seed mixes vary depending on type of species and amount of variety desired

Maintenance

- Mow twice a year for first two years
- Mow annually
- Control invasive plant species

Aesthetic appeal

- High aesthetic appeal, as tall grasses and wildflowers add interest, structure, color and wildlife to property

Implementation Considerations

- Plant in spring
- Monitor and control invasive species

Pervious Pavers

Impervious building materials, such as stone, concrete or brick, laid with space in between to allow for pervious areas (gravel, sand or vegetation) in driveways, parking areas, or walkways.

Photo by Matt Kofroth, LCCD

Benefits

- Increases infiltration and groundwater recharge
- Reduces volume and rate of runoff

Negatives

- More labor intensive to install than other practices
- Nonconventional option to pavement

Cost

$$

- Can save by installing permeable pavers
- May need to excavate and install sub base, increasing costs

Maintenance

- Moderate to high maintenance
- Grass between pavers may have to be mowed
- Inspect for signs of clogging
- Pressure wash and replace pea stone as needed

Aesthetic appeal

- Ranges from low to medium
- Artistic designs with layout can increase aesthetic appeal

Implementation Considerations

- Need to install permeable sub base
- Locate at least 10 feet from building foundations

Rain Barrel/Cistern

A barrel that captures rainwater from a roof and stores it for later use, such as watering plants or gardens. A cistern is a larger container that does the same thing.

Photo by Fritz Schroeder, Live Green

Benefits

- Conserves water
- Captures and reuses stormwater

Negatives

- Minimal volume captured
- Poor construction or maintenance can result in mosquitoes

Cost

$

- Very minimal cost as DIY project
- Can save dollars because of reduced potable water usage

Maintenance

- Clean screen/filter regularly
- Clean gutters twice annually
- Monitor during severe storms to avoid overflow
- Empty before winter months

Aesthetic appeal

- Ranges from low to medium depending on type of barrel used

Implementation Considerations

- Place on level surface
- Full rain barrel weighs 400 lbs

Notes:

Appendix A: Stormwater Management Plan Template

You can use this template to create your stormwater management plan.

Map

First, use the grid paper provided to hand draw your stormwater management plan map. Or, follow the tutorial provided in **Appendix B** to create a computer generated aerial map.

If you hand draw your map, it is suggested you use one ink color to draw existing conditions and a different color to draw your proposed stormwater management practices.

Plan Details

Second, fill in the template to create the details of your plan. For both existing conditions and proposed stormwater management practices, be sure to label all features on your map with numbers that correspond to the plan template.

Stormwater Management Plan

Property Owners Name: _____

Property Address: _____

Municipality: _____ County: _____

Watershed: _____ (example: Little Conestoga)

Name of stream into which stormwater flows: _____ (example: Swarr Run)

EXISTING CONDITIONS

IMPERVIOUS AREAS		
Buildings		
Number	Description (house, shed, etc)	Square Feet
Driveways and Walkways		
Number	Description (driveway, back walkway, front walkway, etc)	Square Feet
Other Hard Surfaces		
Number	Description (patio, deck, etc)	Square Feet
Total Impervious Area:		

LAWN AND LANDSCAPED AREAS		
Number	Description (front yard, back yard, flowerbed, etc)	Square Feet
Total Lawn and Landscape Area:		

NATURAL AREAS		
Woods		
Number	Description (back woodlot, side woods, etc)	Square Feet
Meadow		
Number	Description (back meadow, front meadow, etc)	Square Feet
Total Natural Area:		

Note any water features (streams, wetlands, ponds, etc) on your property:

_____

_____

_____

_____

_____

_____

_____

_____

Total Stormwater Generated in a 1 inch rainstorm:
(Total Impervious Areas x 0.0833 x 7.48)

_____ft^2 x 0.0833 ft x 7.48gal./ft^3 = _____ gallons

Appendix B: Computer Mapping Tutorial

1. Open Internet Explorer.
   Go to Google maps (www.google.com/maps) or Bing maps (www.bing.com/maps) to access an aerial map of your property.

2. Type in your property address.
   Use the zoom functions to zoom in as close as you can to your property, making sure your entire lot is shown on the map. Make sure the "Satellite" or "Aerial" function is turned on so that the map is shown in aerial photography format.

3. Press "Print Screen", Paste.
   In the upper right corner of your keyboard press "Print Screen." Paste the screen shot in the program of your choice to crop and edit. We recommend Power Point, Microsoft Word or Paint.

4. Use drawing tools to add your different elements.
   Using the "shapes" or other drawing tools available you can add your areas affected by stormwater and your new BMPs. The arrows and freeform tools are particularly useful. Be sure to use different colors for different elements of your map. Text boxes can be used to add labels or a legend.

5. Save and print your map.
   When you are done, you can save your map as a .pdf or print it to go with your written stormwater management plan.

Rain Garden		
Number	Description (front yard, back yard, etc)	Square Feet
Riparian Buffer		
Number	Description (tributary, main stem of creek, wetland, etc)	Linear Feet
Tree Planting		
Number	Description (backyard woods, side woods, etc)	Square Feet
Native Meadow		
Number	Description (side yard meadow, back yard meadow, etc)	Square Feet
Pervious Pavers		
Number	Description (front walkway; back patio etc)	Square Feet
Rain Barrel		
Number	Description (side house barrel, shed barrel, etc)	Gallons

STORMWATER FLOW	
Downspouts	
Number	Description (front house, back house, shed, etc)
Drainage Swales	
Number	Description (side yard swale, back yard swale, etc)
Areas of Ponding	
Number	Description (side yard ponding, back yard ponding, etc)

Note any areas of gullying or erosion or any other areas of concern:

gement Plan Map