Wash-Water Pollution:

What it is and how you can prevent it

A practical guide for golf course superintendents

Developed by:

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Introduction

If you're like most golf course superintendents, you're discovering that there are many easy ways you can maintain healthy turfgrass while being an environmental steward. But what you may not know is that one of your most common activities—cleaning mowing equipment—is one of the easiest to modify in order to elevate your course to a more sustainable operation.

Wash water from cleaning mowing equipment that runs freely off a wash pad can pollute nearby water systems. When this happens, pollutants like nutrients, pesticides, lubricants, and oils can have a harmful effect on humans and ecosystems alike. **The New York State Pollution Prevention Institute (NYSP2I)** and **Cornell University** created this guidance document to help superintendents put in place pollution-free wash-pad practices without sacrificing your standards for clean equipment. Importantly, **this guide is designed for budgets and resources of all sizes**—many of the recommendations below can be implemented using the wash-pad setup you already have.

Why use this guide

- Learn simple fixes for saving on water and keeping pollutants out of local water sources, all while keeping your equipment clean.
- Find the approach that's right for your budget and resources.
- Get step-by-step guidance for using your existing wash-pad setup or installing a new system to tackle wash-water pollution.
- Find out how wash-water recycling systems work and what options are available to you in terms of maintenance and installation.

How used wash water becomes a pollutant

An equipment wash station is a potential source of pollution that is often overlooked in large turfgrass-mowing operations. When wash water is not filtered or captured, pollutants are released into the environment where they may reach storm drains or natural waterbodies like lakes and streams.

Grass clippings that end up in water that runs off a wash pad contain nitrogen and phosphorus, two nutrients that cause a process known as "eutrophication" when they find their way into a water body. When this happens, algae blooms can occur that can have many harmful impacts on a local ecosystem. Additionally, trace chemicals from pesticides, oils, and lubricants may be present in wash water that can lead to negative health and ecological effects when introduced into the environment.

The building blocks for cleaner wash water

The risk of pollution that a wash station may pose can be significantly reduced by following three simple steps:

1. **Reduce** the amount of water used.
2. **Remove** grass clippings from water.
3. **Filter** out any remaining pollutants.

There are many ways to put in place each step, from simple or low-cost solutions to more complex scenarios. As was done in the Golf Course Sustainability Practices **poster** and the supplemental **handbook**, the categories of "**Par**," "**Birdie**," and "**Eagle**" are used to outline the range of options available to you as you move towards less impactful wash-station practices. Pars are easy to implement for facilities of all types. Birdies and eagles require a bit more effort or investment, but they can achieve much bigger results when it comes to reducing the environmental impacts of your wash station.

PAR BIRDIE EAGLE

Based in New York State?

If your golf course is in New York State, you may be eligible to receive low-cost engineering support from the New York State Pollution Prevention Institute (NYSP2I). Our team can assist you in evaluating and implementing any of the sustainable practices described below. If you're not in New York State, there may be technical assistance providers in your area who can provide support.

Properly locate the wash area.

The simple act of moving a wash station to a less sensitive area can be a benefit to the environment. Wash stations that lack an organized system to capture and manage the effluent should be located far away from water bodies or steep slopes, and ideally route effluent through naturalized rough areas to act as a bio filter. In some cases, you may elect to designate several areas around the course as wash stations, rotating frequently to avoid overuse of any single station. This tactic disperses the concentration of water contaminants across the property, lowering the potential of point-source pollution concerns.

Blow off clippings.

Contaminants can be removed from wash water by blowing debris off equipment using an air compressor or backpack blower prior to washing. This has an added benefit of reducing the quantity of water used during washing by up to 50 percent. Blowing off clippings reduces clipping content in wash water by 50 percent, and may also extend equipment lifetimes, reduce odor, and keep crew members dry from unintended splashing.

Image 1: Using air hose to blow clippings off reels prior to washing

This area should be separated from the wash station to avoid contaminating effluent water. Dry clippings can be collected in a designated area for compost, or simply dispersed in areas of the course that are far away from water bodies.

Use low-flow hose nozzles.

Simply switching out your current hose nozzle with a low-flow version can save an additional 50 percent on water use without affecting cleaning effectiveness, based on a **case study at Locust Hill Country Club in Rochester, New York**.

Image 2: Low-flow hose nozzle

Projects with several golf courses have revealed that up to 2,000 gallons of wash water per day is used during peak season, meaning an efficient hose nozzle could **save up to 1,000 gallons a day**. Brass hose nozzles, like those manufactured by DRAMM, are built to last and have a finer threading that allows for better control of spray patterns, according to product reviews. Hose nozzles with flow rates of 6 gallons per minute or less are considered low-flow.

BIRDIE

Measure water use.

You won't know how much you can save until you know how much you use. Tracking water use can be accomplished by simply outfitting the primary washing hose with a flow meter and tracking water volume used at regular intervals (e.g., weekly or monthly). Take note of certain times when water use is higher or lower. For example, if the course has received excessive rain causing more debris to collect on equipment, determine if water use was greater during that period of time.

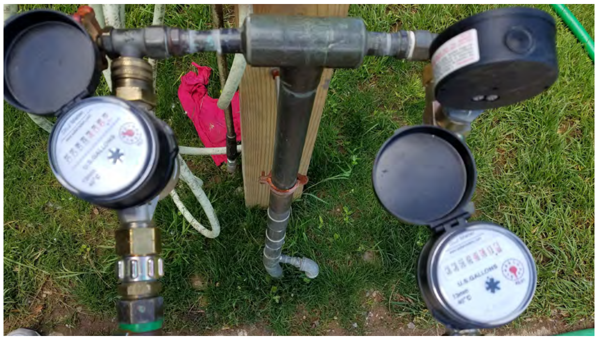


Image 3: Flow meters attached to wash station hose

Filter residual clippings from wash water.

A low-cost method called "coarse filtration" can be used to capture residual clippings in the wash water. Some courses have used double-layered chicken wire placed in the flow path of water, while others have used pre-fabricated clippings and solids separators (pictured). The goal is simply to catch solid material before it exits the wash station. Clipping material should be cleaned out of filters routinely and placed either in a composting area or dispersed far away from water bodies.

Image 4 (LEFT): Double-layered chicken wire filtering out clippings as water flows through trough. Image 5: (RIGHT): An example of a pre-fabricated separator—a hydroscreen—to filter out clippings. A bucket can be placed under this device to collect filtered clippings.

EAGLE

Install a system for recycling wash water.

The most effective way to minimize wash-water release into the environment is to implement a closed-loop water treatment system. These systems recycle and treat a finite amount of water to be used continuously for washing equipment. Reusing water drastically reduces water use and eliminates wash-water discharge into the environment. The common core components of these systems include: a water collection trough, grass clipping filtration, sediment settling, biological treatment, and storage tank.

Wash-water recycling systems are commercially available for purchase from several companies but can also be constructed in-house. Choosing the option that is best for you involves a variety of factors, all of which are addressed in the next section.

Introduction to recycled wash-water systems

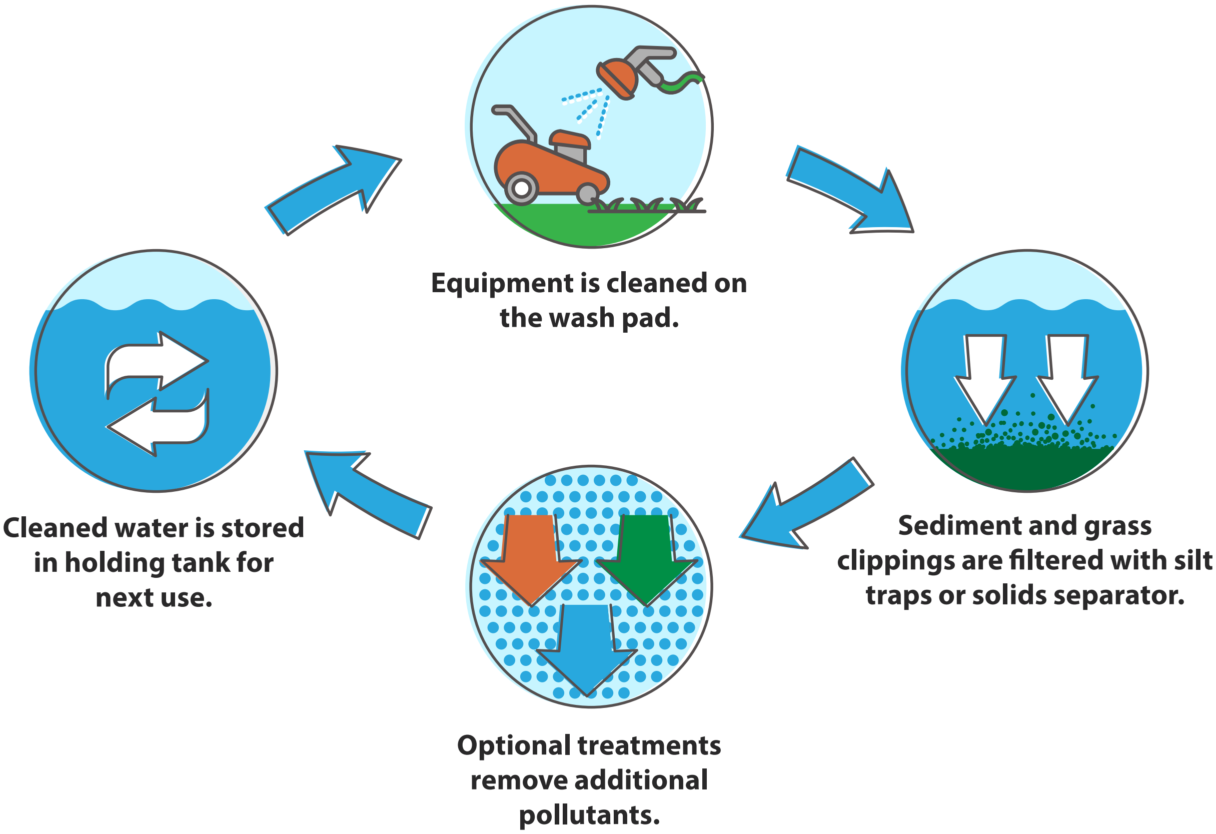
A recycled wash-water system is the best way to reduce risk at your wash-pad site because it collects, contains, and treats all the water used for equipment washing. Typically, these systems are sold and installed by manufacturers as turnkey solutions integrated into existing maintenance areas. However, there is also an option to build one yourself. When installing either kind of system, you should consult your local regulatory agencies to ensure the system conforms to local and state regulations.

Do-it-yourself (DIY) vs. turnkey systems

The primary driver in the decision between a turnkey and DIY system is cost. Turnkey systems can cost between two and four times more than DIY systems, which can be prohibitive to some facilities. However, you should also consider the time and effort that is required to install a DIY system.

How recycled wash water systems work

All recycled wash-water systems use the same general principles to collect and clean water. First, a wash pad is situated such that water used for equipment washing slopes towards a collection area. Sediment and grass clippings are then filtered out, either using silt traps or a solids separator. This removes debris from the water and allows for secondary and tertiary treatment of the water. From there, a variety of other additional treatments can be employed, such as activated charcoal filters, aeration, or biological treatments that help remove additional pollutants in the water. The final component is a holding tank where cleaned water is stored, ready to be used for cleaning once again.



Important considerations

Will the system be sized according to my needs?

It is appropriate to ask if commercial systems can be scaled to your needs. For example, can the system be scaled down to accommodate a nine-hole operation and, conversely, can it be scaled up to fit a 36-hole operation? Different system sizes will have impacts on project costs and routine maintenance.

What is the footprint of the system?

There is often limited space at maintenance facilities between buildings, storage areas, and parking. You should consider the space required for a wash pad, water-recycling components, and a separated space for blowing off clippings during the planning process.

Can the system be retrofitted to an existing concrete pad?

Some systems require pouring a custom pad around system components, while others can be placed on an existing pad. This should be considered when evaluating the overall budget.

What routine maintenance is required?

It is important to know how to maintain system components for optimal performance and lifetime. Regular maintenance may include disposal of solid waste, addition of biological organisms to treatment compartments, or filter replacements. Key parts like pumps and sensors may have to be repaired or replaced. Any system you install will require at least some maintenance.

Where should the system be placed?

The following criteria must be considered in order to maximize the function and lifetime of the system:

- **Proximity to electrical source:** An electrical source is needed to operate any compressed air or pumps required in the system. Locating the source centrally to all the wash-system components is ideal. You may also consider installing solar panels to generate power.
- **Proximity to water bodies:** In case there are any overflow situations due to rain or leaks, it is best to have the system located far from any waterbodies. While this system contains all the water used, it is still necessary to drain the system occasionally to introduce "new" water; water can only be reused so much before treatment or removal is needed. Water from the holding tank should be emptied periodically. Water can be disposed of in one of two ways:
    1. Disperse water in area of rough grass or vegetation.
    2. Have water hauled off site.
- **Proximity to trees:** Facilities have reported that leaves and sticks falling from trees can contaminate the system, requiring frequent clean-up. If possible, locating the station in an open area will reduce maintenance time and extend the system's lifetime.
- **Separation from heavy-equipment washing area:** Most recycled-water systems can handle small amounts of sediment, but they are not equipped to handle large loads of sand or soil that may be washed off of heavy machinery. If tractors or sediment-laden equipment require cleaning, this should be done in a separate area.

Turnkey systems

Below are some commercially available turnkey systems that could be used at golf courses. NYSP2I and Cornell University do not endorse any product in particular; the following information is for educational purposes only.

- **Waste2Water:** https://www.waste2water.com/service/golf-course-and-turf-care/
- **ClearWater:** https://acumenwaste.co.uk/services/clearwater/washdown-pads-and-treatment/
- **Carbtrol:** https://carbtrol.com/industries/golf-courses-and-sport-stadiums/

For those who do not have the budget for a commercially available system, you can consider building your own. The next section explains the key components, site considerations, and routine maintenance practices that will guide you in constructing and maintaining your own recycled wash water system.

Building a DIY recycled wash-water system

Understandably, many are hesitant to install a DIY recycled wash-water system because of the logistics that designing and building it would require. However, if funds for capital expenditures are limited, this option may work. NYSP2I may be able to provide low- or no-cost design and engineering assistance to any golf course in New York State. More information can be found in a free webinar from Cornell's School of Integrative Plant Science, "**Golf Course Pollution Best Management Practices (BMPs)**."

Two versions of a DIY system have been used in New York over the years, both were developed by superintendents with NYSP2I's assistance. The following section explains in more detail how to best build these systems based on current knowledge.

Eight core components make up a recycled wash-water system:

1. Compressed air (for pre-wash blow-off of clippings)
2. Water collection
3. Clipping filtration
4. Water transfer from collection to a settling tank
5. Settling tank
6. Water transfer from settling tank to a storage tank
7. Storage tank
8. Booster pump and hose nozzle

Core components of a DIY wash-water recycling system

1. Compressed air:

A wash-water recycling system still requires an area where clippings are blown off equipment using compressed air prior to washing with water. An area separate from the washing area should be designated to help ensure as many clippings as possible do not load the wash station. In addition, up to 50-percent less water should be needed to wash off equipment. This factor is important as sizing for less water reduces the scale of the recycling system, which leads to lower costs.

2. Water collection:

Water collection is a critical part of any recycling system, whether it be in conjunction with a turnkey system or DIY system. When water is used to wash off equipment, there must be a way to direct that water into a confined area. The easiest approach is to use a concrete pad that slopes towards a trough where water can be collected in a crock and prepared for transfer into a settling tank. The trough also represents an ideal location to filter out any clippings that may remain in the water. (Note: Blowing off clippings prior to washing equipment in a separate area is still recommended.)

Image 6: A pad feeding a trough with two screens to filter out clippings

The wash pad should be large enough to accommodate the maximum amount of equipment that is washed at the same time. The wash pad should slope at a minimum one quarter of an inch (0.25 in.) per foot and drain to a common sump area. The trough in the sump area should be sized to hold an amount of water equal to the maximum water use per day to avoid overflowing.

3. Grass-clippings removal:

Removing grass clippings requires a fine screen, which can be conveniently placed in the wash-pad trough. This initial level of screening catches large clippings, but a finer screen is still required for smaller material. A finer screen can be placed on the crock cover or an external clippings separator can be installed. Several layers of clipping filtration can be used, as pictured below, to fully remove clippings.

Image 7: Clippings buildup at initial screen

Image 8: External hydroscreen to filter out excess clippings

Image 9: Initial chicken wire screen

Image 10: Additional crock cover screen

4. Water transfer from collection to a settling tank:

A pump system will be required to move water from the crock into a settling tank. It is suggested to use a sump pump with a float switch to automate the process of pumping water out of the sump when full (Image 11).

Image 11 (LEFT): A sump pump installed at bottom of well
Image 12 (RIGHT): Dispersal of water into the settling tank using PVC pipe with holes drilled in the bottom

The dispersal of water into a settling tank is important. A polyvinyl chloride (PVC) pipe should be run across the top of the sand filter with holes drilled every 1.5 inches along the length of the pipe (Image 12). These holes allowed water to disperse across the entire area of the sand filter (below). The hole size across the pipe varies to account for pressure dropping across the length of the pipe, with 0.25-inch holes drilled at the beginning, 0.375-inch holes in the middle, and 0.5-inch holes at the end.

5. Settling tank:

The settling tank filters water through a combination of sand and gravel. Samples taken from previously constructed systems showed that there was over a 10-fold decrease in organic material (measured by chemical oxygen demand) after water is run through the settling tank. Significant reductions in bacteria and turbidity were also measured. The settling (and holding) tanks should be sized based on an estimate of a reasonable amount of water needed to wash equipment during a day of maximum wash-station use. It should also be considered that water will need to be treated and then put into the holding tank for reuse.

Image 13: PVC outlet pipe with 0.375-inch holes and mesh covering

An outlet pipe at the bottom of the tank can be installed, with 2 feet of PVC extending into the tank. The extension should have 0.375-inch holes with 1–2-inch spacing so that water can exit through the pipe. This can then be wrapped in mesh to prevent filter media from entering the holes (Image 13).

The filtration media will consist of 12 inches of gravel in the bottom of the tank (Image 14), followed by bunker or topdressing sand to fill the tank up until there was enough room under the PVC pipe for water to disperse (Image 15). It is possible that the depth filtration media, or the kind of sand, may play a role in the degree of water quality that can be achieved, but that is not known yet. It is also yet to be known how often sand requires replacement. Current versions of this DIY systems have replaced sand annually.

Image 14: Gravel base layer

Image 15: Sand filter

6. Water transfer from settling tank to a storage tank:

In prior systems, a transfer drum was required as an intermediary container to move water into the storage tank (Image 16). Water cannot be pumped directly out of the sand filter, so a hydraulic head was used to allow gravity to move water into the transfer drum where it could then be pumped into the storage container (Image 17).

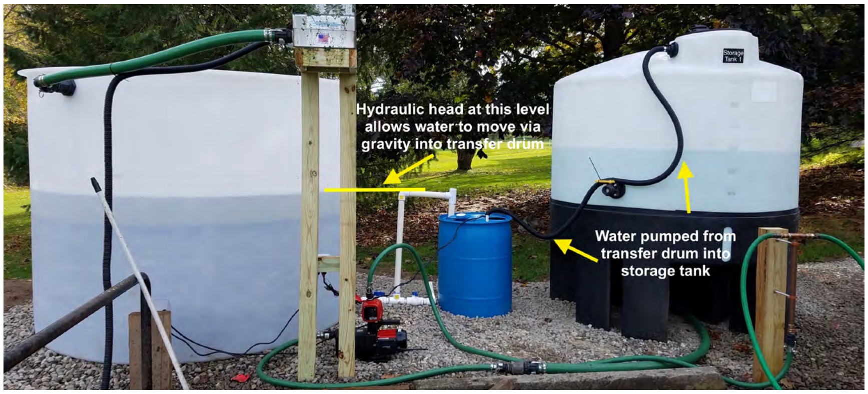


Image 16: Transfer drum set-up

A newer system featured a design change that made use of gravity to support the transfer of water. The bottom of the sand filter was placed at an elevation above the top of the storage tank, and a simple connection between the two tanks using PVC pipe allowed gravity to transfer the water into the storage tank (Images 17, 18). This design modification resulted in two key improvements: 1) It eliminated the need for the transfer drum and transfer pump, and 2) it allowed the sand filter to stay perpetually dry, which reduced microbial growth that required sand replacement.

Image 17 (LEFT): Side view of Version 2 showing settling tank above storage tank; excavating was required to place the storage tank at a lower elevation. Image 18 (RIGHT): Full view showing gravity feed pipe connecting two tanks.

7. Storage tank:

A storage tank, like the settling tank, should be sized based on the maximum daily amount of water used.

8. Pump and hose nozzle:

The last piece to complete the closed-loop cycle is a pump to power the hose for washing equipment. To do this, a simple booster pump can be installed attached to the outlet of the storage tank.

How to maintain a DIY wash-water recycling system

Like commercially available units, this wash system will require a certain amount of routine maintenance.

Daily:

- Clean debris/clippings out of the collection trough.

Weekly:

- Log flow-meter reading on hose nozzle to assess weekly water usage throughout the season.
- Check settling tank surface for organic buildup. Shovel out organic material, if necessary.
- Check storage tank for algae. Water can be drained and replenished with new water or rainwater if algae is present.
- Check water volume in storage tank and release water, if necessary. Over time, water can be lost from the system due to evaporation or added to the system as rainwater. Enough room should be left in the storage tank to handle added water in the case of a large rain event.

Wash-pad surface area (sq ft)	Volume of room left in storage tank (gals)
100	125
150	187
200	249
250	312
300	374
350	436
400	499

Monthly:

- Discharge a portion of water from the storage tank and replace it with either rain or clean water. This helps to dilute any persistent pollutants in the recycled water over time.

Ready to build your own, but don't know where to start?

Engineers from NYSP2I can work with you to design, plan, and implement a wash-water recycling system that is right for your course.

To learn more, email **nysp2i@rit.edu** or call **585-475-2512**.

Resources

- *Best Management Practices for New York State Golf Courses* from New York Golf Course Foundation, Golf Course Superintendents Association of America, and Cornell University: https://nysgolfbmp.cals.cornell.edu/wp-content/uploads/2021/11/new-york-bmps-2nd-edition.pdf
- "Complete Guide to Wash Water" from Waste2Water: https://www.waste2water.com/wash-water-questions-answers/
- "Golf Courses and Wastewater Diversion" from Environmental Equipment Engineering: https://eeeusa.net/golf-courses-and-wastewater/
- "Using Recycled Water On Golf Courses" from the Environmental Institute for Golf: https://www.stma.org/sites/stma/files/pdfs/gcsaa_recyledwater_leaflet.pdf
- "11 Maintenance Operations" from *Best Management Practices for New York State Golf Courses*: https://nysgolfbmp.cals.cornell.edu/11-maintenance-operations/
- The Audubon Cooperative Sanctuary Program for Golf: https://auduboninternational.org/acsp-for-golf/
- "The Golf Course Superintendents Association's (GCSA) statement on water quality": https://www.gcsaa.org/advocacy/priority-issues/water-management/water-quality
- Golf Course Sustainability Program at NYSP2I: https://www.rit.edu/affiliate/nysp2i/golf

About the New York State Pollution Prevention Institute (NYSP2I)

The New York State Pollution Prevention Institute (NYSP2I) is led by the Golisano Institute for Sustainability at Rochester Institute of Technology (RIT) and is a partnership between RIT, Clarkson University, Rensselaer Polytechnic Institute, Binghamton University, Cornell University, and the New York State Manufacturing Extension Partnership.

NYSP2I is a trusted resource for organizations across the state seeking cost-effective strategies for realizing new levels of efficiency and minimizing their impacts on the environment. Its team of engineers and researchers collaborate with decision-makers—small-business owners, manufacturers, community leaders, and municipalities—working to make New York State a national model for sustainability, waste reduction, and pollution prevention.

For more information, visit: **nysp2i.rit.edu**

About Cornell University's College of Agriculture and Life Sciences (Cornell CALS)

Cornell CALS is a premier institution of scientific learning, tackling the complex challenges of our time through purpose-driven science that advances understanding and improves life. As part of New York's land grant university, Cornell CALS connects the life, agricultural, environmental, and social sciences to provide world-class education, spark unexpected discoveries, and inspire pioneering solutions.

Cornell CALS actively pursues its mission to serve the public through its effort in education (more than 3,000 undergraduate and 1000 graduate students), research (350 faculty and more than $200 million in research expenditures), and extension/outreach. Putting knowledge and research to work for local, national, and global communities has always been a primary purpose of the college.

For more information, visit: **cals.cornell.edu**

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