

Common Pollutants in Stormwater Runoff and Actions that Homeowners can Take to Reduce Stormwater Pollution¹

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Introduction

Stormwater runoff is rainfall that flows over the ground and is not absorbed by the soil or evaporated. Rainfall will often encounter impervious or pervious-resistant surfaces such as streets, parking lots, sidewalks, gravel roads or lots, rooftops, and other developed areas. These human-made surfaces will divert the natural flow of rainwater and direct the runoff into storm drains, retention ponds, ditches, or perhaps even the closest body of water. Any contaminants picked up from the impervious surfaces by stormwater runoff mobilize during this process—transporting fertilizer, oil, pet waste, heavy metals, soaps, and other potential pollutants from the environment into receiving waters.

This publication explains what happens when stormwater runoff enters constructed environments, its impacts on water bodies (i.e., surface waters such as lakes, rivers, and bays), and the steps individuals can take to reduce their own stormwater runoff footprint. This guide can increase awareness of ways to reduce each person’s role in water quality impairment by stormwater pollution. This publication is intended primarily for urban residential readers and does not focus on agricultural runoff.



Figure 1. Stormwater ponds and other stormwater treatment areas collect excess rainfall from the land. This stormwater is often polluted with various substances. Actions can be taken to reduce pollutants in stormwater runoff and thus help keep our ponds and other water bodies clean.

Credits: Tyler Jones, UF/IFAS

Common Stormwater Runoff Pollutants

Stormwater runoff can mobilize a variety of pollutants as it makes its way through urban environments. Impervious surfaces such as roads, sidewalks, and parking lots can accumulate pollutants such as fertilizers, soaps

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and detergents, and oil and chemicals from vehicles or industrial processes. When it rains, stormwater picks up and transports these pollutants, carrying them into nearby waterways where they can have harmful effects on the environment and human health. As urbanization continues to increase, the impacts of stormwater pollution on water quality and ecosystems become increasingly significant. Table 1 outlines some common environmental pollutants picked up by stormwater.

The Problem with Stormwater Runoff

Stormwater runoff is a nonpoint source of pollution that contributes to water quality impairment (i.e., compromised water quality) in many water bodies. Nonpoint source pollution refers to pollution that comes from a scattered or non-specific source, such as runoff from multiple farms, parking lots, residential neighborhoods, and construction sites. Unlike point sources from specific places, such as wastewater treatment plants, stormwater runoff is considered a nonpoint source of pollution because it cannot typically be pointed back to one specific place of origin. That makes stormwater runoff challenging to manage and control.

The pollutants carried by stormwater runoff can have a range of harmful effects on water quality and aquatic life. Nutrients such as nitrogen and phosphorus, which are often found in fertilizers and animal waste, can lead to eutrophication (Yang and Lusk 2018), an excess of nutrients that can lead to excessive algal growth and oxygen depletion in water bodies. For example, the harmful algal blooms that often impair Florida's coastal waters have been associated with excess nitrogen from stormwater runoff (Heil and Muni-Morgan 2021).

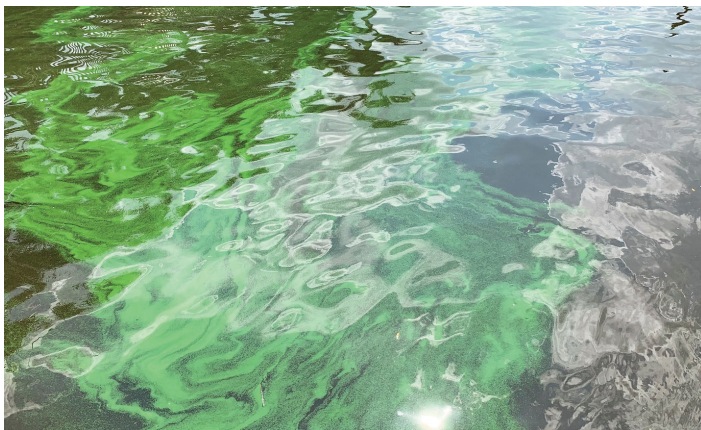


Figure 2. Harmful algal blooms such as this one can develop in our water bodies when excess nutrients from stormwater runoff are carried into the water.

Credits: Dail Laughingho, UF/ IFAS

Heavy metals such as lead, cadmium, and mercury can cause long-term damage to aquatic ecosystems by contaminating sediments and entering the food chain. Bacteria in stormwater can be harmful if they are carried to a receiving water body used for recreational swimming, where people may be exposed to the bacteria. Microplastics, which are extremely small plastic particles, can harm aquatic organisms and accumulate in the food chain, leading to long-term impacts on human health. In addition, sediment and debris carried by stormwater runoff can reduce water clarity, which can harm aquatic plants and animals by limiting the amount of light that reaches them. Thus, it is crucial to implement effective stormwater management strategies to reduce the amount of pollution entering water bodies and to protect the health of our ecosystems and communities. Below are several actions that homeowners and the general public can take to reduce the impact of stormwater runoff in urban areas.

Water Management goes a Long Way

Because water mobilizes urban pollutants and carries them to nearby water bodies, water management is one of the best forms of stormwater pollutant management. This means that simply reducing the generated volume of stormwater runoff, from the beginning, will in turn reduce the impacts of stormwater runoff. Homeowners can reduce the volume of stormwater in their communities by introducing opportunities for rainfall to infiltrate the ground. You can do this by planting rain gardens on your property and keeping soils covered with vegetation. This will promote good water infiltration by preventing soil compaction. Learn about planning and planting a rain garden here: <https://gardeningolutions.ifas.ufl.edu/design/types-of-gardens/rain-gardens.html>.

Also, roof downspouts should be diverted to pervious surfaces. Often, downspouts are turned to drain onto driveways, where excess water then flows to the stormwater network. By instead diverting your downspouts to pervious surfaces, you allow that excess water to infiltrate the soil and reduce the overall volume of stormwater flow in your neighborhood.

Finally, reclaimed water used to irrigate lawns likely contains nitrogen and phosphorus in excess compared to potable water (Toor and Lusk 2011). If sprinkler systems are not maintained to only water vegetated surfaces, then some irrigation-driven runoff may occur on impervious surfaces. Thus, irrigation systems should be checked regularly to

make sure only grass and plants are being watered and not the streets and sidewalks (Lusk and Rainey 2021).



Figure 3. Rain gardens are pervious areas of the landscape that can soak up rainwater and prevent stormwater runoff. Rain barrels can also be incorporated into the landscape to collect excess rainwater and prevent runoff.

Credits: Cat Wofford (top), Tyler Jones (bottom); UF/ IFAS



Figure 4. Reclaimed water used for irrigation may contain elevated levels of nutrients. Be sure to adjust sprinkler systems and only water vegetation, not sidewalks and streets. Images like this one not only represent wasteful use of water but also demonstrate how nutrients from reclaimed water irrigation could be mobilized to the environment in urban landscapes.

Credits: Tyler Jones, UF/ IFAS

Addressing Impacts from Fertilizers and Yard and Pet Waste

Fertilizers and yard and pet waste are common sources of nutrients, bacteria, and sediments in stormwater runoff from urban areas (Krimsky et al. 2021; Jani et al. 2020). Urban soils are often compacted and have poor drainage, making them a major contributor to increased stormwater runoff in urban areas. The process of urbanization can lead to the compaction of soils, as heavy construction equipment and increased foot and vehicle traffic can cause soil particles to become tightly packed, reducing the ability of the soil to absorb water. As a result, rainwater can quickly accumulate on the surface, leading to increased runoff and the potential for flooding. Additionally, urban soils in Florida are often sandy with low organic matter, making it difficult for them to retain moisture and nutrients, which can impact plant growth and soil health. To compensate for this, fertilizer inputs may be necessary to maintain healthy plants and vegetation.

Residential fertilizers can be managed through the 4 “Rights” (aka 4 Rs), which are 4 general areas of influence (Right Source, Right Rate, Right Time, and Right Place) involved in fertilizer management, with specific actions detailed in Table 2.

Urban residents typically have property maintenance that occurs regularly, and even more so in Florida with a year-round, sub-tropical climate in most of the state. This upkeep leads to accumulated yard waste (e.g., grass clippings, leaf litter, and trimmings/deadfall from trees, bushes, and shrubbery) within the property. Like other forms of organic matter, yard waste will break down into the basic elements that form the makeup of plant life, specifically the macronutrients nitrogen and phosphorus (Lusk, Toor, and Inglett 2020).

Nutrient loads refer to the amount of nutrients entering a water body at any time. To minimize the accumulation of mobile nutrient loads from yard waste, prevent grass clippings from leaving the permeable surface of the lawn. An example of this would be using mulching blades on the lawn mower which deposit the broken-up grass clippings onto the lawn. Alternatively, materials like grass clippings and leaves can be collected and composted. They should always be kept out of community storm drains, swales, and stormwater ponds.

Pet waste contains bacteria, as well as nitrogen and phosphorus, and have been identified as one potential source of excess nutrients in stormwater runoff in Florida’s coastal

areas (Krimsky et al. 2021). Pet waste should be collected and disposed of in a pet waste disposal bin or the municipal garbage. Pet waste should not be added to compost materials if the compost will be used for gardens or will make contact with food crops, since the pet waste may contain harmful bacteria.

Addressing Secondary Inputs: Soaps, Detergents, and Automobile Fluids

Soaps and detergents in stormwater runoff can impair receiving waters through the addition of ammonia, phenols, acids, and antibiotics. Detergents used in some car wash cleaners have significant effects on aquatic life due to the key ingredient surfactants, also known as surface active agents. These will influence a water body by killing fish eggs, damaging fish gills, and reducing the fish's ability to protect itself from parasitic and bacterial threats.

The use of car cleaners that are phosphate-free, water-based, and biodegradable is an immediate step to reduce the individual footprint from soap and detergent run-off; although, these products are not so easily found at local markets. Phosphate-free alternatives will not contribute to the nutrient loading of water that can occur when stormwater mobilizes phosphate from phosphate-based detergents. Additional steps are to minimize the volume of water used when washing the vehicle by using a bucket of water or a flow-regulating hose spray head and to wash on areas that are more permeable than a driveway, street, or paved area.

Wash-water containing phosphate and/or non-biodegradable cleaners should not be allowed to soak into the ground at all, if possible. Washing the automobile on gravel or grass gives the water an opportunity to be filtered before it can arrive at a storm drain, surface water body, or groundwater source. If washing on a paved surface is unavoidable, then locate any areas that allow the flow of gravity and the slope of the terrain to drain the water towards vegetated parts of the lawn.

Additionally, whenever emptying the wash buckets, whether filled with conventional soap/detergent or the biodegradable, water-based, and phosphate-free variety, always dispose of them in the sinks or toilets of your home instead of down storm drains or in the landscape.

To reduce the amount of automotive fluid mobilized by stormwater runoff, an effective strategy is addressing oil leaks in vehicles and identifying the proper channels to

dispose of oil and other automobile related pollutants. The Florida Department of Environmental Protection (FDEP) has a resource to help identify the nearest center for oil collection through their [public, used oil collection center search](#).

Addressing the Emerging Contaminant of Concern: Microplastics

Microplastics are becoming more recognized as an emerging contaminant of concern. Since nylon and polypropylene are used in many consumer products, it is virtually impossible for the average consumer to have not contributed to this input category. Microplastics are defined by the U.S. National Oceanic and Atmospheric Administration (NOAA) as fragments of plastic less than 5 mm in length.

Microplastics typically arrive in stormwater runoff from the chemical, biological, or sunlight weathering-fueled breakdown of larger plastics such as bottles, plastic bags, and weed whip trimmer line used in lawn maintenance. Due to the sheer prevalence of this contaminant, it is extremely difficult to erase all inputs into the watershed. Instead, commit to recycling plastics and avoid littering as effective steps to reduce this pollutant entering the environment.



Figure 5. Plastic waste can contribute to microplastics pollution in stormwater. Be sure to avoid littering and recycle plastic as much as possible to reduce the load of microplastics pollution in the environment.

Credits: Tyler Jones, UF/ IFAS

The FDEP has extensive resources, including their [recycling program contact list](#) of individuals who can help you determine where the appropriate recycling center near you is located.

Summary

This publication serves as a resource for the public to understand the various factors and land management strategies to consider regarding pollutants mobilized by stormwater runoff. The 4 “Rights” of fertilizer management and recommendations surrounding yard waste serve as effective ways to maintain and tend to lawns and gardens while reducing the stormwater footprint of the homeowner. Secondary pollutants like soaps/detergents and automobile fluids can be addressed by using more environmentally safe products like phosphate-free soap/detergent as well as general vehicle upkeep and proper disposal of automobile fluids. Microplastics are the newest addition to the list of monitored contaminants in the environment, and they are deemed an emerging contaminant of concern. FDEP resources for the proper channels of disposal of microplastics, oil, and other contaminants are linked within this publication to connect readers to these services and options.

Resources

UF/IFAS Garden Solutions on Rain Gardens: <https://gardeningolutions.ifas.ufl.edu/design/types-of-gardens/rain-gardens.html>

UF/IFAS Analytical Services Laboratories (ANSERV Labs) for Soil Testing: <https://soilslab.ifas.ufl.edu/>

EDIS Publication #LH014 with Fertilizer Information: <https://edis.ifas.ufl.edu/publication/LH014>

Florida Department of Environmental Protection (FDEP) for Oil Collection Search: https://fldeploc.dep.state.fl.us/www_rcra/Reports/puocc_query.asp

Florida Department of Environmental Protection (FDEP) for Recycling Program List: <https://floridadep.gov/waste/waste-reduction/content/recycling-program-contact-list>

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Table 1. Common urban runoff pollutants and their sources.

Pollutant	Common sources of the pollutant
Nutrients (Nitrogen and Phosphorus)	Fertilizers used in yards, gardens, and agricultural lots are often a contributing factor to high nutrients in water bodies. Soil, grass clippings, and yard waste can also contribute to nutrients in water bodies when they are washed off the lawn or yard, and the plant matter in them breaks down into these nutrients. Some nitrogen and phosphorus are present in natural rainwater. Additionally, nitrogen and phosphorus may be present in irrigation water if reclaimed water is used in the landscape.
Pesticides	Weed and insect treatments can be washed off from lawns and enter the stormwater runoff.
Soaps/Detergents	The origins of these pollutants are commonly seen when washes involving soaps/detergents are used on bare lawn space or on impermeable surfaces like a driveway (e.g., washing a car or pet outside).
Bacteria	Pet wastes (not picked up by pet owners) or leaky sewer lines can contribute bacterial contamination to stormwater.
Oil/Automobile Fluids	These often originate from changing oil or automobile fluids somewhere other than at a specific facility (i.e., at home versus a mechanic's shop). Although, general transportation will also contribute to the accumulation of these pollutants on roadways.
Heavy Metals	These include various metals such as zinc, cadmium, chromium, aluminum, lead, etc. All often come from vehicle exhaust, industrial processes, and tire treads.
Microplastics	Within household-level contributions, these come from a variety of sources, which often include the breaking down of litter such as plastic bags, plastic bottles, and lesser-known sources, like weed trimmer line as it breaks apart with use.

Table 2. The 4 "Rights" of fertilizer management.

"Right" name	Recommended steps
Source	Determine what fertilizer will provide the soil with the missing nutrients needed for plant growth. Determine if a single source of fertilizer or a combination of fertilizer products will be needed. Your local UF/ IFAS Extension office can give you information on soil testing for home lawns and gardens to help you identify the correct fertilizer source for your situation.
Rate	Using a soil test can help you appropriately apply fertilizer for lawn/grass needs. In larger lawn settings, having properly calibrated spreading equipment will increase the likelihood of proper distribution of fertilizer. Your county will have a recommended fertilizer rate for the type of turfgrass or ornamental vegetation you grow. See EDIS publication #LH014 to find the recommended rate for common Florida turfgrasses.
Time	Avoid applying fertilizers before rain events and focus fertilizer application during times of active plant growth (typically, the warm rainy season). See EDIS publication #LH014 to find recommendations for the timing of turfgrass fertilization for each part of Florida.
Place	Avoid fertilizer applications on sloped land or near surface water bodies, including stormwater ponds. If some of the fertilizer lands on impervious surfaces such as sidewalks or streets, sweep it up and place it back in the bag or on the lawn.