

## Fact Sheet #1

### Lawn Care Practices/Reducing Over Fertilization

#### Do you fertilize your lawn?

Not many homeowners realize that lawn fertilizer can cause water quality problems (Figure 1.1). Furthermore, homeowners are usually unaware of the actual nutrient needs of their lawns. According to surveys, over 50% of lawn owners fertilize their lawns, yet only 10 to 20% of lawn owners take the trouble to perform soil tests to determine whether fertilization is even needed (CWP, 1999). In addition, the majority of lawn owners are not aware of the phosphorus or nitrogen content of the fertilizer they apply (Morris and Traxler, 1996) or that mulching grass clippings into lawns can reduce or eliminate the need to fertilize. Informing residents and lawn care professionals on methods to reduce fertilizer, limit water use, and avoid land disturbance can help alleviate the potential impacts of a major contributor of non-point source pollution in residential communities.



Figure. 1.1  
Source: CWP

#### How can you fertilize and help keep your waters clean?

Fertilizer packages are labeled with three numbers that indicate the percentage by weight of the three nutrients most essential to plants. The order is always nitrogen, phosphate, and potash (potassium). Nitrogen promotes overall grass shoot growth. Phosphate supplies phosphorus, which promotes strong root growth. Potash supplies potassium and helps grass withstand stresses such as drought or disease. Recommendations provided with soil test results (see below) will tell you if you need to apply these three nutrients. If you do fertilize, try to keep the following in mind (MD CES):

- # Try to keep fertilizer off of paved surfaces. If granular fertilizer gets onto paved surfaces, collect it for later use or sweep it onto the lawn.
- # Use a drop spreader instead of a rotary spreader in restricted spaces, especially when near water, driveways, or sidewalks.
- # Calibrate your spreader to make sure you are not over-applying fertilizer.
- # Fill and wash spreaders over grassy areas, not on hard surfaces.
- # Avoid getting fertilizer into natural drainage areas on your property.
- # Never apply fertilizer to frozen ground or dormant lawns.
- # Use fertilizers sparingly. Many plants do not need as much fertilizer or need it as often as you might think.
- # Don't fertilize before a rain storm.
- # Consider using organic fertilizers; they release nutrients more slowly.

- # Use commercially available compost or make your own using garden waste. Mixing compost with your soil means your plants will need less chemical fertilizer and puts your waste to good use. Commercial compost and soil amendments may be available from your solid waste or wastewater utility as well as your local garden store.

### Why is soil testing important?

Testing the soil for nutrients and pH is important to provide your lawn with the proper balance of nutrients while avoiding over application. If you are establishing a new lawn or landscaping, a soil test is strongly recommended. Soil testing takes the guesswork out of fertilization, is extremely cost effective, and can eliminate over-usage of fertilizers that contribute to non-point pollution in our streams.

### How do I get my soil tested?

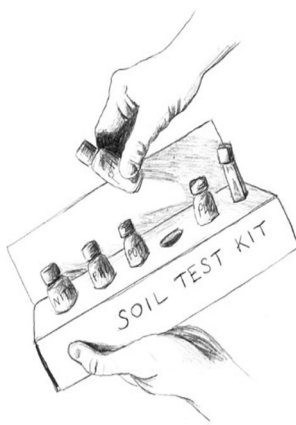


Figure.1.2  
Source: CWP

- # **Home testing:** There are home test kits available for pH, nitrogen, phosphorus and potassium at local garden centers (Figure 1.2). These kits will give a general idea of the nutrients in your soil, but are not as reliable as lab tests.
- # **Outside organizations:** services are available at land grant universities and other commercial testing services, providing more accurate results and more detail. There is also an option for requesting micronutrient testing if you suspect a problem.
- # **Landscaping Companies:** Professional lawn care companies should test your soil before adding any fertilizers. Support companies that employ techniques to limit fertilizer use to the minimum necessary to maintain a green lawn.

### How do I perform a soil test?

If you intend to send your sample to a land grant university contact the local Cooperative Extension Service for information and sample bags. If you intend to send it to a private testing lab, contact them for specific details before sending a sample. The following are some general guidelines for collecting a sample.

- # Sample soil when the soil is moist but not wet.
- # For each acre of land to be tested, 10-15 sub-samples are recommended. Areas that appear different or are used in a different manner should be sampled separately.
- # Use a clean pail or container
- # Clear away the surface litter or grass
- # With a spade or soil auger dig a small amount of soil to a depth of 6 inches and place in the clean container.
- # Mix the samples from each homogeneous *land* area together thoroughly and collect a sub-sample that will be sent to the testing facility.

# Send the sample immediately, and do not dry before sending.

**How frequently should I test?**

Testing should be done every two or three years. Sample more frequently if you desire closer monitoring of the nutrient levels in your lawn.

**References and Resources**

Center for Watershed Protection (CWP). 1999. Diazinon sources in runoff from the San Francisco Bay Region. Technical Note 106. *Watershed Protection Techniques*. 3 (1):613-616.

Maryland Cooperative Extension Service. Fact Sheet 702 - Lawns and the Chesapeake Bay. University of Maryland, College Park, MD.

Morris, W. and D. Traxler. 1996. Dakota County Subwatersheds: Residential Survey on Lawn Care and Water Quality. Dakota County, Minnesota, Decision Resources, Ltd.

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## Fact Sheet #2

### Integrated Pest Management

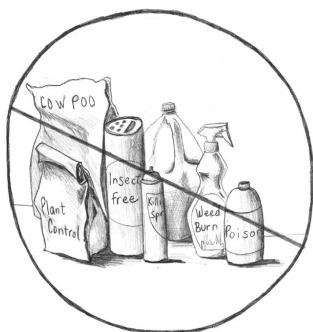


Figure 2.1  
Source: CWP

#### What is Integrated Pest Management?

Integrated Pest Management (IPM) is a holistic approach to pest control that uses a combination of cultural, mechanical, biological, sanitary, and chemical controls. The goal of IPM is to manage pests to an acceptable level with as little impact to the environment as possible.

#### Why should I use Integrated Pest Management?

Because IPM uses chemical controls only as a last resort, and even then uses the least toxic forms of chemicals, there is minimal impact on water quality. IPM is a good alternative to simply applying pesticides, which contaminate stormwater runoff, and directly impact the health of aquatic organisms. The greatest source of pesticides to urban streams is home applications of insecticides and herbicides in the lawn and garden (Figure 2.1). Pesticides in stormwater runoff can also affect human health by contaminating drinking water supplies.

#### How does Integrated Pest Management work?

The basic principle of IPM is the acceptance of a certain number of pests and a certain level of damage to your plants. For example, the “perfect lawn” does not have to be dandelion free. Preventative measures such as mechanical, cultural, biological, and sanitary controls are used to keep pest levels below a certain critical level. Once the number of pests reaches a certain threshold, a treatment may be needed which can include chemical controls. There are different thresholds for different pests, and these may also vary for different plants. Listed below are specific eco-friendly actions for controlling pests. Many of the practices are applicable to management of flower and vegetable gardens as opposed to lawn management. However, the same principle of avoiding chemical application and looking for alternative controls applies to lawn management as well.

#### Cultural controls:

- # **Crop rotation:** Plant a crop in an area of the garden where it has not been planted for at least a year. This prevents disease build-up in the soil and discourages insect infestation.
- # **Selection of disease-resistant plants**
- # **Trap crop:** A trap crop can be planted just outside your garden as a decoy to attract pests. This will help keep the pests away from your garden, and you can remove the insects from the trap crop if you like.

#### Mechanical controls:

- # **Row covers:** Allow for the penetration of sunlight, air, and moisture, but not insects.
- # **Collars:** Place paper plates, aluminum pans, and tin cans around the bases of individual plants to protect them from insects.

- # **Traps:** Vary depending on the type of pests it will be used for, but some use pheromones, and sticky substances to attract and trap pests. Do not place traps directly in your garden.
- # **Sprayers:** Spraying your plants with a hose will dislodge and kill many pests.
- # **Weeding, mulching and hoeing:** These methods work well for weed removal.
- # **Fences, netting and tree-trunk guards:** These methods can be used to limit damage from small mammals and birds.
- # **Bug zappers**
- # **Mowing:** Low and infrequent mowing may be the major cause of lawn deterioration. It is best to remove no more than ½-inch of the grass blade each time you mow. For example, to maintain a 3-inch height, do not let the grass get much taller than 4 inches. Mowing to the proper height can reduce weed problems by as much as 50 to 80 percent (MD CES).

### **Sanitary controls:**

- # Removal of overripe produce and diseased plants. This prevents the diseases from spreading to healthy plants.

### **Biological controls:**

- # **Insect control.** Use naturally occurring beneficial insects to control pests. Examples include using ladybugs to control aphids, and using the praying mantis for most types of pests.
- # **Plant flowers:** attract beneficial insects by planting dill and angelica.

### **Chemical controls:**

- # Use only as a last resort, and then only the least toxic forms. Less toxic chemical controls include soaps and horticultural oils, inorganic pesticides such as lime sulfur and copper, botanical pesticides, and microbial pesticides.

### **Individual IPM approach**

Because thresholds vary with the pest and type of plant, each individual lawn and garden may require a different IPM approach. Contact your local lawn and garden center or extension agent for more information.

### References and Resources

- California Environmental Protection Agency. 1995. Consumer Factsheet: Urban IPM. Department of Pesticide Regulation, Sacramento, CA.
- Center for Watershed Protection (CWP). 1999. Diazonin Sources in Runoff from the San Francisco Bay Region. Technical Note 106. *Watershed Protection Techniques*. 3(1): 613-616
- Maryland Cooperative Extension Service. Fact Sheet 702 - Lawns and the Chesapeake Bay. University of Maryland, College Park, MD.
- Schueler, T. 1995. Urban Pesticides: From the Lawn to the Stream. Center for Watershed Protection, Ellicott City, MD. *Watershed Protection Techniques*. 2(1):247-253.
- United States Geological Survey (USGS). 1999. The Quality of Our Nation's Waters – Nutrients and Pesticides. U.S. Geologic Circular #1225. Website address: [water.usgs.gov/pubs/FS/FS-116-99/pdf/fs-116-99.pdf](http://water.usgs.gov/pubs/FS/FS-116-99/pdf/fs-116-99.pdf)





## Fact Sheet #3

### Lawn Conversion



Figure 3.1  
Source: Bannerman

#### What is lawn conversion?

Many homeowners today are choosing to convert their lawns or a section of their lawns to a more natural state (Figure 3.1). This includes planting hardy native plant species of grasses, shrubs, wildflowers and/or trees, which require less maintenance than the conventional expansive bright green lawn. This is a smart choice given that the estimated 25 to 30 million acres of residential lawns across the county make for a lot of mowing!

#### Why convert your lawn?

The use of native plants can provide an aesthetically pleasing landscaping choice (Figure 3.2), preserves native species and biodiversity, and creates habitat for wildlife. Native plants tend to be better adapted to local environmental conditions, therefore require less maintenance than typical lawns. In the long run, lawn conversion can save time, money, and energy, not to mention the added benefit to local water bodies of requiring little or no fertilizer or pesticides. Native plants may even be used to solve landscaping problems such as shady or wet areas. Furthermore, lawn conversion presents excellent opportunities to provide stormwater management that promotes groundwater infiltration, water quality treatment, and even flood control.



Figure 3.2  
Source: CWP

#### How do I convert my lawn?

Before converting a section of your lawn to more natural conditions, it is important to first assess the conditions of the site in order to choose plants that are well suited to those conditions. Keep in mind that urban areas tend to be very infertile, compacted, and not well-suited for vegetative growth, so a site may require some initial work before planting. Some factors to consider are sun exposure, soil texture, pH, fertility (see fact sheet #1), moisture conditions, pest problems, and history of use. If your soil is very acidic or compacted, soil amendments may be required. Since the type of plants will vary with lawn conditions, it may be useful to talk with a local extension agent or lawn and garden center about what species to plant and how to test your soil. In general, native prairie or meadow plants work well in sunny open areas or areas with poor drainage. Woodland plants are generally well suited for fertile, moist areas with high organic content.

### **References and Resources**

- Center for Watershed Protection (CWP). 2000b. The Compaction of Urban Soils. Technical Note 107. *Watershed Protection Techniques* 3(2): 661-665.
- Center for Watershed Protection (CWP). 1999a. Stormwater Pollution Source Areas Isolated in Marquette, Michigan. Technical Note 105. *Watershed Protection Techniques* 3(1):609-612.
- Bannerman, R., D. Owens, R. Dodds, and N. Hornewer. 1993. Sources of Pollutants in Wisconsin Stormwater. *Water Science & Technology*. (28):3-5 pp. 241-259.
- Schueler, T. 2000. On Watershed Behavior. Center for Watershed Protection. *Watershed Protection Techniques*. 3 (3):671-679.

## Fact Sheet #4

### Pet Waste Management

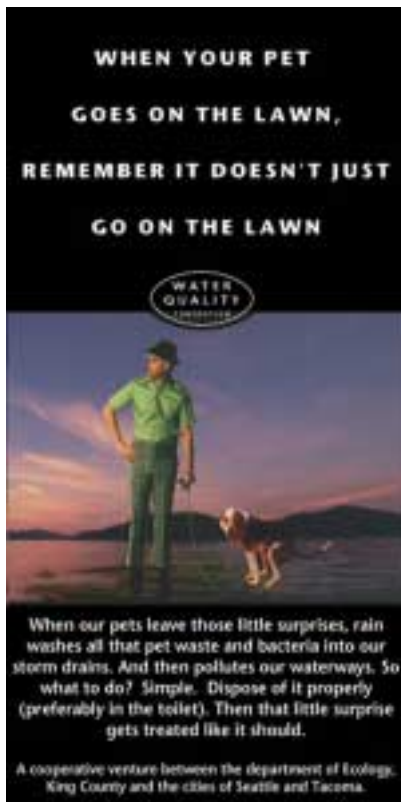


Figure 4.1  
Source: Water Quality Consortium

#### Do you pick up after your pets? You should!

Animal waste contributes both phosphorus and harmful bacteria to local waters. According to recent research, non-human waste represents a significant source of bacterial contamination in urban watersheds. These bacteria can pose health risks to humans and other animals, and result in the spread of disease.

#### What are examples of awareness programs?

Animal waste collection programs use awareness and education, signs, and pet waste control ordinances to alert residents to the proper disposal techniques for pet droppings.

Programs to control pet waste typically use "pooper-scooper" ordinances to regulate pet waste cleanup. These ordinances require the removal and proper disposal of pet waste from public areas and other property before the dog owner leaves the immediate area. Often a fine is associated with failure to perform this act as a way to encourage compliance. Some ordinances also include a requirement that pet owners remove pet waste from their own property within a prescribed time frame.

Brochures and public service announcements (Figure 4.1) describe proper pet waste disposal techniques and try to create a storm drain-water quality link between pet waste and runoff.

Signs in public parks (Figure 4.2) and the provision of receptacles for pet waste also encourage cleanup.

Another option for pet waste management is the use of specially designated dog parks where pets are allowed off-leash. These parks typically include signs reminding pet owners to remove waste, as well as other disposal options for pet owners. The following management options have been used in Australian dog parks and could be incorporated for dog parks here (Harlock Jackson 1995).



Figure 4.2  
Source: CWP



Figure 4.3  
Source: Unknown

**Doggy loos:** These disposal units are installed in the ground and decomposition occurs within the unit (Figure 4.3). Minimal maintenance is required (no refuse collection).

**Pooch patch:** A pole is placed in the park surrounded by a light scattering of sand. Owners are encouraged to introduce their dog to the pole on entry to the park. Dogs then return to the patch to defecate and special bins are provided in which owners then place the deposit.

**The "Long Grass Principle":** Dogs are attracted to long grass for defecating and areas that are mowed less frequently can be provided for feces to disintegrate naturally. A height of around 4 inches is appropriate.

### What can I do?

- # When going for dog walks, take a half-dozen plastic sandwich bags and a larger zip-lock bag. When doggie makes a deposit, turn a baggie inside out over your hand and use it as a glove to pick up the waste. Transfer to zip-lock bag and either flush or deposit in the trash when you get home.
- # Take a poop-scoop with you to pick up the waste and deposit the waste in a proper disposal location (Figure 4.4).
- # Another disposal strategy is to dig a small trench where your pets tend to defecate and toss the feces in the trench, cover with a layer of leaves, grass clippings, and dirt.
- # Train your cat to use a cat box even if it is an Aoutdoor® cat.



Figure 4.4  
Source: CWP

### References and Resources

- Harlock Jackson Pty. Ltd., J. K. Blackshaw, and J. Marriott. 1995. *Public Open Space and Dogs: a Design and Management Guide for Open Space Professionals and Government*. Harlock Jackson. Victoria, Australia.
- Lim, S. and V. Olivieri. 1982. *Sources of Microorganisms in Urban Runoff*. John Hopkins School of Public Health and Hygiene. Jones Falls Urban Runoff Project. Baltimore, MD.
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- United States Environmental Protection Agency (US EPA). 1993. *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters*. US EPA, Office of Water. Washington, DC.
- Van der Wel, B. 1995. "Dog Pollution." *The Magazine of the Hydrological Society of South Australia*. 2(1)1.
- Water Quality Consortium. 1996. King County, WA Pet Waste Management Campaign.



## Fact Sheet #5 Car Washing

### Do you wash your car?

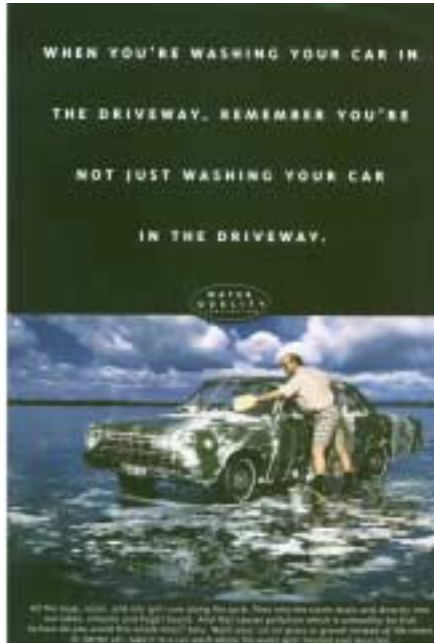


Figure 5.1

Source: Water Quality Consortium

Car washing is a common routine for residents and a popular way for organizations such as scout troops, schools, and sports teams to raise funds. However, when cars are washed in driveways and parking lots, the dirty wash water finds its way to the storm drain system and ultimately to streams and lakes. The wash water often contains pollutants such as: oils and grease, phosphates (from the soap), and heavy metals, all of which have negative impacts on water quality.

Currently, only a few pollution prevention programs incorporate proper car washing practices as part of an overall message to residents on ways to reduce non-point source pollution (Figure 5.1). The best programs have extended this message to include charity car washes and even provide these charity groups with equipment (catch basin inserts, vacuum pumps, and protective booms) and training to alleviate the problems associated with polluted wash water entering the storm drain system.

### What should you do?

- # Never direct wash water to catch basins and the storm drain system without adequate pretreatment over a vegetative filter such as a grass swale.
- # Wash your car on gravel, grass or other permeable surfaces (Figure 5.2).
- # Wash your car at a commercial facility that treats its water.
- # Use non-phosphate soap. Phosphates are nutrients that can cause environmental problems if washed into streams or ponds.
- # Block off the storm drain during charity car wash events or use an insert with a vacuum pump to catch wash water and discharge into sanitary sewer system.
- # Use hoses with nozzles that automatically turn off when left unattended.
- # Use biodegradable soaps.
- # Storm drain stenciling programs emphasize the connection between the storm drain system and runoff and help reinforce that car washing activities can have an effect on local water quality.



Figure 5.2

Source: CWP



### **References and Resources**

Center for Watershed Protection (CWP). 1999. On Watershed Behavior. *Watershed Protection Techniques*. 3(2).

Kitsap County Sound Car Wash Program. 1999. *Personal communication and webpage*. Web site address: [www.wa.gov/kitsap/departments/pubworks/carwash.html](http://www.wa.gov/kitsap/departments/pubworks/carwash.html).

Lance Winslow III. 1999. *How to Run a Successful Car Wash Fundraiser*. Car Wash Guys International, Inc.

Water Quality Consortium. 1996. King County, WA Pet Waste Management Campaign Ad.



## Fact Sheet #6

### Automotive Maintenance

#### Does it matter where I maintain my car?

Fluid spills and improper disposal of materials result in pollutants, heavy metals and toxic materials entering ground and surface water supplies, creating public health and environmental risks (Figure 6.1). It has been estimated that each year over 180 million gallons of used oil is disposed of improperly (Alameda CCWP, 1992), and that a single quart of oil can pollute 250,000 gallons of drinking water (DNREC, 1994). For this reason, it is imperative that residents follow proper automotive maintenance. Alteration of practices involving the cleanup and proper storage of automotive fluids and cleaning of vehicle parts can help reduce pollution in our drinking water resources.

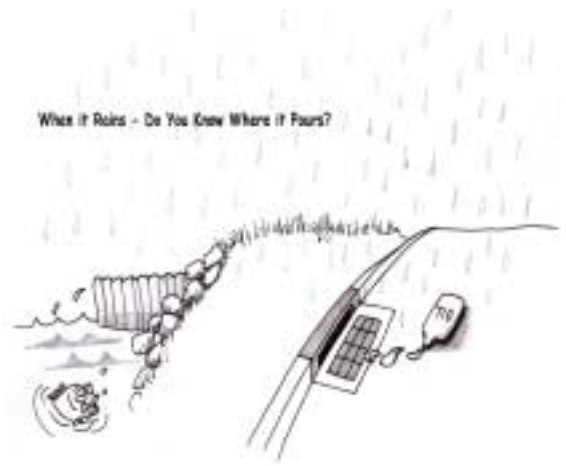


Figure 6.1  
Source: CWP

#### How can I reduce automobile maintenance waste?

The number of solvents used should be kept to a minimum to make recycling easier and to reduce the hazardous waste management costs. All liquid cleaning should be done in a centralized station to ensure that solvents and residues stay in one area. Drip pans and draining boards should be properly located to direct solvents and oils into a holding tank for reuse or proper disposal container.

#### What are safer alternatives?

Use non-hazardous cleaners when possible. Reduce chlorinated solvents with non-chlorinated solvents such as kerosene or mineral spirits. Recycled products such as engine oil, transmission fluid, antifreeze and hydraulic fluid can be purchased if available to support the market of recycled products.

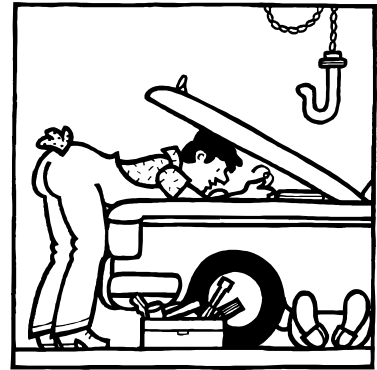
#### What is the proper method for controlling spills?

Use as little water as possible to clean spills, leaks and drips. Rags should be used to clean small spills, dry absorbent material for larger spills, and a mop for general cleanup. Mop water can be disposed of via the sink or toilet to the sanitary sewer.

#### General household pollution prevention

The following is a list of good housekeeping methods to prevent and reduce the amount of pollution caused by routine automobile maintenance.

- Conduct maintenance work such as fluid changes indoors.
- Parked vehicles should be monitored closely for leaks and pans should be placed under any leaks to collect the fluids for proper disposal or recycling.
- Promptly take all fluids into the proper waste facility for recycling or disposal.
- Do not pour liquid waste down floor drains, sinks or outdoor storm drains.
- Obtain and use drain mats to cover drains in case of a spill.
- Store cracked batteries in leak proof secondary containers.



### References and Resources

Alameda Countywide Clean Water Program. 1992. Keeping It All in Tune: Car Repair and Pollution Prevention. Alameda Countywide Clean Water Program, Hayward, CA.

Center for Watershed Protection. 1995. Auto Recyclers-Onsite BMP's Mitigate Urban Runoff Hotspots. *Watershed Protection Techniques*, Vol. 1, No. 4.

Natural Resources Defense Council. 1999. Stormwater Strategies: Community Responses to Runoff Pollution. Natural Resources Defense Council, Inc., New York, New York.

## Fact Sheet #7

### Rain Barrels

#### What is a rain barrel?

A rain barrel or cistern is a rainwater collection system that stores rooftop runoff to be used later for activities such as lawn and garden watering, car washing, and even window cleaning (Figure 7.1).

#### Why use a rain barrel?

Residential irrigation can account for 40% of domestic water consumption in a given area. This can be a problem particularly in summer, when the majority of outdoor water use occurs, and also the time when there is likely to be a water shortage. Collecting rainwater from your roof during storms by using a rain barrel can not only lower your water bills, but also help to decrease water demand during the hot summer months. Rainwater collection and reuse is beneficial to the environment because the stored water would otherwise run off into the storm sewers, bringing pollutants such as oil and grease, bacteria, and nutrients with it. Once water gets into a storm sewer, it eventually ends up in our streams and rivers. Also, the more rainwater that is reused, the less need there is for chlorinated or chemically treated tap water.



Figure 7.1  
Source: CWP

#### Where can I get one?

You can purchase a rain barrel at most major lawn and garden centers. Call your local center to see if they carry them or can order a rain barrel for you. Or, if you are feeling especially creative, you can make your own rain barrel using a large trashcan, agricultural supply container, or other large container and a little ingenuity. Listed below are some links to rain barrel sources online. Barrel sizes range from 50 to 250 gallons, and prices range from \$99 to \$325 plus shipping charges.

Watertanks.com	<a href="http://www.watertanks.com/rainwatertank.html">http://www.watertanks.com/rainwatertank.html</a>
The Garden Watersaver	<a href="http://www.gardenwatersaver.com">http://www.gardenwatersaver.com</a>
The Spruce Creek Rainsaver	<a href="http://www.sprucecreekrainsaver.com">http://www.sprucecreekrainsaver.com</a>
Plastmo	<a href="http://www.rio.com/~plastmo/gardnh2o.html">http://www.rio.com/~plastmo/gardnh2o.html</a>
The Urban Rain Barrel	<a href="http://www.greenculture.com/ps/pp_ws.html">http://www.greenculture.com/ps/pp_ws.html</a>
Urbangardencenter.com	<a href="http://www.composters.info/#overture">http://www.composters.info/#overture</a>

### How do I install a rain barrel?

Most rain barrels are easy to install; however, actual installation methods may vary depending on the individual brand of rain barrel. Installation of a typical barrel will involve disconnecting your downspout, cutting off a portion of the downspout and redirecting it into



Figure 7.2  
Source:  
Urbangardencenter.com

the top of the barrel. Most rain barrels have an overflow pipe that redirects the rainwater back into the downspout or onto your lawn or other surface in the event the barrel becomes full (Figure 7.2). Other features may include safety features, spigots, connector barrels, mosquito proofing, and even water filters. Always be sure to empty your barrel before winter comes so you don't end up with a barrel full of ice!

### What are cisterns?

A cistern is similar to a rain barrel, but has much greater storage capacity, and requires a little more engineering (Figure 7.3). You can use a cistern to collect rainwater from your roof, filter the water, store it, and reuse it for your lawn and garden, or in your house for



Figure 7.3  
Source: [www.texasmetalcistern.com](http://www.texasmetalcistern.com)

toilet flushing, clothes washing, etc. A cistern is considerably more expensive than a rain barrel, but can provide for more of your water needs, and may pay for itself in the long run.

## References and Resources

Maryland Department of Natural Resources. 2000. Maryland Green Building Program: Building a Simple Rain Barrel. Maryland Department of Natural Resources. Annapolis, MD.

Texas Metal Cisterns. Website address: [www.texasmetalcistern.com](http://www.texasmetalcistern.com)

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## Fact Sheet #8

### Impervious Surface Reduction

#### What are impervious surfaces?

Impervious surfaces include driveways, sidewalks, patios, and rooftops B any surface that does not allow rainwater to percolate into the ground.

#### Why should I reduce impervious surfaces?

As water flows over paved surfaces, it collects soil, pet wastes, salt, fertilizers, oils, and other pollutants. Even if your house is not near a stream or river, the runoff will flow down the street and into the storm drain system, which will then carry the runoff to the nearest body of water, taking dirt and pollutants along with it.



Figure 8.1  
Source: CWP

#### How do I reduce stormwater runoff from my yard?

One way you can help to reduce stormwater runoff and associated pollutant loads is to minimize the amount of impervious surfaces on your property. As you add or rebuild driveways, patios and garden pathways, consider alternative techniques to the traditional concrete or asphalt. For instance, paving blocks, permeable pavements, grass driveway strips (Figure 8.1), wood decks, wood chips, and crushed rock allow rainwater to soak through and help to reduce stormwater runoff.

**Paving Blocks:** There are many types of grid or lattice paving blocks that have holes in the concrete blocks. These holes can be filled with soil and planted with grass, or they can be filled with gravel. A fraction of stormwater runoff is trapped in the shallow depressions in the paving blocks, and some may actually infiltrate into the soil. Not only do paving blocks help to reduce runoff, but also they often serve as a very attractive alternative to pavement. They typically come in different colors, shapes, and patterns. Paving blocks can be found at most major home centers. Also, traditional bricks can be used. As you lay them out, leave space in between the bricks (Figure 8.2). You can fill this space with sand and the effect will be the same as using paving blocks.

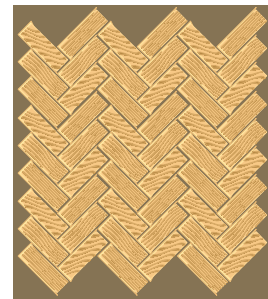


Figure 8.2

**Permeable Pavement:** Permeable pavement or concrete is similar to traditional pavement and concrete used on our sidewalks and roads, except that the gravel used in the mix is larger, which results in larger pore spaces in the pavement itself. The rainwater can then percolate through these pore spaces. Most pavement contractors should be able to provide you with more information about this option.





Figure 8.3

**Wood Decks:** Wood decks allow rainfall to flow between the boards and percolate into the soil underneath (Figure 8.3). However, you should be careful in your selection of timber for your deck avoid wood treated with chemical preservatives, which can leach into groundwater.

### A few things to consider

Before you replace driveways or sidewalks with grid pavers or permeable pavements, check with the building department of your community. Most cities have regulations regarding the types of paving materials that may be used for driveways and sidewalks.

As you are laying out your new patio or pathway, grade the surface so that it slopes to natural areas, such as garden beds. You don't want rainwater flowing off of this surface to head towards the street or the foundation of your house!

When it comes times to clean your patio, deck, sidewalk or driveway, use a broom rather than a stream of water. This will reduce the chance of the pollutants that have accumulated on the surface from entering the storm drain system. Also, this will save several gallons of water.

### References and Resources

- Bay Area Stormwater Management Agencies Association (BASMAA). 1997. Start at the Source: Residential Site Planning and Design Guidance Manual for Stormwater Quality Protection. BASMAA, San Francisco, CA.
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## Fact Sheet #9 Green Rooftops

### What is a green rooftop?

A green rooftop, also called a “Living Rooftop<sup>®</sup>”, is a thin layer of vegetation installed on top of a conventional flat or sloped roof (Figure 9.1). The vegetation can range from turfgrass to shrubs or even trees, depending on the climate and the load-bearing capacity of the roof.



Figure 9.1  
Source: Rooftops Inc.

### Why use a green rooftop?

Rooftop area as a percent of impervious area ranges from 30 to 35% in suburban development to as much as 70 to 75% in downtown business districts, and maybe as high as 80% in some warehouse/semi-industrial districts. Even partial control of these areas can reduce overall runoff volume by up to 50%. In highly urban areas, rooftops can be an unsightly element. Green rooftops and rooftop gardens provide an aesthetic appeal in the community.

In the summer, green rooftops retain 70 to 100% of the precipitation that falls on them; in the winter they retain 40 to 50%. Green rooftops can reduce the total annual runoff volume by 50 to 60%.

### What are green rooftops made of?

A green rooftop typically consists of several layers, including a waterproofing membrane, insulation, protection layer, drainage layer, filter mat, soil layer, and vegetation (Figure 9.2). Green rooftops may have an internal drainage network that directs an overflow away from the roof to inhibit ponding. Turf based green rooftops range in weight from 5 to 30 lbs per square foot, while rooftop gardens typically range from 40 to 100 lbs per square foot. The thickness of a green rooftop can range from 1 inch of soil to over 75 inches of soil, depending on the intended use and load-bearing capacity of the roof. Green rooftops can be built on roofs with slopes up to 30 degrees.

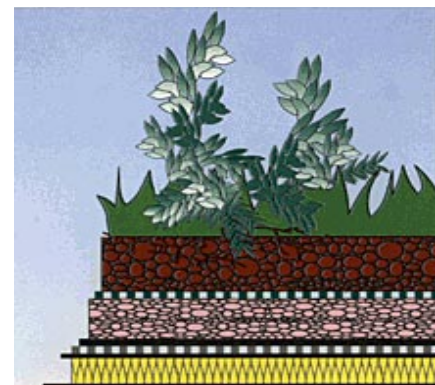


Figure 9.2  
Source: [www.greenroofs.com](http://www.greenroofs.com)

### How do I get a green rooftop?

If the projected live load of a green rooftop is greater than 17 lbs per square foot, consultation with a structural engineer is required. Rooftops gardens with large trees and seating areas (Figure 9.3) will require more structural support so it is recommended to consult a professional before installing a green rooftop.

### How much does a green rooftop cost?

The initial cost of a green roof can be 30% greater than a conventional roof, but long term maintenance and energy cost savings can offset this cost increase by a lifespan increase of 50%. Two green roof projects in the city of Toronto ranged in cost from \$33 per square foot to \$55 per square foot for re-roofing and green roof installation. One source states the green rooftops prolong the life of a conventional roof by 20 years ([www.greenroofs.com](http://www.greenroofs.com)). Green rooftops can be warranted up to 15 years, and the plant material is typically warranted for one growing season.



Figure 9.3  
Source: Optigrun International AG

## References and Resources

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