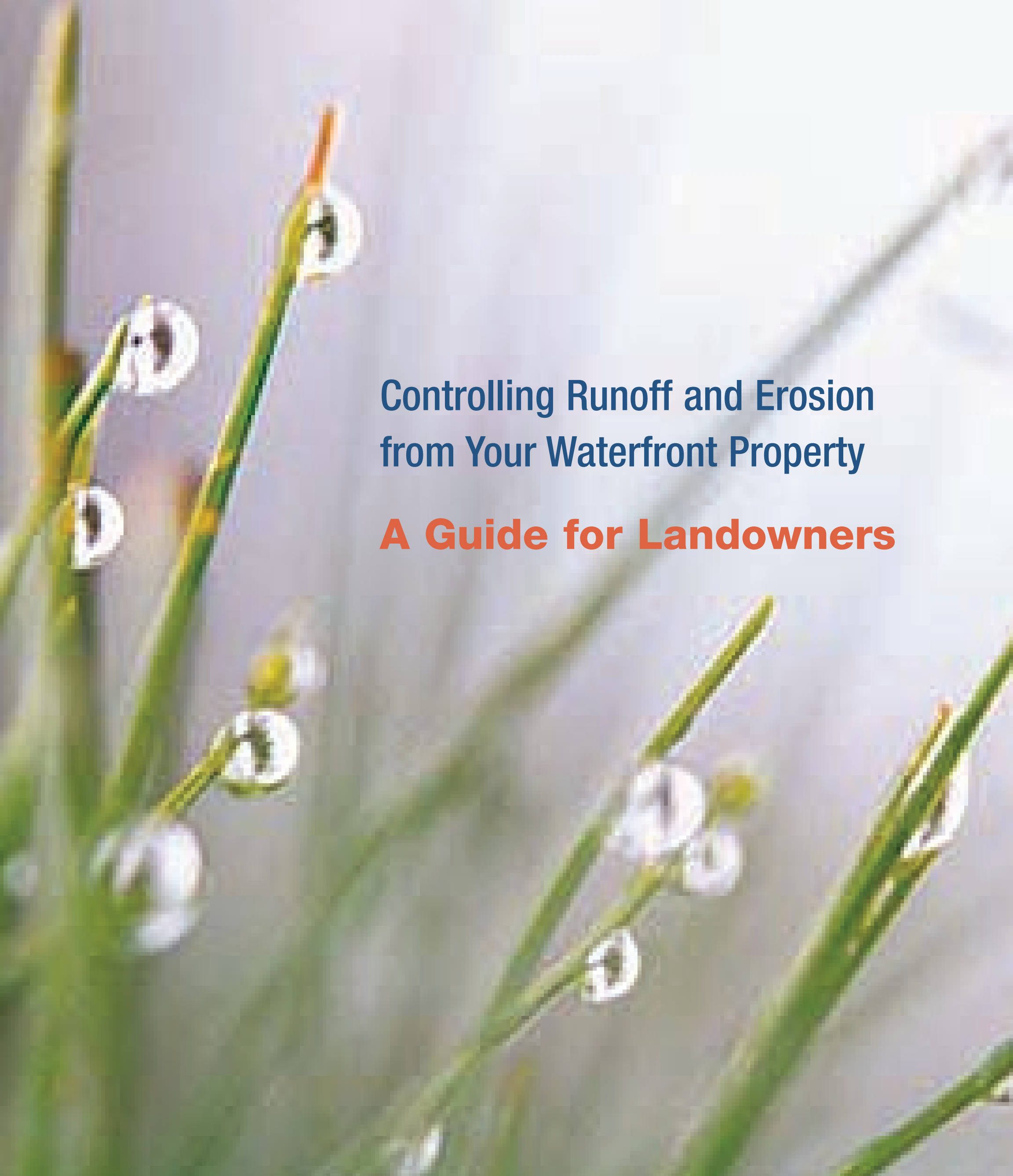

Controlling Runoff and Erosion from Your Waterfront Property

A Guide for Landowners

A project of

Bayfield County Land and Water Conservation Department
Burnett County Land and Water Conservation Department
Balsam Lake Protection and Rehabilitation District
Harmony Environmental
Wisconsin Department of Natural Resources

June 2008

This guidebook provides landowners with practical, how-to information to address runoff and erosion from waterfront property. The descriptions and illustrations walk the reader through methods to assess runoff concerns and to address them through minimizing, diverting, and infiltrating runoff water.

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A Few Definitions

Runoff is the portion of the rain and snow falling on the surface of the earth that doesn't soak into the soil and ultimately flows to lakes and streams. Runoff frequently picks up and carries pollutants as it travels across disturbed and impervious areas.

Disturbed areas are areas with bare soil that are prone to erosion. Construction, foot traffic, runoff water, and other forces create disturbed areas.

Impervious areas are hard, non-porous surfaces like roofs, paved driveways, and cement sidewalks. Impervious areas do not allow water to infiltrate.

Infiltration is when water soaks into the soil.

Erosion is the wearing away or loss of soil particles. Erosion is caused when soil particles are dislodged by water falling on or running across bare soil. Soil particles are carried by runoff and finally deposited in a lake or a stream, or sometimes in a resting place along the way.

Additional definitions are found throughout this book.

Introduction

Runoff and erosion – why should I care?

Bottom line is you should care because how you and your neighbors manage your properties has an impact on lake water quality. Runoff from waterfront property carries pollutants such as sediment and phosphorus to the lake. Where there is erosion, pollutant concentrations are even higher.

Keep in mind that many city storm drains flow to lakes and streams. So, even if you don't own waterfront property, runoff water from your lot may carry pollutants to local lakes and rivers. In essence, your property impacts the lake just as much as waterfront property.

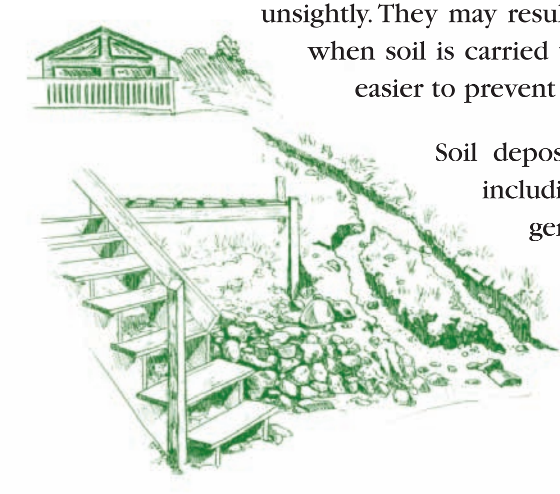
This booklet provides practical guidance for controlling runoff and reducing erosion from your property. The information focuses on reducing erosion caused by runoff that flows from your property to the water. It does not address erosion caused by waves against the shoreline.

This guidebook expands upon one first developed for waterfront property owners in Burnett County, Wisconsin. Burnett County is located mostly in the Sand Barrens of Northwest Wisconsin. The county's sandy soils erode easily – especially when vegetation is removed. On a more positive note, sandy soils also provide great opportunities for reducing erosion by encouraging infiltration – allowing runoff water to soak into the soil.

This edition is expanded in scope to cover more areas of the state and more types of soil. It will guide you through a process to evaluate your property and consider ways to maximize infiltration and reduce runoff. You will find instructions for diverting water and for sizing and establishing infiltration areas. The end result? Cleaner water in your lake!

Impacts of Erosion

Erosion on waterfront property can be a serious problem both for the property owner and the lake or river ecosystem. Gullies or large eroded channels are



unsightly. They may result in loss of depth of water frontage when soil is carried to the lake. It is usually cheaper and easier to prevent rather than repair erosion problems.

Soil deposited in the water carries nutrients including phosphorus, the nutrient that triggers algae blooms in most Wisconsin lakes. Sediments bury fish and wildlife habitat such as walleye spawning beds. Sediment accumulation may also lead to dense aquatic plant growth.

Erosion of sediment to lakes and rivers is especially problematic during construction activities. Erosion rates from construction sites where soil is bare and runoff is uncontrolled can be up to 1000 times greater than from a naturally vegetated site. A one-acre naturally vegetated site may loose about .2 tons or 400 pounds of sediment each year. An unprotected one-acre construction site may loose 200 tons or 400,000 pounds of soil each year. Erosion is of particular concern when it occurs near lakes and rivers because that's where the sediment and nutrients end up.

Impervious surfaces like roofs and driveways can make the problem worse because they don't allow water to soak into the ground creating more runoff. The increased amount of runoff water has additional force to erode soil, which may create gullies – deep, eroded trenches like the one shown above.

Problems Resulting from Erosion

- Unsightly gullies and loss of property
- Pollutants carried to the lake or stream
- Loss of fish and wildlife habitat

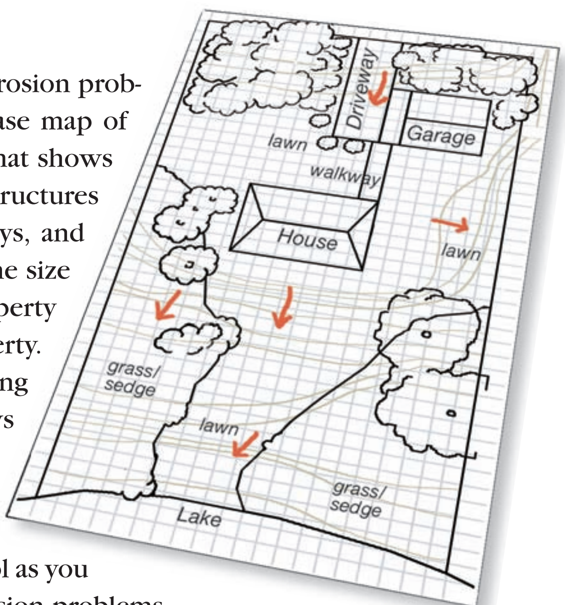
What to do on your lot

Assess the Problem

Look for areas where erosion is occurring. Runoff water is likely the cause of erosion. Right after a big rainstorm is the perfect time to look at erosion patterns. Can you see the pathway of water flow? Are leaves and pine needles or groundcover vegetation removed by flowing water? Follow the path of water uphill to its source. Is a channel created by runoff from a roof, driveway, road, or other hard surface? Don't ignore small channels and eroded areas. These spots frequently turn into bigger problems. Erosion that you identify may get worse if you increase the hard surfaces on your lot or if you experience a lot of rain in a short period of time.

Develop a Base Map

You can do a better job assessing your erosion problem and developing solutions with a base map of your property. Start by drawing a map that shows your entire property to scale. Include structures like your house, garage, sheds, pathways, and paved areas. Also measure or estimate the size of uphill areas that drain to your property from a road or your neighbor's property. Look at the direction of water flow during or after a large rain event and add arrows to illustrate the flow on the map. The eroded areas or gullies identified above also give you clues for placing flow arrows. The base map will be a useful tool as you begin to figure out solutions to your erosion problems.



Estimating Drainage Area

The size of the area that flows to a problem area is important information for coming up with runoff solutions. You might need some help with this step. Your local land conservation department or a landscaper might be able to provide assistance.

To do this yourself, keep in mind what we all know, water flows downhill. So, look uphill to find the source of water. This might be easy if the flow is from a roof or a driveway that clearly drains to your problem area. It may be more difficult when there isn't much slope or slope varies from point to point. Look for culverts that drain under roads and driveways. A culvert may carry water from another section of land you haven't considered.

Once you have an idea visually of the drainage, draw the area on the base map, take some measurements and do some calculations. Divide the area into shapes so area is easy to calculate. (Here's where you get to use your sixth-grade math!)

Area of a rectangle = length X width
Area of a triangle = base X 1/2 height
Area of a circle = π r2
(where π is 3.14 and r is the radius or half the distance across the circle)

Figure Out a Solution

The next step to controlling runoff is to investigate and select options to minimize, divert, and infiltrate runoff water. Each lot is unique. A variety of tools may be needed to address the problem. If erosion problems are minor, start with simple practices like planting native vegetation and diverting water to relatively flat areas with good vegetative cover. Moderate to severe erosion will probably require more complex, structural practices. If the practices you have installed don't work the first time, don't give up. Reconsider patterns of water flow and erosion and adjust your plan of action.

Concepts and tools to consider are described on the following pages. A combination of diversion and infiltration of water is generally needed, and may need to be installed both above and below buildings. The drawings in this handout are conceptual and the suggestions are general. Seek professional assistance from an engineering firm or your Land and Water Conservation Department for more detailed recommendations.

Professional assistance is recommended where one or more of the following occur:

- Construction occurs on slopes >20%
- More than 20,000 square feet are cleared
- More than two acres drain to an eroded area
- Severe gully erosion (at least one foot deep) is present
- You are not comfortable implementing solutions on your own
- You have tried the suggestions in this guidebook, and your problems remain

Minimize hard surfaces

Hard surfaces and buildings prevent water from soaking into the ground, increasing runoff and erosion. To minimize these nonporous (or impervious) surfaces:

- Use gravel instead of pavement for driveways and sidewalks. Avoid gravel with fines and clay that compact and form an impervious surface such as WI Class 5 gravel. Instead use clean 3/4-inch rock or pea gravel.
- Install stepping stones for a pathway instead of using concrete.
- Avoid compacting soil with heavy equipment. It may take many years for natural processes to restore infiltration rates. Keep heavy equipment on a designated pathway if possible.
- When developing adjacent properties, design development with shared driveways and roads. This may require special zoning approval, easements, and agreements.
- Think small. A structure that covers less surface area will have less of an impact on your lake environment.
- Use porous paving materials.

Before beginning a project in the Shoreland Zone

- Check local and state permitting requirements (WDNR and County Zoning Office).
- Call diggers hotline before excavating (1-800–242-8511 or diggershotline.com in Wisconsin).
- Install temporary erosion control measure, such as silt fence, downhill from the area to be disturbed. This will prevent sediment from entering the water during construction.
- Have a plan to re-vegetate disturbed areas as quickly as possible.

Porous Paving

Porous paving materials are concrete or asphalt blocks with openings or plastic mesh that can be filled with gravel, sand, or soil and sometimes planted with vegetation. Porous, poured concrete is also available from some contractors. Porous paving materials allow water to soak into the soil.

It is important to note that the surface below the paving material must be permeable. Many times this means that low permeable soils must be removed, and a sand or gravel base installed. Topsoil is added to the surface (top 1 to 3 inches) when grass is planted among the paver grid. Care must be taken during installation to avoid soil compaction. Prevent sediment from accumulating over porous paver materials because sediment will clog the pore spaces that allow infiltration.

Porous concrete sidewalk at the Clam Narrows boat landing in Burnett County.

Concrete porous paving block
Concrete porous paving blocks allow water to soak in when installed on a bed of sand or gravel. Sandy topsoil can be added to the top inch or two of the voids to plant grass, if desired.

Plastic porous paving block
Plastic porous paving blocks are installed on a 6-inch layer of sand, filled with 1 to 2 inches of sandy soil, then planted with lawn grass. They are strong enough to use for temporary parking areas.

Vegetate

Planting to cover bare soil has many benefits. Vegetation helps to reduce erosion by covering the soil, cushioning the impact of raindrops, and slowing runoff water flow. Deep rooted, native vegetation is especially beneficial for reducing erosion and increasing infiltration. Each layer of vegetation provides particular benefits.

Trees and Shrubs

- Cushion the force of raindrops
- Hold rainwater on leaves and branches
- Roots keep soil in place

Grasses and Groundcovers

- Slow runoff flow
- Filter pollutants
- Allow water to soak in along root channels

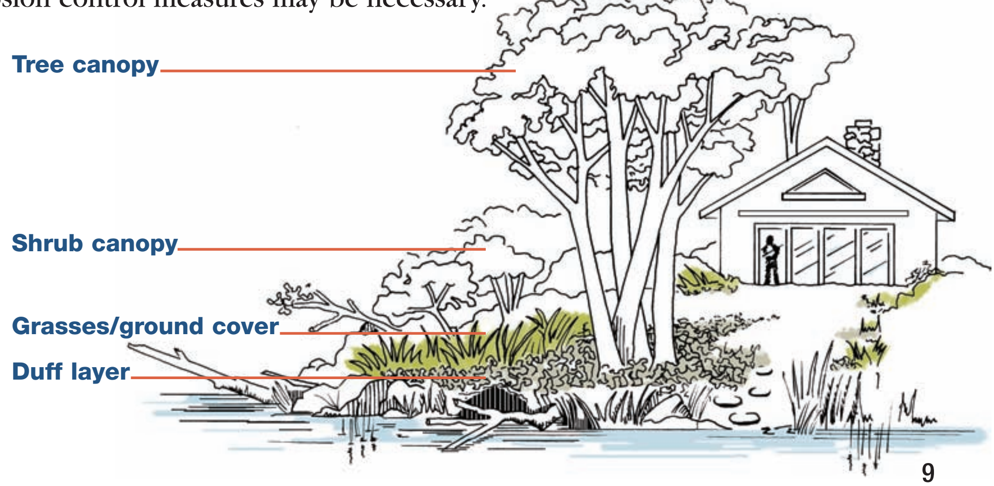
Duff Layer (leaves, small branches, and pine needles on soil surface)

- Covers soil
- Slows runoff flow
- Allows water to soak in

Deep-rooted native shoreline plants stabilize banks and help minimize erosion. Kentucky bluegrass on the far left is a nonnative, common turf grass. *Drawing used with permission of MN DNR.*

Many resources provide guidance for re-vegetation with native plants. A few are listed at the back of this guidebook.

Where vegetation doesn't work to stabilize the soil entirely, additional runoff and erosion control measures may be necessary.



A Few Definitions

Divert means to re-direct runoff water.

Berms are small, mounded rows of earth about 6 to 12 inches high. Berms can also be constructed of concrete, asphalt, or gravel to direct water across a driveway to an infiltration practice.

Drain tile is perforated, smooth high density polyethylene (HDPE) or corrugated plastic pipe. The perforations disperse water as it flows along the length of the pipe.

Channels are depressions or ditches created to carry water to a desired area.

Filter fabric is woven or nonwoven, geo-textile (plastic) with small pore spaces to allow water but not sediment particles to penetrate through the fabric.

Broad-based dips are depressions covered with gravel that divert water across the slope of a driveway.

A **water bar** is a shallow trench with a mound (or berm) to intercept runoff water and provide cross drainage.

Do not transfer problems by diverting water to your neighbor's property! You may need to work together with several neighbors to solve a runoff problem.

Shared Rain Garden

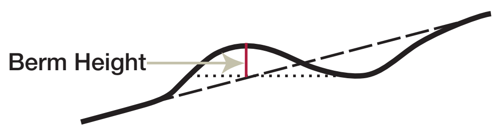
Divert

Runoff should be diverted to a flat area that is well-vegetated with grasses and groundcovers and/or to where the soil is covered with a thick duff layer. Where water doesn't soak in naturally, you can divert water to an infiltration practice as described beginning on page 19. A variety of techniques are available to divert runoff water.

Grading

On some properties the best way to avoid runoff problems is to grade or slope the land away from the lake. This is an especially useful technique to consider before undertaking a construction project. Keep in mind that heavy equipment may compact the soil and discourage infiltration. Slope driveways, sidewalks, and other non-porous surfaces so they drain away from the lake or river. Avoid sloping toward a house or septic drain field.

Berms

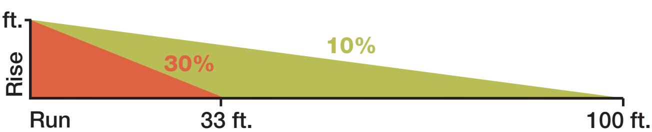


Berm

Berms can be used to direct small amounts of water across a slope or to capture water for drainage to a pipe or infiltration practice. A berm across the top of a slope in very sandy soils will encourage infiltration and prevent erosion along the hillside.

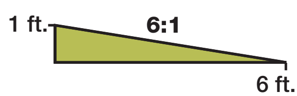
Use berms only on gradual slopes (less than 10 percent). A ten percent slope increases (or decreases) in elevation 10 feet vertically for every 100 feet horizontally as illustrated below.

Measuring Slope by Percentage



Slope Percent = $\frac{\text{Rise}}{\text{Run}} \times 100$

Measuring Slope by Ratio



Slope Ratio = horizontal:vertical

Keep the slopes of the berm gradual. A 4 to 1 slope (four feet horizontal for every one foot vertical) or even more gradual slope is best. Revegetate the berm immediately by seeding with a perennial grass in combination with a quickly germinating annual grass. See recommended seeding rates for annual grasses in the box below. Staking erosion control netting in place over the seeding is recommended. Some Land and Water Conservation Departments have rolls of erosion control netting available for sale.

Seeding rates for quick stabilization

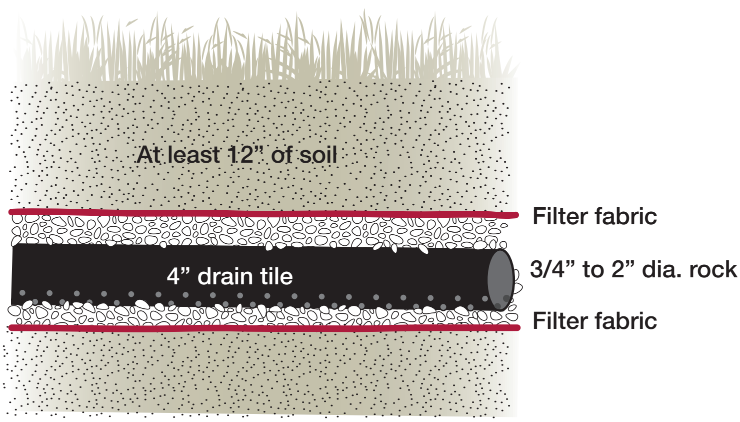
	Rate per 1000 ft^2
Annual rye (after August 1st	0.5 – 1 lb.
Oats (before August 1st)	0.5 – 1 lb.
Canada wild rye	1 oz.

Drain Tile

Drain tile is used in many applications to direct and disperse water. For example, drain tile attached to rain gutter downspouts can be buried to disperse water underground, and come back to the surface to release the remaining water in a well-vegetated or rocked area. Drain tile is also frequently used around a basement to collect and divert water away from the foundation of the house.

A 4- to 6-inch diameter drain tile is generally appropriate for single-lot use. Drain tile is installed with perforations at the bottom. The pipe can be buried at least one foot to prevent compaction and freezing during the spring and fall and should slope slightly to allow water drainage. Surround the drain tile in a bed of 3/4-inch to 2-inch diameter rock to encourage infiltration of the water flowing through the pipe. Line the trench for the rock with filter fabric to prevent sediment from entering the pore spaces between the rock and the drain tile itself. Drain tile is also available with a sock that keeps sediment from entering the pipe. Cover the opening where the drain tile surfaces to prevent small animals and debris from entering the pipe.

Drain tile is perforated, smooth high density polyethylene (HDPE) or corrugated plastic pipe. The perforations disperse water as it flows along the length of the pipe.

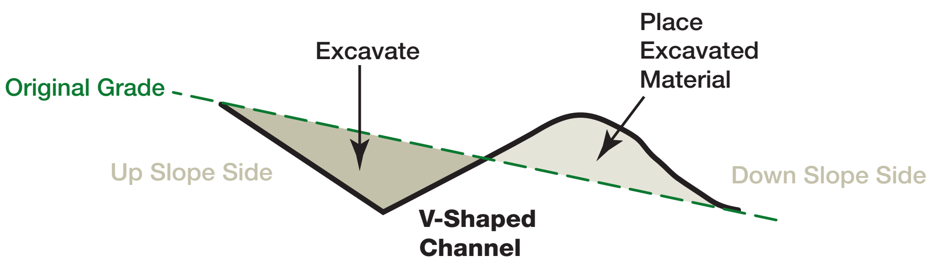


Channels

Channels are generally used where water flow is heavy enough to wash out an earthen berm or where a ditch is more desirable for visual or practical reasons. Because channels are exposed, they are easier to maintain than pipes. Water directed in a channel across a slope, rather than down slope, will flow more slowly and prevent erosion. Two channel configurations are shown below.

Channels can generally be lined with grass where downhill slopes do not exceed four percent and the impervious area that drains to the channel does not exceed 2 acres (90,000 sq. ft.). Remember to consider all areas that flow to the channel in this calculation – both on and off your lot. Stabilize the channel by seeding with annual and perennial grasses followed by installation of erosion control netting.

Where there are larger drainage areas or steeper slopes, it may be necessary to reinforce the channel with rock. A county zoning permit may be required to install rock in the shoreland zone. Install filter fabric beneath rock to keep underlying soil from working its way to the surface. Avoid placing rock in the shoreland setback area (setbacks vary in Wisconsin counties but are generally 75 to 100 feet back from the ordinary high water mark).



Channels are depressions or ditches created to carry water to a desired area.

Driveway and Path Diversions

Erosion frequently occurs along driveways and paths to the lake, especially where slopes are steep. Broad-based dips and water bars placed to divert water at intervals along a driveway or pathway slope will minimize erosion downhill. These diversions must be directed to a well-vegetated area or designed infiltration area to prevent further erosion. Driveway grades should not exceed ten percent.

Driveway or pathway broad-based dips or water bars recommended placement interval for one-foot depth is shown in the table on page 15. Drainage across pathways might be constructed at more frequent intervals with more shallow water bars or dips. For example, place path water bars three times closer together and four inches deep across pathways.

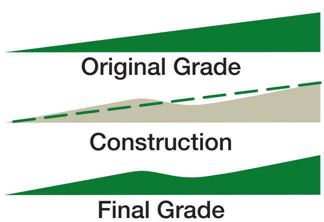
Broad-based Dips are depressions covered with gravel that divert water across the slope of a driveway.

Construct broad-based dips deeply enough to provide adequate drainage and at least the width of the driveway to allow vehicles to pass safely.

Dips should angle downhill at about 30 degrees.

Place a surface of crushed stone or gravel on the dip.

Broad-based Dip Cross-section

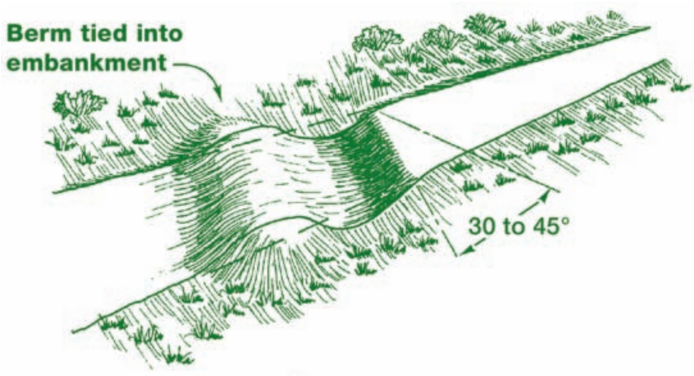


A **Water Bar** is a shallow trench with a mound (or berm) to intercept runoff water and provide cross drainage.

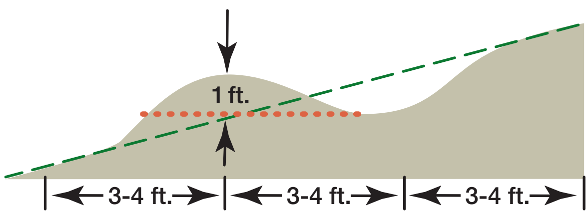
Place water bars angled 30 to 45 degrees downhill with a slope of about 2 percent across the driveway. A 6- to 8-inch berm will redirect water without being difficult to walk or drive across.

Water bars for pathways can also be constructed with treated lumber by creating a channel between two planks.

The slope of the driveway should determine the distance between water bars and broad-based dips. See the table for recommended placement.



Water Bar Cross-section



Recommended distances between drainage structures on driveways

Percent slope of driveway	Distance between water bars (feet)	Distance between broad-based dips (feet)
1	400	500
2	250	300
5	130	180
10	80	150
15	50	130
25+	40	110

Roof Rain Gutters and Downspouts

Runoff from roofs frequently creates erosion. In fact, many of the eroded channels that lead to the lake begin where water falls from rooftops. To control water flow and alleviate this problem, install roof gutters and downspouts and spread or infiltrate the roof water.

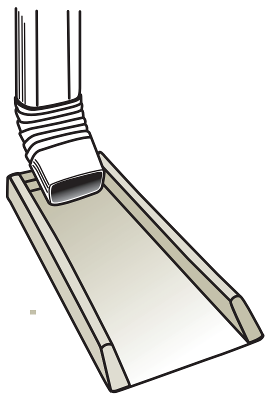
Consider "self-cleaning" or enclosed gutters to prevent clogging from leaves, pine needles and other debris. Cleaning the roof gutters regularly will prevent clogging and keep the water leaving the downspout clean.

Roof gutters will not help to control erosion unless the outflow is managed properly. To effectively prevent erosion, the flow of the water from the downspout must be spread out, diverted to an infiltration area, or sent to a rain barrel.

Outflow Options

Spreaders

Plastic or concrete spreaders placed beneath downspouts will spread outflow in an attempt to produce sheet flow rather than channelized flow. Sheet flow will be produced only if the surface where water flows out is flat. The outflow may need to be reinforced with 1- to 2-inch clean rock underlain with filter fabric.



Spreader

Drain tile

Drain tile will disperse water as it flows along the length of the pipe. Bury the drain tile as described on page 12, and outlet at a well-vegetated, flat area.

Infiltration pit or flat area

Send water to a well-vegetated flat area to soak into the ground or to an infiltration pit as described in more detail on page 23.

Infiltration Areas Where the slope is flat and the soil is sandy, it may be possible to divert water to an area where it can soak in.

Rain Barrels

Many styles of rain barrels are available commercially or you can build one yourself. The photo at right shows a do-it-yourself rain barrel with a hose connected to the overflow hole to release extra water from the barrel. As an alternative, a small diameter hose near the base of the barrel will release water slowly. Be sure this hose discharges water away from the foundation of your house in an area where water can soak into the ground. Cover the barrel to keep small children and animals safe and prevent mosquito breeding. Clean rain barrels at least once each year, and drain before winter. The biggest limit of rain barrels is their capacity. They will fill up quickly in large rain storms.

How big of rain barrel (or how many barrels) do I need?

It depends upon the roof area that drains to the downspout. A one-inch rainfall on a 10 foot by 10 foot roof yields 60 gallons of water. There are about six rainfalls that are at least one inch each summer, and many smaller rainfall events. This is generally a good amount of rainfall to use to estimate the barrel(s) needed.

Calculate your roof runoff volume from a one-inch rain by multiplying the square footage that drains to each downspout by 0.6 gallons. There is no need to consider the slant of the roof, just measure the horizontal distances.

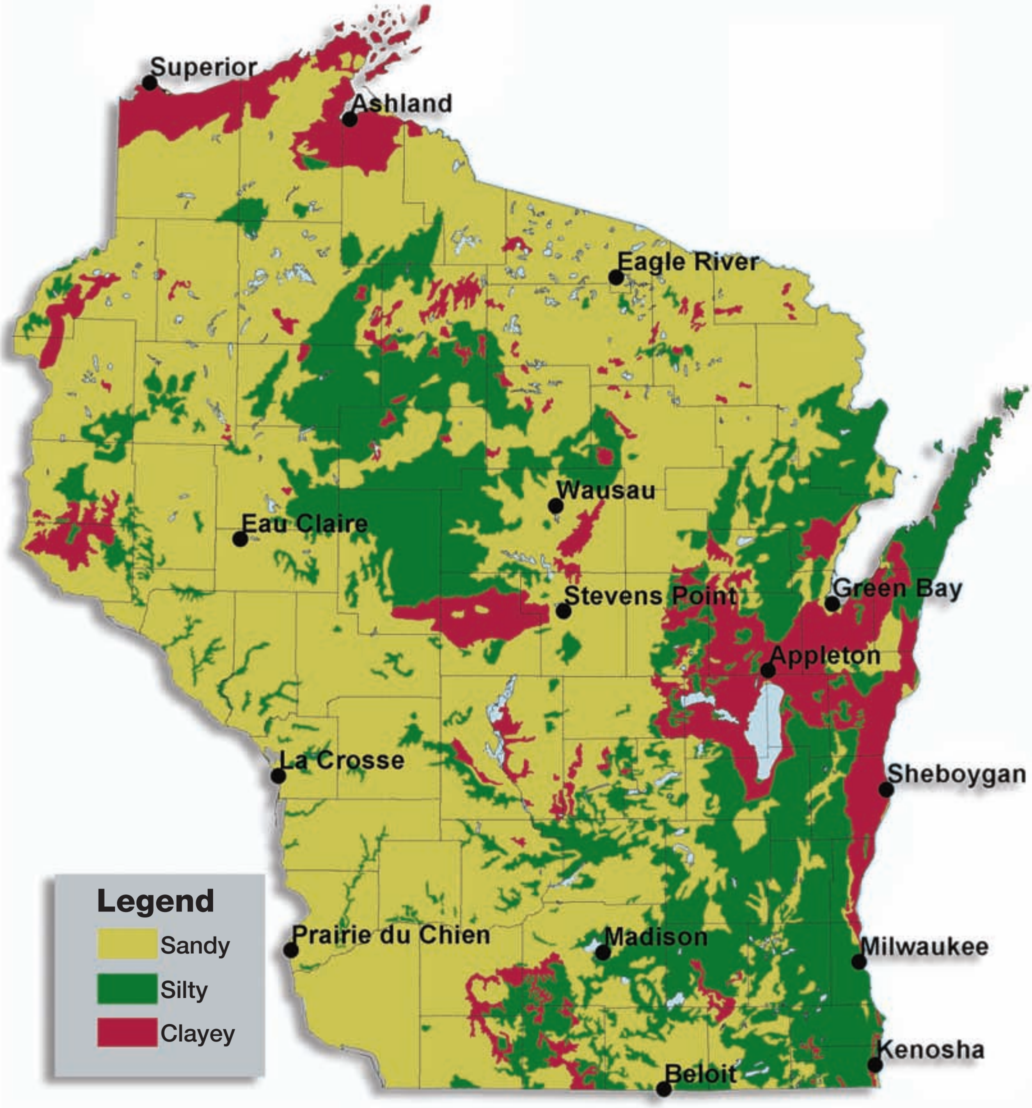
Rain barrels can be connected together with hoses if one barrel doesn't provide the collection volume you need. You can also connect a regular hose or soaker hose to the overflow hole as described above.

Look for links to information about constructing and purchasing rain barrels at the back of this guidebook.

Drop Pipe

If erosion is severe and space for infiltration is limited, only roof water, which is relatively free of pollutants, may be piped to outlet at the lake. The outlet may need to be reinforced with rock to avoid erosion at the end of the pipe. A Department of Natural Resources and/or County Zoning permit may be required.

Wisconsin Soils



A general soils map of Wisconsin. Local soils will vary greatly.

Infiltrate

Infiltration practices hold runoff water in a flat area and allow water to soak into the soil. They work well where infiltration rates (speed that water soaks into the soil) range from 0.5 to 3 inches per hour. Sandy soils provide lots of opportunity for infiltration. Do not install infiltration practices if there is not at least 3 feet of separation to groundwater.

Infiltration practices are not recommended where soils consist of more than 30 percent clay or more than 40 percent silt and clay. Rain gardens are the exception. With rain gardens, plant roots create pore spaces for water to travel along and soak into the garden bottom.

Approximate Infiltration Rates of Soils

Sand	1.2 to 3.0 inches or more per hour	**Infiltration pits and trenches work well**
Sandy Loam	0.8 to 1.2 inches per hour	
Loam	0.3 to 0.8 inches per hour	
Clay Loam	0.2 to 0.3 inches per hour	**Rain gardens are the only infiltration method**
Clay	0.04 to 0.2 inches per hour	

Measuring Infiltration Rates

You can perform a simple infiltration (or more accurately percolation) test by digging a hole with straight, vertical sides to the depth where you want to infiltrate water and filling it with water to moisten the soil. Allow this water to drain, then fill the hole again. Measure water depth after filling and every 15 minutes until the hole drains. Measured every fifteen minutes, the infiltration rate per hour is four times the average decrease in water depth.

Assessing Soil Type

Two do-it-yourself methods for assessing soil type follow. Soil test kits may be also available from your local UW-Extension Office. Another source of soils information is the Natural Resources Conservation Service. With a high speed internet connection and a fast computer, you can look up soils mapped for your property. To try this go to the NRCS Web Soil Survey: http//websoilsurvey.NRCS.usda.gov/app. Follow the instructions on the web site. Be patient, depending upon the speed of your internet connection and computer, it can take awhile to get to your desired location.

NRCS soil information is available by hydrologic soil group. This classification groups soils by their infiltration capability. *A* soils are sandy soils with high infiltration rates. *B* soils have moderate infiltration, and *C* soils have low infiltration rates. Soils may vary considerably from site to site – especially where fill is brought in during construction.

Estimating Soil Texture

A simple hand testing method will provide an idea of your soil texture.

1. Take a small handful of soil.
2. Make sure the soil is reasonably moist.
3. Form a small round ball with one hand.
4. Work the soil by pushing part of that ball between your thumb and forefinger.
5. This process should form a ribbon. The ribbon should be long enough to measure with a small ruler.

Soil Texture	Ribbon length
Sand	0 - 1/2 inches
Sandy loam	1/2 - 1.0 inches
Loam	1.0 inches
Clay loam	1.0 - 1.5 inches
Clay	2.0 + inches

The table shows soil textures simplified into categories based on the length of the ribbon.

Identifying soil texture by measurement

1. Spread soil on a newspaper to dry. Remove rocks, roots, and other debris. Crush soil clumps and finely pulverize the soil.
2. Fill a tall slender jar 1/4 full of soil.
3. Add water until the jar is 3/4 full.
4. Add a teaspoon of powdered, non-foaming dishwasher detergent.
5. Cover with a tight-fitting lid and shake hard for 10 to 15 minutes. This breaks apart the soil and combines it into similar soil particle sizes.
6. Set the jar where it will not be disturbed for 2 to 3 days.
7. Soil particles will settle out according to size. After 1 minute, mark the depth of the sand on the jar.
8. After 2 hours, mark the depth of silt on the jar.
9. When the water clears (after 1 to 3 days to a few weeks) mark the depth of clay.
10. Measure the thickness of the sand, silt, and clay layers.
11. Calculate the percentage thickness of each layer by dividing the thickness of a particular soil layer by the total depth of soil and multiplying by 100.

Test and additional information about assessing soils from Garden Notes #214 Estimating Soil Texture. Colorado State University Cooperative Extension.

Professional Soil Testing

For problem sites where practices need to be large and deep, it is a good idea to have soil tested by a professional. Direct the certified soil tester to dig a pit to 3 feet below the potential depth of the infiltration practice. Have the soil tester characterize the soil and ask for a report that specifies soil texture at various soil depths. Also have them identify where soil shows evidence of a high water table.

Certified soil testers can be found in the yellow pages under "Soil Testing" or "Perc Testing." A list of certified soil testers in your area may be available from your county zoning office.

Soil Compaction from Construction

Many developed properties have severely compacted soils. These soils were compacted when heavy machinery drove over native or fill soils during construction. Compaction resulting from construction activities can last decades. This is why it is important to avoid use of heavy machinery on waterfront property if at all possible.

To increase infiltration in compacted soils, till soils deeply (at least one foot) and add 3 to 6 inches of compost. Composted materials like leaves and grass will add organic material and pore spaces to the soil and increase infiltration.

Leveling Infiltration Areas

To maximize the volume for holding the infiltrating water, the bottom of infiltration practices should be level. To check the bottom of an infiltration practice, place a 2X4 plank across the bottom and measure with a carpenter's level.

Important things to keep in mind when infiltrating water

- Place infiltration practices at least 10 feet from the house to prevent undermining of the foundation or seepage into the basement.
- Infiltration practices should be at least 50 feet from drinking water wells. Newly constructed wells must be at least 25 feet deep, but older, more shallow wells may still exist.
- Be sure the bottom of an infiltration area is separated at least three feet from the groundwater to prevent groundwater contamination.
- Avoid locating infiltration uphill of or over a septic drain field.

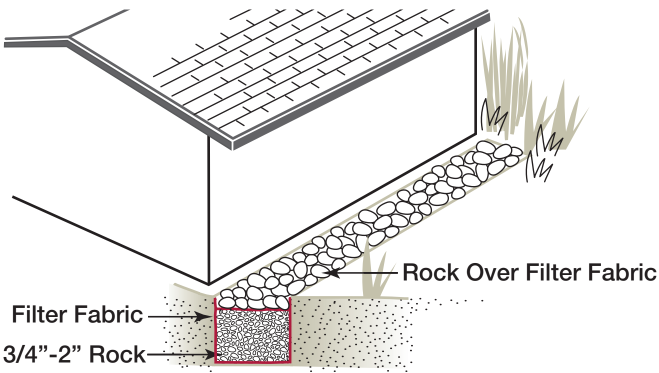
Rock Infiltration Trenches

Use a rock trench to capture runoff from a roof or parking area. A filter fabric trench liner prevents soil from entering the spaces between the rocks where water is held. Filter fabric is available from many hardware stores and some Land and Water Conservation Departments.

Try to keep sediment out of the rocks at the top of the trench to maintain the pore spaces and extend the life of the trench. One method to do this is to create an area that can be readily cleaned out. Fill trench to within six inches of the top with rock. Place a layer of filter fabric over the rock then fill to the surface. This allows removal of rock and sediment cleaning from the top six inches. The filter fabric prevents sediment from reaching lower layers.

Trenches may be constructed next to buildings without basements or foundations such as pole sheds. It is a good idea to leave at least six inches between the edge of a poured concrete slab or asphalt driveway to prevent undermining. This area can be covered with rock at the surface, if desired. Do not place trenches within ten feet of a house where water could soak into the basement. Allow a fifteen-foot wide strip of grass between a heavily used parking area and a rock trench to clean the water before it soaks into the ground.

Infiltration Trenches are long, relatively shallow excavated areas, lined with filter fabric, then filled with rock.



Trench size depends upon the amount of water to be captured and the rate of infiltration of underlying soil. The space between the rocks holds water, which then soaks into the soil beneath the trench. A two-foot deep trench along a roofline will capture a significant volume of water. The table on page 23 lists the length of trench necessary to capture a one-year, 24-hour storm event. These trenches will probably overflow with large storms. The edge where the overflow occurs should be made as level as possible to reduce the creation of channelized flow.

Sizing for rock trenches along roofs and parking areas.[1, 2]

Area of hard surface (sq. ft.)	Length (ft.) of 2 ft. wide trench	Length (ft.) of 3 ft. wide trench
200	17	11
400	33.5	22
600	50	33.5
800	67	45
1000	84	56
1500	126	84
2000	167	112
2500	209	140
3000	251	168

1 *Trenches are all two feet deep.*
2 *Trenches are sized to capture a one year 24-hour storm event.*

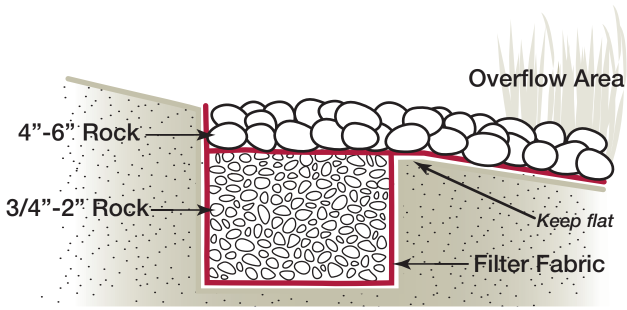
IMPORTANT NOTE:
Sizing in the table is for areas with sandy or sandy loam soils with drainage rate of at least 0.5 inches per hour.

Rock Infiltration Pits

An infiltration pit is constructed similarly to a trench, except that a pit is deeper, and a pit is designed to fit into available area. This deeper pit may reach sandy soils with higher infiltration rates when a shallower trench does not. With sandy soils, a 3-foot deep infiltration pit should be 5 to 10 percent of the size of the impervious surface that drains to it. A 4-foot deep infiltration pit should be from 4 to 8 percent of the size of the impervious surface that drains to it. See the table on page 24 for sizing in sandy loam soils.

If this much space isn't available, a smaller pit will still help reduce pollutants by capturing runoff from small rain events and the first flush from larger storms. Be sure to consider how water will flow from the pit when it overflows. The overflow area should be broad (2 to 4 feet) and absolutely flat across the overflow for even flow. Reinforce the overflow area with clean 4- to 6-inch rock underlain with filter fabric to prevent underlying soil from washing out. Do not construct a pit deeper than five feet because the soil beneath the pit will compact and drain more slowly.

Rock Infiltration Pit



Sizing Infiltration Pits – Area of pit compared to impermeable area that drains to it*			
Soil Type	Infiltration Rate	3 foot deep pit	4 foot deep pit
Sand	More than one inch per hour	5-10 percent	4-8 percent
Sandy Loam	0.5-1 inch per hour	10-20 percent	8-15 percent
Silt or Clay	Do not use infiltration pits or trenches unless you can dig to a sandy soil layer		

* *This will capture the runoff from a 1 year, 24-hour storm event to a 10 year, 24-hour storm event. Across Northern Wisconsin this ranges from just over 2 inches (1 year storm) to around 4 inches (10 year storm) of rain in a 24-hour period.*

Preventing Sediment Accumulation

To prolong the life of your infiltration pit, install a layer of filter fabric six inches below the final top surface. Cover the filter fabric with clean rock to the surface.

Follow these steps to maintain the infiltration system

1. Remove pine needles and any other matter that has collected on top of the system.
2. For small rock, remove rock and sift with a 3/4" mesh to remove sediment.
3. Rinse rock.
4. Remove remaining sediments and replace or rinse filter fabric.
5. Refill with clean rock.
6. Place recovered fine sediments in bordered flower bed or other contained area and mulch.
7. Discard dirty water and sediment in a contained area on your property such as a plant bed.

Subsurface Infiltration Pits

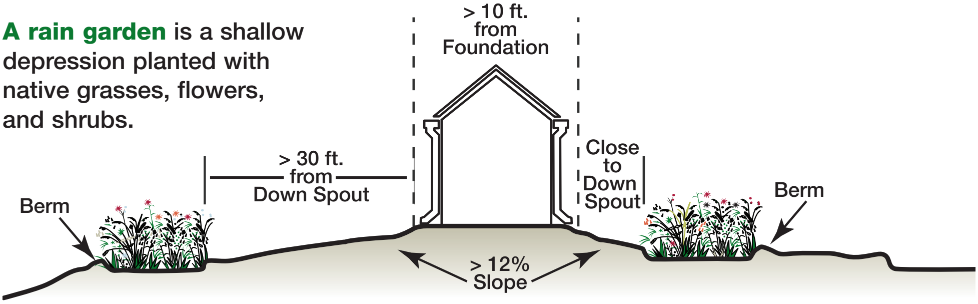
An infiltration pit can be constructed beneath the soil and grass, but be sure to keep the following in mind:

- Cover rock with filter fabric to prevent soil from entering the spaces between the rocks.
- Be sure the location of the infiltration pit is noted above ground. To minimize compaction and maximize effectiveness, do not drive across this area.
- An overflow device is needed.
- A direct connection to a rain gutter downspout may deliver leaves, pine needles, and other debris below ground and clog the rock spaces. See photo on page 25 for a tube system that provides overflow for excess water and allows access to clean out debris.

Rain Gardens

Rain garden plants are an attractive addition to the landscape. Their roots help to increase infiltration and absorption of water. Rain gardens are generally designed to drain within 24 to 48 hours.

A rain garden is a shallow depression planted with native grasses, flowers, and shrubs.



The upstream side and the top of the downstream berm of the rain garden should be level to evenly spread the flow of water. Water should run through grasses before entering the rain garden except where a rain gutter downspout enters the garden directly. The bottom of the garden should be level so that the pool of water spreads across the entire area. The downstream side of the berm should slope gradually with a 3 to 1 or 4 to 1 slope.

Rain gardens planted with a variety of colorful native flowers and grasses attract hummingbirds and butterflies to your yard.

An infiltration pit with a pipe cleanout system (blue slanted pipe) for leaves and other debris.

Photo courtesy of Chuck Brookshaw, Rivers North Contracting.

Steps to Complete a Rain Garden

1. Install a silt fence down slope of where the garden will be constructed.
2. Excavate a shallow depression: 6 to 18 inches deep for sandy soil; 6 to 12 inches deep for loamy soil; and 6 to 8 inches deep for clay soils. Depths decrease with smaller soil particles because these soils drain more slowly than sand.
3. Sizing depends on space available, depth of garden, and impervious surface area draining to the garden. Rain gardens generally range from 150–600 ft^2. A rule of thumb for sandy soil is to construct a garden that is 5 to 10 percent of the impervious (hard surface) area draining to it. Double the size for silty soils. Rain gardens must be even larger with clay soils at 20 to 43 percent of the size of the impervious area draining directly to the garden.
4. Remove remaining non-native vegetation by hand pulling or using herbicide. A glyphosate herbicide like *Roundup* is recommended if you use herbicide. Follow label instructions. Leave turf in place on upstream side.
5. Mulch area to be planted with 2 inches of wood chips or 3 to 4 inches of straw or leaves. You might also install a wood fiber erosion control blanket and plant seedlings through the blanket. Wood fiber (excelsior) blankets may be available from your Land and Water Conservation Department.
6. Plant with native plants spaced 12 to 18 inches apart. Rain garden plant selection can be challenging. Choose plants appropriate for soil and light conditions that will tolerate short periods of standing water and drying out between rain events. Guidance is available in DNR publications and from local experts. Re-seed remaining disturbed areas with lawn grass.
7. Supplemental watering may be required during dry periods, especially to establish plants.
8. Remove weeds the first year.
9. Remove standing dead material in the spring (optional).

Rain Garden Resources

The Wisconsin Department of Natural Resources has excellent information about rain garden sizing, construction, and placement on its website: www.dnr.wisconsin.gov/runoff/rg.

Preserve an Ice Ridge

An ice ridge is a ridge of soil and rocks that forms naturally from the force of ice pushing toward the shoreline.

An ice ridge is beneficial because runoff water will soak into the soil behind it. Many landowners remove the ice ridge after it forms because of its appearance and for ease of access to the lake. Removing the ice ridge is an on-going effort. While the ridge may not form each year, if it forms once, conditions are likely to occur again that will re-form the ridge.

Instead of destroying this ridge, plant with native plants suited to the moisture conditions the ice ridge creates. Consider ways, such as a short stairway or sloped boardwalk to the lake, to improve access without removing the ice ridge. It may be possible to grade a narrow opening to allow easy access to the lake. If this is done, consider the resulting flow of water and grade the slope away from the opening. Opening a channel in the ice ridge that flows to the lake will defeat the infiltration benefits of the ridge.

Possible photo or illustration of ice ridge to come

Additional Resources for More Information

Finding the Supplies You May Need

Building Supplies Porous landscape fabric, filter cloth, drain tile, erosion control fabric, silt fence. Local hardware stores, Land and Water Conservation Departments, building supply companies or nurseries.

Clean Washed Rock Local landscapers, haulers, excavators, septic drainfield installers

Native Plants For a list of native plant suppliers in Wisconsin:
http://clean-water.uwex.edu/pubs/index.htm.
View Home and Garden Clean Water Practices.

Rain Barrels

http://www.rainbarrelguide.com

http://www.duluthstreams.org/citizen/rainbarrel.html

www.rwmwd.org
Go to publications and under *Landscaping for Water Quality* find Rain Barrel publication.

Getting Help From an Expert

Department of Natural Resources
www.dnr.wisconsin.gov/runoff/staff (might want to start with regional staff contacts)

Land and Water Conservation Departments
www.datcp/state.wi.us keyword search "LCD Directory"

Landscapers and Engineering Firms
Check the Yellow Pages.
Ask state, county, or lake organizations representatives for a list.

Ask Questions:

- Have you installed rain gardens or other infiltration practices?
- Have you completed any training classes to address waterfront runoff?
- Can you provide a list of customers with similar completed projects?
- What do you charge for your services?

Soil Testers
Certified soil testers can be found in the Yellow Pages under "Soil Testing" or "Perc Testing." A list of certified soil testers in your area may be available from your county zoning office.

Publications and Web Sites

Construction Site Erosion Control

Erosion Control for Home Builders provides methods of preventing soil erosion during home construction, including a look at lawn sodding and seeding, silt fences and a sample erosion control plan.

Standard Erosion Control Plan for 1- and 2-family dwelling construction sites. This worksheet includes a site diagram template and a checklist of site characteristics, erosion control practices, and management strategies.
http://clean-water.uwex.edu/pubs/storm.htm
Scroll to above publications.

Plant Identification and Photos

Vascular Plants of Wisconsin is produced by the Herbarium, Department of Botany, UW-Madison. This is probably the best and most complete site for Wisconsin plants. Search by scientific name, habitat type, status, county, family, genera, or common name. The results give a detailed description of the plant and most have a photo and distribution map. Also available is a link to the Atlas of Wisconsin Prairie and Savanna Flora and a key to WI conifers and rare lichens of WI.
http://www.botany.wisc.edu/herbarium

Rain Gardens

The Wisconsin Department of Natural Resources has comprehensive information about rain garden sizing, construction, and placement on its website:
www.dnr.wisconsin.gov/runoff/rg

University of Wisconsin Extension Publications has two excellent rain garden publications for download. Go to http://clean-water.uwex.edu/pubs/home.htm#yard. Scroll to publication names.

A Household Way to Improve Water Quality in Your Community
A basic introduction providing information on how rain gardens help protect water quality, and general step-by-step instructions on how to build a rain garden in your yard.

A How-to Manual for Homeowners
A detailed manual that covers rain garden sizing and site, construction details and planting and maintenance. Includes 11 conceptual planting designs with plant species lists.

Shoreland Runoff

Rethinking Yard Care

UW-Extension Publication # GWQ009. This is an 8-page brochure that describes the impacts of nonpoint source pollution and suggests simple best management practices homeowners can use to help protect the environment.

For a downloadable format, see: http://clean-water.uwex.edu/pubs/home.htm#yard

Scroll to Rethinking Yard Care.

Runoff and Impervious Surfaces: a Three Part Series:

> *Rain and Snow – Where Do They Go and What Do They Take With Them?*
> This color fact sheet describes how streams and fisheries are affected by impervious (hard) surfaces and land use.
>
> *Impervious Surface – An Environmental Indicator*
> This fact sheet describes the results of increased impervious surfaces and community actions that can be adopted to address them.
>
> *Siting Rural Development To Protect Lakes and Streams and Decrease Road Costs*
> This fact sheet explores the existing road system in Wisconsin and its cost per person and offers specific tools for minimizing pollutant sources and pollutant delivery to lakes and streams.

All three fact sheets in this series are available from the Center for Land Use Education (715-346-3783). For a downloadable version, see:
http://www.uwsp.edu/cnr/landcenter/pubs.html. Go to Fact Sheets.

Vegetating Shorelines

Lakescaping for Wildlife and Water Quality represents six years of research and the collaborative efforts of Carrol Henderson, DNR non-game wildlife specialist, Carolyn Dindorf, award-winning soil and water conservationist, and Fred Rozumalski, highly acclaimed landscape ecologist. Learn techniques to prevent shoreline erosion, restore wildlife habitat, wildflowers and clean water. This book will show you alternatives to the conventional practice of planting "lawn all the way to the lake," a practice detrimental both to wildlife and to water quality. Lakescaping includes chapters about the lake ecosystems, designing lakeshore landscapes, site preparation and general tips on stewardship of the land and water. Not only for lakeshore owners, the ideas presented in this book also apply to landscaping along rivers, streams, and wetlands. Access to ordering this book along with other shoreland restoration information.
www.dnr.state.mn.us/lakescaping/index.html

Natural Shorelines Restoration Stories

Burnett County Land and Water Conservation Department. Includes before and after pictures of sites with native plantings. To download a .pdf copy visit
http://www.burnettcounty.com/burnett/lwcd

Shoreland Buffer Restoration. A Guide for Landowners
Burnett County Land and Water Conservation Department. Includes step-by-step instructions for site preparation, plant selection, and planting. Also includes sources of native plants. To download a .pdf copy visit
http://www.burnettcounty.com/burnett/lwcd

Shoreland Stewardship Series: A Fresh Look at Shoreland Restoration
An introduction to shoreland stewardship and the benefits of shoreland restoration, including some helpful suggestions.

Protecting and Restoring Shorelands
An overview of shoreland restoration considerations, including habitat and aesthetics, site characteristics, and first steps to take.

Protecting Our Living Shores
An overview of the importance of shoreland protection with additional focus on beneficial plants, small mouth bass, and wildlife.

Water's Edge
How good stewardship of waterfront property can help protect and improve habitat for fish and wildlife.

http://clean-water.uwex.edu/pubs/shore.htm#wisconsin
Scroll to Shoreland Stewardship Series

Wisconsin Native Plant Sources
Seeds and plants for prairies, woodlands, wetlands, and shorelands. 2004.
To download and print, visit:
http://clean-water.uwex.edu/pubs/shore.htm#wisconsin
Scroll to Wisconsin Native Plants

The following resources were used to create this publication

Estimating Soil Texture. Garden Notes #214. Colorado State University Cooperative Extension.

Home and Garden Practices for Lake Protection. 1988. WI DNR.

Minimize Runoff from Shoreland Property. Shoreland Best Management Practices. Number 8 of 18 in the Series. 1998. University of Minnesota Extension.

MN Shoreland Management Resource Guide. www.shorelandmanagement.org

Minnesota Urban Small Sites BMP Manual. Stormwater Best Management Practices for Cold Climates. 2001. Prepared for the Metropolitan Council by Barr Engineering Company.

Protecting Water Quality in Urban Areas. Best Management Practices for Dealing with Storm Water Runoff from Urban, Suburban and Developing Areas of Minnesota. 2000. Minnesota Pollution Control Agency.

Rain Barrels. More Than a Drop in the Bucket for Conservation. Ramsey-Washington Metro Watershed District. 2006.

Rain Gardens Nature's Way to Control Runoff Pollution. 2002. WI DNR.

The Stormwater Managers Resource Center. Center for Watershed Protection. www.stormwatercenter.net

The Wisconsin Stormwater Manual. WI DNR.

Wisconsin's Forestry Best Management Practices for Water Quality. 1995. Bureau of Forestry Wisconsin Department of Natural Resources.

And most importantly...
Landscaper consultations and many visits with waterfront homeowners like you!

Please direct suggestions for future editions of this guidebook to:

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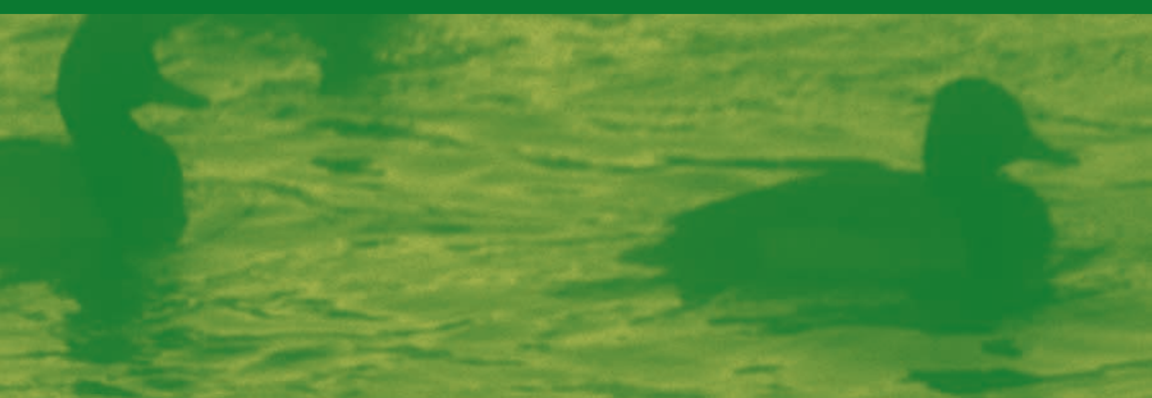
harmonyenv@amerytel.net



Bayfield County

SEAL OF BURNETT COUNTY WISCONSIN

Harmony Environmental
Finding a balance
People Land Water

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