Municipal Stormwater Toolbox for Maintenance Practices
June 2016

This toolbox was adapted from materials prepared for the Oregon Association of Clean Water Agencies.

Table of Contents

Chapter 1
Introduction

What is the toolbox?
This Stormwater Toolbox for Maintenance Practices was developed to assist Town staff in developing and implementing a pollution prevention program. The toolbox provides quick and easy guidance for staff about ways to integrate water quality-friendly practices into routine everyday maintenance activities.

How should the toolbox be used?
The toolbox can be a guide for maintenance managers and field crews alike. Managers can use the activities checklist in Chapter 2 as a starting point for describing the overall maintenance program. Crews can refer to Chapters 3 through 7 in the field. These chapters provide "Clean Water Tips" for various types of maintenance practices, such as roadway repair and storm sewer cleaning and repair. Case studies from other organizations with successful stormwater programs are presented, together with names and numbers of contacts to help locate additional information. Chapters 8 and 9 present ideas for Town staff about stormwater education and Chapter 10 lists resources for more information.

Each chapter in the toolbox may be pulled out and used individually, so naturally there may be some redundancy between chapters. The toolbox should be considered a starting point for describing and evaluating your program. It does not provide detailed guidelines or design specifics. Refer to the documents listed in Chapter 10 and other design manuals for more details.

How does maintenance affect stormwater quality? Maintenance practices, which remove sediment, trash, and debris from roadways and storm sewers can help prevent flooding and related damage and erosion. But, these practices can also help protect stormwater and stream quality. Sediment removal is particularly important. This is because metals, pesticides, and other pollutants are often physically or chemically bound to the dirt and organic leaf materials that wash from town streets and other paved surfaces. A maintenance program which removes this material before it is discharged into storm sewers and drainage courses helps improve water quality. Sediments reaching streams and rivers can cover fish spawning gravels, create cloudy water conditions, and lead to silt build-up. Pollutants carried in these sediments — including oil and grease, hydrocarbons and metals from auto use — can degrade water quality and build up in stream bottom materials. Floatable wastes (e.g., trash and debris) carried to streams through the storm sewers collect at points where the stream narrows, blocking water flow and creating an eyesore and public nuisance. Large amounts of vegetative (organic) material reaching the streams will deplete oxygen levels as it breaks down, and these low oxygen levels will not support fish and aquatic

life. Other maintenance operations also can affect stormwater quality. These include inspection and servicing of fleet vehicles and equipment and the manner in which the maintenance facilities and yards are operated. When waste materials and chemicals leak or spill at these locations, they may be carried from the site in stormwater runoff to the storm sewers or nearby creeks. Simple housekeeping practices can reduce the risk of adding these pollutants to the environment.

The use of sands and gravels for ice control in the winter can contribute to the suspended solids loads delivered to a stream. Also, the use of certain deicing chemicals can deplete a waterway's dissolved oxygen which is needed for fish to survive. Pesticides and herbicides improperly applied in roadside areas have the potential to cause damage in receiving streams. Large amounts of some of these chemicals accumulating over time can kill or cause deformities in fish and other aquatic life. Some pesticides are very persistent in the environment and take many years to naturally degrade. Use of these materials should be a careful decision – choose chemicals that are less harmful to the environment and rotate types of chemicals applied. Select herbicides that are designed to destroy invasive plants while retaining a certain amount of vegetation, which can help filter stormwater runoff, stabilize slopes and prevent erosion. Strike a balance between chemical treatment needed for safety and fire control with protection of water quality.

Finally, roadway repair and utility work in the right-of-way can contribute sediment and construction waste materials to stormwater runoff. Proper and regular maintenance of the entire storm sewer system, including components such as pipes, inlets, and ditches is important. Regular inspection and cleaning of specialized stormwater quality facilities such as oil/water separators, compost and sand filters, detention ponds and grassed swales is also critical. Otherwise, stormwater flows may bypass these facilities without any treatment at all.

Why should we act now?
Many municipalities in Virginia have stormwater permits, which require them to conduct maintenance practices in a manner which protects water quality.

- Many of the actions described in this toolbox are common sense ideas for environmental protection.
- Most activities can be easily adopted as part of existing daily maintenance routines.
- The public expects water quality and natural resource protection to be handled, in addition to traditional flood control.
- Staff should set an example of effective pollution prevention for the general public.
- Improved maintenance practices that reduce pollutant loadings to sensitive streams can help protect and potentially restore fisheries.

- Finally, the new stormwater regulations require these types of improved actions for both large and small municipalities.

Chapter 2
Developing a Water Quality-Friendly Maintenance Program

This chapter of the Toolbox is intended for operations and maintenance managers. The goal is to provide guidance for design and implementation of the overall maintenance program in your organization. Presented here are six steps for improving your program and an easy checklist for describing your current program. Following the checklist are ideas for funding, a discussion of the need for coordination between maintenance and other planning efforts, and finally, suggestions for dealing with maintenance contractors. Six steps for managers – integrating water quality-friendly practices into your program

Step 1: Describe and evaluate your existing program
Use the Checklist. Refer to the Activity Checklist later in this chapter as a starting point in describing your organization's maintenance practices. Check those activities that apply, or add other activities in the spaces provided. For each maintenance practice listed, go to the specified Toolbox chapter for more guidance and case studies describing lessons other communities have learned about water quality protection.

Step 2: Gather input and ideas for improving maintenance practices
Use the last column in the Activity Checklist to record your own notes about how your organization's practices might be improved or modified. Then share these ideas with other staff in your organization and ask for their input. The outcome of this task will likely be a list of simple, low-cost improvements, as well as some larger, more costly improvements your organization can make over the coming years. Examples of lower cost solutions include training staff about water quality issues or purchasing simple inlet protection materials for crews. Improvements that will require a major capital investment might include purchasing a new vacuum truck for cleaning storm sewers or streets.

Step 3: Initiate a pilot program and keep records
Consider making some of the more major program improvements on a pilot scale level to test the practices before applying in your entire service area. Plan to run pilot tests for six months to one year. This can be very cost-effective. Keep records during the pilot program about what is working and what is not.

Step 4: Develop a work plan and record keeping/tracking forms
Once possible maintenance improvements have been identified, develop a schedule for making the changes. Indicate who is responsible for doing the work and who will be following-up. Adjust standard record keeping forms, so that maintenance staff can begin to keep records of their actions to protect water quality. For instance, for storm sewer cleaning, it would be good to track how much and what type of debris was removed, notes about any signs of pollution observed, and when further follow-up is needed.

Step 5: Implement your work plan and annually assess the program
Implement your work plan according to the schedule defined in Step 4 and keep records. Every year, before your budgeting process begins for the coming fiscal year, take some time to reevaluate your agency's maintenance practices.

Answer these questions:

- Are the maintenance staff aware of how their actions affect stormwater quality?
- Have staff been making improvements — what do the records show?
- Are the improvements working (in your opinion, as well as staff's)?
- Is more improvement needed — what other practices need to change?
- What lessons were learned during the pilot test(s)?
- Are additional resources and capital required to continue the program?
- Refer to your Activity Checklist again to make sure that all possible practices have been considered during this annual assessment.

Step 6: Share results
Finally, consider sharing your success stories and lessons learned with other agencies. Others can learn from your experiences!

Maintenance Manager's Activity Checklist

Use the checklist on the next page as a starting point in describing your organization's maintenance practices. Remove the checklist and make additional copies for future use and reference. Check those activities that apply to you or add other activities in the spaces provided. For each practice, refer to the specified Toolbox chapter for more guidance and case studies. In the "Manager's Notes" column, make notes about improvements you'd like to make related to each activity on the checklist.

Maintenance Manager's Activity Checklist

Use this checklist as a starting point in describing your organization's maintenance practices. Check those activities that apply, or add other activities in the blank spaces provided. For each practice, refer to the specified Toolbox chapter for more guidance.
Name, Title: _____ Date: _____

Practice	Applies (Y/N)	Toolbox Page #	Manager's Notes
Maintaining the Storm Sewer System		**Chapter 3**	
Culvert cleaning & repair		13	
Pipe cleaning & repair		13	
Catch basin/inlet cleaning & repair		15	
Drainage channel (ditch) maintenance		16	
Natural stream maintenance		17	
Detention pond maintenance		18	
Maintenance of other treatment devices		18	
System retrofitting		19	
Maintaining & Repairing Roadways		**Chapter 4**	
Street cleaning		24	
Roadway repair		25	
Surfacing & resurfacing		27	
Pavement marking		28	
Snow & ice control		28	
Bridge repair & maintenance		29	
Utilities in roadways		30	
Maintaining Roadside Areas		**Chapter 5**	
Roadside ditch cleaning		32	
Vegetation management		34	
Erosion control		34	
Litter control		35	
Wall & slope maintenance		35	

Practice	Applies (Y/N)	Toolbox Page #	Manager's Notes
Pedestrian facilities maintenance		36	
Guardrail & fence repair		37	
Keeping a Clean Maintenance Yard		**Chapter 6**	
Vehicle maintenance		40	
Vehicle washing		40	
Bulk materials storage		40	
Hazardous materials storage		40	
Above ground fuel tanks		40	
Fueling areas		40	
Garbage dumpsters		41	
Oil & grease controls		41	
Erosion controls		41	
Sediment controls		41	
Stormwater filter(s)		41	
Detention pond/wetlands		42	
Other treatment devices		42	
New or remodeled facility being planned		42	
Waste minimization program (recycling, etc.)		42	
Site drainage map		42	
Stormwater outfalls		42	
Storing and Disposing of Waste Materials		**Chapter 7**	
Concrete, asphalt & slurry		44	
Road fill/base material		44	
Sludge & sediment (vacuum & street sweeping waste)		44	
Dredged sediments		44	
Dropped leaves		44	
Other vegetation		44	
Deicing sands & gravel		44	
Recycling practices		44	
Dewatering practices		44	

Stormwater Toolbox for Maintenance Practices

Practice	Applies (Y/N)	Toolbox Page #	Manager's Notes
Educating Staff about Stormwater Quality		**Chapter 8**	
Safety meeting presentations		45	
Training		45	
Tools for maintenance crews		45	
Signs posted at facilities & yards		45	
Involve staff		45	
Recognize accomplishments		45	
Educating Public about Stormwater Quality		**Chapter 9**	
Informational flyers		46	
Door hangers		46	
Newsletter/paper articles		46	
Utility insert(s)		46	
Direct mailers		46	

Chapter 3
Maintaining the Storm Sewer System

This chapter of the Toolbox describes various maintenance practices for the separate storm sewer system and provides a few easy tips for conducting the work in a way that helps protect the environment:

- Inspecting the system
- Cleaning and repairing storm sewer pipes and storm drain inlets
- Cleaning ditches and stream channels
- Maintaining detention ponds and other stormwater treatment devices

The importance of inspection

Why inspect? Regular maintenance of the storm sewers is important for flood control, structural integrity, and water quality reasons. This chapter suggests how often to clean, based on what other communities have found. However, each agency should ultimately determine the best schedule to meet its needs. The way to do this is through a routine inspection program.

In addition to helping determine how often to clean, regular inspection of the storm sewer system will identify problems. Small problems such as clogged inlets and illegal dumping can be addressed in short order before they cause serious damage or harm. Greater problems such as large amounts of silt build-up or streambank erosion should be studied further to identify the source of the problem and plan the best solution. Other problems that routine inspections might uncover are collapsed pipe and leaking joints. Both of these situations can saturate soils and cause sinkholes and flooding. Failing pipes can also allow dirt and sediment to enter stormwater, which carries the material out to streams and rivers.

How often to inspect? A good rule of thumb is to conduct inspection of storm drain inlets, ditches, channels, ponds and other treatment facilities at least once a year, prior to the beginning of the rainy season. Complete inspections early enough so that repairs can be made during dry weather. Catch basins should be inspected at least once every six months. Some stormwater treatment devices, such as oil/water separators, may require more frequent inspection. For these, check the manufacturer's specification or other design guidance handbooks. Sewer pipes and culverts should be inspected every three to five years, or in response to a reported problem. Most agencies inspect their sewer pipes six inches or larger with a TV camera, and pipes 36 inches or larger with a walk-through inspection. All other parts of the system are inspected visually.

What to look for during an inspection? Look for excessive silt build-up, erosion, unusual algal growth, cracked or collapsed pipes, misaligned joints, and other signs of problems such as a sheen on the water surface, discolored water, or an unpleasant odor. Check with product manufacturers or stormwater handbooks for advice on what to look for when inspecting more sophisticated treatment devices such as flow splitters and diverters. When a problem is noted, take steps to correct the problem, or route this information immediately to the appropriate individual(s) in your organization who can respond. If needed, develop a good response plan to ensure quick follow-up in the future.

Culvert/pipe cleaning and repair

Description:

A culvert is a relatively short section of pipe usually designed to convey flow under or away from a roadway. Because of its semi-open nature, it is prone to blockages from vegetation, trash, and other debris in addition to sediment. Localized flooding indicates the existence of problems. Inspection is usually a simple visual observation.

Cleaning procedures also tend to be relatively easy, due to access from the open end, although it often requires some hand work. Most maintenance crews have an assigned territory and know which culverts are likely to cause flooding problems.

Pipes are longer than culverts and more likely to be deeper underground and located in areas such as backyards where access is difficult. Inspection and cleaning of pipes generally requires confined space entry training and procedures. That's the bad news. The good news is that pipes are less likely than culverts to become clogged.

Tree roots, sediment buildup, collapse and poor alignment are all causes of blockage problems. Problems with tree roots occur mostly in smaller, older pipes at shallow depths (12 inches or less, 1950's or earlier, and less than 10 feet in depth). Willows, poplars, cottonwoods, and other moisture loving trees tend to be the most common culprits.

Culvert and pipe cleaning is usually done in response to flooding complaints. The main sources of maintenance problems in culverts and pipes are sediment accumulation, entry of roots and infiltration and inflow. Commonly used cleaning methods to remove sediments from storm sewer pipes (roughly in order of increasing cost) are:

- Jet cleaning/vactor cleaning. Jet cleaning flushes the sewer with water and collects the material flushed from the sewer in a basket as it gravity flows down the pipe. A vactor assembly is often combined with the jet to vacuum out the flushed water and debris.
- Sewer balls are placed in the upstream end of the sewer and forced through the pipe by a jet of water. There are many variations in terms of the sewer balls; some are ridged, for instance, causing them to spin and more thoroughly clean the pipe. This technique can be risky in terms of damage to pipes and is generally more common in Europe than the U.S.
- Rodding involves pushing cleaning tools through the sewer to clear blockages.
- Bucket machines drag buckets along a line from manhole to manhole to clear sewers.

There are four main ways to control root infiltration in storm sewer pipes:

- Construct infiltration-free systems.
- Seal joints or defects in existing pipes to prevent entrance of roots.
- Cut and physically remove root formations in the pipes.
- Kill roots with chemical applications

Clean Water Tips:

1. Inspect sewer pipes and culverts as needed when problems are suspected (i.e. backups/overflow). Schedule TV or walk-through inspections in order to identify and eliminate water quality and other structural problems.
2. Use long-lasting cleaning measures. For root removal, build-out and block-out are more permanent and have the least water quality impacts. These methods can last for 20 years or more. Removal of roots with power rodders with an attached cutting tool (clean out), on the other hand, is effective for only three to twelve months. According to a study done by Sullivan in 1977, chemical applications tend to be effective for three to five years, if the pipes are temporarily blocked during application to increase residence time. However, there's always the risk that using chemicals will add pollution to stormwater.
3. Use rodding instead of chemicals for removing roots. Rodding is effective at removing roots, and to a lesser degree, sediment buildup.
4. Prevent chemical pollution. If chemicals must be used to kill roots, block pipes downstream of the application to prevent chemicals from traveling downstream. This also increases chemical effectiveness by increasing contact time with the roots. Foam chemicals are also more effective than liquid to increase the contact time and better fill the pipe. When the job is completed, vacuum the chemical residue and dispose of properly. Note that this residue may be regulated as a hazardous waste.
5. Target maintenance to sewers most in need. Perform maintenance only on those pipes which really need it. Sediment buildup depends on several factors, including sewer size and gradient. For most storm sewers that are sized and placed correctly, silt will begin to build up immediately after cleaning and reach an equilibrium within a few weeks or months. These pipes can go for years without requiring sediment removal. If sewer slopes are too gradual, however, the sewers are at risk of clogging.
6. Install downstream debris traps before cleaning sewers. Use baskets or other materials to trap silt and debris and a vacuum hose to collect it, instead of flushing the materials downstream.

Catchbasin/inlet cleaning and repair

Description:

Catchbasin/inlet cleaning and repair has traditionally been performed to respond to localized flooding problems in streets. Catchbasins are inlets at the curb with a small trap (usually six inches to one foot deep) below the sewer pipe. These devices help to clean stormwater because particles in street runoff settle into the trap before the water enters the storm sewers. Catchbasins require regular cleaning of the sediment trap to be effective (see below). Since the late 1960's, however, most agencies have stopped using catchbasins and are installing "self-cleaning" storm drain inlets instead. The inlets do not trap sediments and don't need cleaning unless they are plugged. Cleaning for either catchbasins or inlets can be done by hand (e.g., with a clamshell or shovel) or with a vacuum truck.

Clean Water Tips:

7. Inspect and clean catch basins as needed. Unlike inlets, catch basins need to be cleaned even if they are not plugged, in order to receive the water quality benefits. Studies have shown that when 50 percent of the trap is filled, efficiency drops a lot. Therefore, to protect water quality, inspect catch basins as needed and clean them out before they are half-full.
8. Inspect and clean storm drain inlets as needed. A good rule of thumb is to inspect inlets at least once a year before the rainy season, and clean them as needed based on the observations.
9. Dispose of sediments and debris properly. The sediment removed from a catch basin may contain high levels of pollutants. It must be tested to determine if the waste is hazardous. Hazardous wastes must be disposed of in a licensed hazardous waste landfill. See Chapter 7 for more information. Collected leaves may be landfilled, or if possible, composted. Additional regulations for disposal of wastes cleaned out of stormwater facilities may be published by federal and state regulatory agencies in the future.

Drainage channel (ditch) maintenance

Description:

Removal of silt, debris, and overgrown vegetation helps to maintain the flood control capacity of drainage ditches. Sediment and debris removal may also improve water quality downstream by removing the pollutants contained in those deposits. However, leaving some vegetation in place helps to prevent erosion, trap sediment, and filter stormwater. Maintenance frequency for ditches will vary and should be based on problems identified during inspection.

Clean Water Tips:

10. Inspect and clean ditches and channels as needed. Generally, sediments need to be removed annually and mowing is necessary several times during the growing season. Small amounts of sediment or debris may be removed by hand. Larger deposits may require heavy machinery, such as a backhoe or specialized ditch cleaning equipment.
11. Do not overclean. Leave some vegetation along the banks of channels to help stabilize the soil and prevent erosion.
12. Alternate cleaning. When cleaning ditches, use machines to clear select sections and leave untouched sections in between to allow for filtering of stormwater and settling of sediments. The sections not cleaned on the first pass may be cleaned once the vegetation has reestablished itself in the previously cleaned sections.
13. Dispose of sediments properly. The sediment removed from a ditch may contain high levels of pollutants; if so, it should be disposed of properly. See previous note in this chapter about testing requirements to determine disposal options, and also refer to Chapter 7.

Natural stream channel maintenance

Description:

Like ditches, removal of silt, debris, trash, and overgrown vegetation helps to maintain the flood control capacity of stream channels. Sediment and debris removal may also improve water quality downstream by removing the pollutants contained in those deposits. However, leaving some vegetation in place can help prevent erosion, trap sediment, and filter stormwater. Care should be taken not to disturb wildlife or aquatic life in the stream, including any riparian vegetation which is needed for the wildlife to survive. Agencies usually clean stream channels in response to complaints or a field staff's observation of a problem. Much of the maintenance work in natural streams is done by hand. When necessary, large sediment deposits may need to be removed by heavy machinery.

Clean Water Tips:

14. Keep records of problem areas. Keep records of problems and complaints, and schedule more frequent cleaning of these areas accordingly.
15. Control pollution sources to streams. The emphasis in natural streams should be prevention of water quality problems by eliminating sources of pollutants. Use proper erosion control measures for construction activities occurring near streams. Maintain buffer strips of vegetation between the stream and roadways or other paved areas. For buffer areas, native grasses, shrubs, and trees are more effective than manicured lawns in filtering pollutants as well as providing shade.
16. Stabilize erosion areas. Stabilize eroded banks and stream channels to prevent sediments from washing downstream. Consider "bioengineered" methods that use jute netting, staked live willows, and other natural means to keep the bank secure while vegetation is establishing. See Chapter 10 for reference documents which describe these methods. Use structural measures such as riprap and log walls sparingly, since these usually do not provide wildlife habitat or shade.
17. Revegetate with native species. Revegetate exposed and eroding stream banks with native vegetation as much as possible, and establish trees to shade the streams and lower water temperature. Nuisance plant species, including non-native garlic mustard, purple loosestrife, and common reed grass should generally be replaced with native species, which provide more environmental benefits. See the native planting reference documents listed on http://www.dnr.state.oh.us/tabid/2005/Default.aspx , and refer to the Ohio Department of Natural Resources. Get local volunteer citizens groups involved in planting activities, as a low-cost alternative to agency staff.
18. Dispose of sediments properly. The sediment removed from a stream bed, especially in urban areas, may contain high levels of pollutants and should be disposed of properly. See previous note in this chapter about testing requirements and proper disposal options, and also refer to Chapter 7.

Detention pond maintenance

Description:

Detention ponds provide temporary storage for stormwater, which allows sediments and pollutants to settle out of the water to the bottom of the pond. Most ponds in the past were designed to hold back floodwaters and release it slowly to streams, but these days, agencies are installing ponds for water quality benefits as well. The effectiveness of a pond is based on its ability to hold a certain amount of water, or design volume, for at least 24 hours. This allows enough time for particles to settle out.

In order to maintain the pond's design capacity, silt must be removed from time to time. This is usually done using draglines or bucket dredges (when the pond contains water), or bulldozer/backhoe (when the pond is drained of water). However, unless construction activities or other highly erosive activities take place upstream, it may be twenty years or so before sediment removal is required. More frequently, maintenance is needed to remove trash and debris, mow, and remove blockages from the pond's outlet structure.

Clean Water Tips:

19. Inspect detention ponds annually. Inspect ponds once a year, preferably, after large storms. Check for flooding, trash, excessive silt build-up, undue algal growth and other signs of pollution such as oil sheens, discolored water or unpleasant odors. Schedule cleaning if needed.
20. Monitor drain times. For the best water quality benefit, the pond should hold water for at least 24 hours. It should drain within 72 hours to avoid conditions, which might increase water temperatures, deplete oxygen, and/or cause odors.
21. Maintain and protect vegetative buffer around ponds. As with natural channels, a buffer zone of vegetation should be left around the pond perimeter. Within the buffer strip, the grass should be kept at a longer height and shrubs and trees encouraged for shade. Also take care to protect native vegetation and wetland plants in and around ponds.
22. Dispose of sediments properly. The sediment removed from a detention pond, especially in urban areas, may contain high levels of pollutants and should be disposed of properly. See previous note in this chapter about testing requirements and proper disposal options, and also refer to Chapter 7.

Maintenance of other stormwater treatment devices

Description:

Many other types of stormwater treatment devices exist and more are being invented all the time. Most fall into one of three categories:

- Settling devices that remove pollutants by settling, such as oil/ water separators, sedimentation basins, vortex separators, and sedimentation manholes;
- Filtration devices that remove pollutants by filtration, including grassy swales, vegetated filter strips, compost filters, sand filters, and infiltration sumps;

- Facilities which remove pollutants by a combination of settling and filtration, such as wetlands.

Generally speaking, the settling devices are better at removing large loads of sediment and require less maintenance. Devices which use filtration measures tend to be overwhelmed by large loads of sediment and require more maintenance, but they are better at removing finer particles and associated pollutants which are suspended in water. Because each type of treatment device treats stormwater differently, many agencies encourage them to be installed in series (e.g., a sedimentation basin followed by a wetland).

Clean Water Tips:

23. Inspect monthly. Inspection frequencies for treatment devices will vary according to the amount of rain, presence of leaves and nearby construction activities. A good rule of thumb is monthly just before and during the wet season.
24. Monitor sediment build-up. Check stormwater setting devices and filters regularly for sediment build-up, and remove when about half of catchment area of filter capacity is reached.
25. Check for clogged filter. The most common cause of failure for filtration devices is clogging. If water is not draining through the filter, it may need cleaning or replacement.
26. Dispose of sediments properly. The sediment removed from sedimentation and filtration facilities may have elevated levels of pollutants (particularly in industrial areas) and should be disposed of properly. See the discussion regarding testing requirements and disposal options previously in this chapter. Also refer to Chapter 7.

System retrofitting

Description:

In the past, flood control efforts have focused primarily on decreasing the volume or peak rate of water that abruptly enters waterways because of new development and an associated increase in paved surfaces. Traditional methods to reduce flooding include dry detention basins to temporarily detain and store water, channelization of drainage courses and stream bank hardening to increase carrying capacity of the receiving stream, and floodplain restrictions that limit development in flood-prone streamside areas. These types of flood control measures were not designed to control stormwater pollution caused by increased urbanization. The historical focus was on quantity control, not quality control.

Today, urban planners and designers recognize the importance of designing systems with both flood control and pollutant removal in mind. This works for new facilities, but existing facilities may require modifying, or retrofitting. Projects might include

enlarging structures, changing the inflow and outflow patterns, and increasing detention times.

Retrofits can be done as stand-alone projects, or as a part of repair and replacement projects scheduled for the future. Usually retrofits are done on older parts of the storm sewers in areas that are already built out. With the premium on space, the following suggested measures are typically more feasible than large land-intensive facilities:

- Replace simple drain inlets with trapped catch basins.
- Install compost filters in manholes.
- Replace lawns with sustainable, low-maintenance native vegetation for greater pollutant filtering.

Clean Water Tips:

27. Include water quality considerations in retrofits. If a storm sewer facility needs replacement because of poor condition, consider replacing it with one that also improves water quality. An example is replacing inlets with trapped catch basins.
28. Match retrofits to land use. Opportunities for retrofits of the storm sewer system often exist in older, more industrialized areas where pipes tend to be older. For retrofits, choose facilities that provide the best stormwater treatment benefits for the type of pollutants expected from the land use (e.g., industrial, commercial or residential).

Chapter 4
Maintaining and Repairing Roadways

This chapter of the Toolbox describes various road maintenance practices and provides a few easy tips for conducting the work in a way that helps protect the environment:

1. Cleaning streets
2. Repairing roadways
3. Surfacing and resurfacing
4. Marking pavement
5. Controlling snow and ice on roadways
6. Maintaining bridges
7. Installing utilities in roadways

A handy roadway maintenance checklist is provided on the next page.

Roadway Maintenance Checklist

Use this checklist of clean water tips as a guide for staff in conducting or water quality-friendly maintenance practices. Refer to the rest of this chapter for details regarding each clean water tip.

Practice	Done √	Clean Water Tip	Tip #
Street cleaning		Use more effective sweeper	1
		Eliminate street flushing	2
		Recycle sweeping debris	3
		Recycle leaf material as compost	4
		Support research	5
		Use covered storage containers	6
		Deal with illegal dumps	7
		Create recordkeeping system	8
Roadway repair		Schedule work in dry weather	9
		Protect storm drain inlets	10
		Protect roadside ditches	11
		Avoid using water to clean up	12
		Place stockpiles away from streams	13
		Contain water and wastes	14
		Recycle used asphalt & concrete	15
		Use drip pans for leaks	16
Surfacing & resurfacing		Avoid wet weather for paving	17
		Protect storm drain inlets	18
		Protect roadside ditches	19
		Avoid using water for clean up	20
		Place stockpiles away from streams	21
		Contain water and wastes	22
		Recycle used asphalt	23
		Use drip pans for leaks	24
Pavement marking		Develop paint handling procedures	25
		Protect storm drain inlets	26
		Avoid using water to clean up	27
		Contain water and wastes	28
Snow & ice control		Recycle sands & gravel	29
		Place stockpiles away from streams	30
		Do not use salts	31
		Use chemicals sparingly	32
Bridge repair		Follow water quality requirements	33
		Don't use heated water/detergents	34
		Don't use lead-based paints	35
		Contain sand blast grit	36
		Paint over graffiti	37
		Protect exposed soil	38
		Recycle scrap materials	39
Installation of utilities in roads		Protect storm drain inlets	40
		Avoid using water to clean up	41
		Do not discharge dewatering wastes directly	42
		Contain water & wastes	43

Practice	Done √	Clean Water Tip	Tip #
		Place stockpiles away from streams	44

Street cleaning

Description:

Street cleaning is performed to meet the following goals:

- Remove street dirt, debris and other hazards for health, safety and appearance.
- Protect air quality through road dust removal.
- Remove street debris and sediments, which tend to block flow and cause flooding.
- Protect public investment in transportation facilities from damage.

Street cleaning in the Town of Warrenton generally involves one or more of the following activities: mechanical sweeping, vacuum/air sweeping, flushing, and leaf removal.

- Mechanical and vacuum/air sweeping occurs on regularly scheduled routes, typically very often (e.g., daily or weekly) in downtown business districts and only periodically along major arterials (e.g., weekly or monthly) and residential neighborhoods (e.g., monthly or quarterly). Frequencies vary depending on the expected average daily traffic, air quality regulations (dust control), or budget available. Typically signs are posted to inform residents of sweeping operations in congested areas. This reduces parking obstructions and increases effectiveness. Most agencies issue parking citations for those not obeying signs.
- Flushing is done in two stages: (1) advance flushing to reduce dust and increase effectiveness of street sweeping operations that follow, and (2) back flushing to move residual material away from traffic lanes.
- Leaf removal prevents flooding and traffic hazards through localized seasonal leaf pick up. Generally, flushers and sweepers work together (i.e., flushing follows sweeping) to reduce dust and pickup leaf debris. Roll-off trucks and drop boxes are placed along the route to temporarily store materials and reduce the unproductive travel time of sweepers.

Clean Water Tips:

1. Use a more effective street sweeper. In general, street sweeping with mechanical sweepers has a poor reputation as a best management practice for protecting water quality. Mechanical sweepers are good at picking up litter and debris, but cannot pick up the fine sediments that generally contain the pollutants of concern for stormwater quality. Most sweeper experts agree that mechanical-broom sweeper efficiency can be improved by broom height/angle adjustment, but only marginally. Vacuum sweepers have been shown to be more effective than mechanical sweepers at removing fine particles from street surfaces. However, keep in mind that vacuum sweepers are most effective on dry pavement and may not work well in very wet areas.
2. Eliminate street flushing activities, or temporarily protect storm drain inlets during flushing. Flushing street surfaces can add petroleum hydrocarbons or metals pollutants to the storm sewer systems. Cover inlets with plates or mats,

or consider several filter inserts that are on the market, to filter out fine sediments, dust, gravel, and oil and grease. Use booms and vacuum or allow area to dry before uncovering storm drain inlets.

3. Recycle street sweeping debris. Consider recycling debris in your community as a way to protect the environment and save money on landfill disposal costs.
4. Recycle leaf material as compost for use in city parks and facilities. Look for opportunities to sell the compost to local suppliers.
5. Support research. Continue to support local and national research that promotes recycling and reuse of waste materials.
6. Use covered storage containers. Use only covered roll-off trucks and drop boxes to temporarily store street cleaning debris and leaf material. This will prevent rainfall and street runoff from carrying the debris to the storm sewers.
7. Deal quickly with illegal dumps. Establish an agency procedure for quickly dealing with illegally dumped materials discovered by street cleaning crews. Consider posting "do not dump" signs in areas where dumping tends to occur the most.
8. Create a recordkeeping system that allows crews to track curb miles swept, amount of debris collected, and problems requiring follow-up. Set up a routing procedure for the forms to make sure incidents are followed up promptly.

Roadway repair

Description:

Five basic types of road repair activities are described here: base repair, shoulder repair, cold milling, profiling and concrete street repair.

- Base repair involves replacement and compaction of new base material, after the hard surface and base materials are removed. Base paving includes the placement of lifts of asphaltic concrete in localized areas. Base repair is performed to correct, restore, or improve the load-bearing capacity and structural integrity of the underlying bedding material. This helps extend the life of the overlying road surface.
- Gravel shoulder maintenance supports the edge of the roadway pavement and provides a way to drain both surface and subsurface moisture away from the roadbed.
- Cold milling is a method of preparing the roadway for resurfacing by grinding or cutting away the surface material and providing a structurally sound base.
- Profiling restores appropriate shape and grade to the road surface to relieve drainage or safety problems.
- Concrete street repair involves placement of forms, pouring concrete, and leveling and floating the surface smooth. A broom or other finish is applied and edges and joints are troweled as needed. The forms are then stripped and the curb face is finished if necessary.

Clean Water Tips:

9. Schedule repair during dry weather. Wet weather patterns mean that repair activities during rain events is unavoidable. However, try to schedule major repair jobs during the drier summer months.
10. Protect storm drain inlets and open manholes during repair activities. Cover with plates or mats, or consider using one of the several filter inserts on the market, to filter out fine sediments, dust and gravel. If runoff water contains oil and grease, consider using sandbags or absorbent booms to pool the water, and vacuum. If runoff water contains gravel, sands and other particles, use gravel-filled burlap bags as berms around the inlet to filter the water before it enters the storm drain system. Biobags (mesh bags filled with wood chips) can also be used, but keep in mind that they do not stay in place as well as gravel-filled bags and they can be destroyed if vehicles and equipment drive over them.
11. Protect roadside ditches. During wet weather on uncurbed roadways, use temporary berms or dikes at the edge of the road to prevent sediment, debris and waste materials from washing into roadside ditches. Keep in mind that certain types of protection (e.g., sandbags, fences) hold the water back, while others (e.g., gravel-filled burlap bags and hay bales) slowly filter the water as it drains through. Choose the method that will work best in the given situation. Sediment builds up behind all of these devices and should be inspected during and after rain events and cleaned as needed.
12. Avoid using water to clean up. Sweep or vacuum dust and debris generated during repair activities. DO NOT wash residue into the storm sewers.
13. Place stockpiles away from drainage courses and storm drain inlets to prevent materials from being washed into streams. Cover stockpiles or contain within berms.
14. Contain water and wastes generated during cleaning and flushing of spray equipment and hauling trucks, and field servicing of equipment. The first choice for disposal of this rinsate is to the sanitary sewer system. If this is not allowed, wait to clean equipment until it is returned to the yard.
15. Recycle used asphalt materials, such as concrete and fill material when possible. Store these materials properly.
16. Use drip pans to contain leaks from parked vehicles and equipment parked at the site overnight.

Surfacing and resurfacing

Description:

Resurfacing is generally part of an overall pavement management system designed to minimize the costs of maintaining and replacing entire roadways. The activities described here protect roadways by restoring road surfaces and controlling moisture damage to subgrades. They protect the base, prevent erosion, provide a smooth and safe surface for traffic, slow deterioration of surfaces and improve appearance. Basic activities of surfacing and resurfacing include:

- Paving is the application of a layer of asphaltic concrete over base material to seal and protect the road.
- Hot patch repairs surface defects in asphalt and oil-gravel streets using hot mix asphalt concrete. Damaged surfaces such as potholes, depressions and pavement cuts are broken out and replaced.
- Slurry seal is a mix of asphaltic emulsion and aggregate used to seal structurally sound surfaces. This method provides a practical alternative to asphaltic concrete overlays.
- Crack filling seals cracks and small holes in hard-surface pavement with a rubberized asphalt material. Cracks are cleaned with compressed air, and then sealant is applied with a pressurized system.

Clean Water Tips:

17. Avoid paving in wet weather in dry parts of the state. In other wetter parts of the state where some work during rain events is unavoidable, try to schedule major paving jobs during the drier late summer months.
18. Protect storm drain inlets and open manholes during road repair work, to prevent slurry mixes, dust, and debris from entering the storm sewers. (See notes above under Roadway Repair for ways to protect inlets).
19. Protect roadside ditches. During wet weather on uncurbed roadways, use temporary berms or dikes at the edge of the road to prevent sediment, debris and waste materials from washing into roadside ditches. (See notes above under Roadway Repair regarding temporary dikes along the roadway edge).
20. Avoid using water to clean up. Mechanically sweep and/or vacuum dust and debris following all activities. DO NOT wash residue into the storm drain system.
21. Place stockpiles away from drainage courses and storm drain inlets to prevent materials from being washed into streams. Cover stockpiles or contain within berms.
22. Contain water and wastes generated during cleaning and flushing of spray equipment and field servicing of equipment. Use booms and inlet protection, and vacuum or allow area to dry before uncovering storm drain inlets. Also, refer back to Tip #1 in this chapter.
23. Recycle used materials such as asphalt. Store these materials properly.
24. Use drip pans to contain leaks from vehicles and equipment parked at the site overnight.

Pavement marking

Description:

Several types of pavement marking activities can pollute stormwater runoff:

- Street line painting/striping/stenciling applies specialized paint (may contain reflective beads) to mark traffic lanes and parking areas. This can be permanent or temporary.
- Hot plastic pavement marking involves placing hot molten thermoplastic material to mark special traffic control features such as stop lines, cross walks and turn bays. Deteriorated markings are swept, ground or pressure washed before new markings are installed.
- Cold plastic markings lays out and places pre-cut plastic markings using primers or adhesives. For very specialized pavement markings, bituminous adhesive may be used for bonding.

Clean Water Tips:

25. Develop paint-handling procedures for proper use, storage and disposal of paints to keep the materials contained. Educate staff about the procedures.
26. Protect storm drain inlets, open manholes and roadside ditches during grinding and pressure washing activities. (See notes above under Roadway Repair for ways to protect inlets and ditches).
27. Avoid using water to clean up. Mechanically sweep and/or vacuum grindings and dust following all activities. DO NOT wash residue into the storm drain system.
28. Contain water and wastes generated during cleaning and flushing of equipment and field servicing of equipment. Use booms and inlet protection, and vacuum or allow area to dry before uncovering storm drain inlets. Also refer back to Tip #14 in this chapter.

Snow and ice control

Description:

There are several maintenance activities designed to protect public safety during snow and ice storms:

- Sanding involves applying abrasive material to surfaces covered with snow, ice or slush for traction.
- Deicing involves applying chemicals to iced surfaces to promote melting for traction.
- Plowing or blading snow moves accumulated snow or slush to the edge of traffic lanes or off the edges of uncurbed streets.

Clean Water Tips:

29. Recycle sands and gravels. Sweep up sands and gravels as soon as possible after winter storms so that they are not washed into storm sewers. Screen and wash sands for reuse.
30. Place sand stockpiles away from drainage courses and storm drain inlets to prevent materials from being washed into streams. Cover stockpiles or contain with berms. This practice applies to new and used sands.
31. Use salt for anti-icing sparingly. Inspect salt spreader before each use to make sure it is calibrated properly, check spinners for width of spread and make sure operator controls are working properly. Consider posting spreading rates in the cab of salt trucks. Salts can seriously harm aquatic life in streams. Consider safer biodegradable chemicals.
32. Use biodegradable chemical de-icers sparingly. Limit use of chemicals to fire access routes, bridges, steep arterial streets, and airport runways, where sanding and plowing are not possible or quick de-icing is required. Do not use these chemicals near sensitive waterways and small streams. Keep informed about research on "safer alternatives" that biodegrade quickly and change practices if possible. Train staff about proper chemical application rates and methods, or use licensed applicators.

Bridge repair and maintenance

Description:

Bridge repair and maintenance involves the restoration, cleaning and maintenance of bridges and bridge parts for public safety. The following are some typical activities:

- Bridge repair reconditions damaged or deteriorated concrete, steel or timber bridge parts to restore structural integrity and extend service life. This may also involve reconstruction of bridge footings or use of rocks, riprap or similar materials to reinforce and protect exposed soil areas around footings.
- Bridge washing is generally conducted using low pressure water during high flow conditions. Heated water and detergents should not be used.
- Expansion joint cleaning and repair involves flushing dirt, gravel and other debris from joint to protect the structure or removing and replacing damaged or deteriorated joints. This activity helps protect bridges from water and freeze damage.
- Painting occurs periodically, according to an established schedule and available funding. This may involve pressure washing or sand blasting to remove built-up grit and flaking paint before painting.
- Graffiti removal is generally accomplished using spray cleaners, pressure washing with a chemical or baking soda solution, or painting over the graffiti.

Clean Water Tips:

33. Follow special water quality requirements for bridges over sensitive waterways and in environmental protection zones. Check with the regional offices of the

Environmental Protection Agency for applicable requirements and technical assistance.

34. Do not use heated water or detergents in bridge washing operations.
35. Do not use lead-based paints and apply chemicals and solvents sparingly with spray cans or rags in small areas.
36. Contain sand blast grit and other residues. Enclose sand blasting, pressure washing, grinding and welding activities to protect streams and rivers. Capture and dispose of wastes properly.
37. Paint over existing material or graffiti whenever possible, to avoid generating waste residue.
38. Protect exposed soil in areas around footings and under decking so that sediments do not erode and move downstream. This might include vegetation, riprap, rock, or some other technique, depending on agency preference and type of erosion.
39. Recycle scrap metal, concrete and wood whenever possible. Integrate bridge maintenance with overall agency waste reduction/recycling program.

Installation of utilities in roadways

Description:

Utilities such as sewer and water lines are generally installed in the roadway by the public agency or its contractors, except in new developments, where they may be installed by a developer and later deeded over to the agency. Public utility companies also hire contractors to install electrical, gas and telecommunication lines and structures in the public right-of-way. Utility work involves sawcutting and breaking pavement, trenching, laying the lines in gravel or slurry fill, backfilling, and road repair. For sewer and water utilities, the work may include constructing and repairing drain inlets, laterals and manholes.

Clean Water Tips:

40. Protect storm drain inlets, open manholes and roadside ditches during utility activities. (See notes above under Roadway Repair for ways to protect inlets and ditches).
41. Avoid using water to clean up. Mechanically sweep and/or vacuum dirt and debris following all activities. DO NOT wash materials into the storm sewers.
42. Do not discharge dewatering wastes directly to the storm sewer or receiving stream without some form of treatment. First, consider land applying or reusing the water. If this is not possible, temporarily store the water to allow sediments to settle out before discharge. This activity may require a permit from Ohio EPA.
43. Contain water and wastes generated during sawcutting activities as well as during cleaning and flushing of equipment. Use booms and inlet protection, and vacuum or allow area to dry before uncovering storm drain inlets. Also refer back to Tip #14 in this chapter.

44. Place stockpiles away from drainage courses and storm drain inlets to prevent materials from being washed into streams. Cover stockpiles or contain within berms.

What's Been Learned About Street Sweeping Since the 1980's?

The 1980's Nationwide Urban Runoff Program studies appeared to support the belief that sediment buildup occurred only during dry weather and washing off occurred just during wet weather. Street sweeping was shown as ineffective at removing the fine particulates that tend to carry pollutants to streams. Things have changed. More recent studies have shown:

- Substantial sediment accumulation occurs during the rainy season between storms as well as during extended dry periods.
- Pollutant washoff from paved surfaces appears to be a year-round process.
- Newer street sweepers appear much more effective than the mechanical broom sweepers cited in the 1980's studies.
- Using a tandem sweeper (mechanical sweeping followed by vacuum) can improve pollutant removal efficiency.
- To have maximum effect, sweeping should be conducted six times a year.

These findings show that it is important to maintain a consistent street sweeping program year round. When purchasing new equipment, it would also be worthwhile to consider the newer vacuum or air-type sweepers. The added cost could be justified by improved performance and water quality benefits.

Chapter 5
Maintaining Roadside Areas

This chapter of the Toolbox describes various practices to maintain roadside areas and provides a few easy tips for conducting the work in a way that helps protect the environment:

- Cleaning roadside ditches - see Chapter 3
- Managing vegetation
- Controlling erosion
- Controlling litter
- Maintaining walls and slopes
- Cleaning and repairing pedestrian traffic areas
- Repair and painting of guardrails and fences

A handy roadside area maintenance checklist is provided on the next page.

Roadside Area Maintenance Checklist

Use this checklist of clean water tips as a guide for conducting water quality-friendly maintenance practices. Refer to the rest of this chapter for details regarding each clean water tip.

Practice	Done √	Clean Water Tip	Tip #
Vegetation management		Use native vegetation	1
		Contain plant & grass clippings	2
		Use covered storage containers	3
		Limit irrigation water	4
		Don't kill all the vegetation	5
		Follow application guidelines	6
Erosion & sediment controls		Apply erosion controls	7
		Use sediment controls	8
Litter control		Dispose of wastes properly	9
		Use covered storage containers	10
		Deal with illegal dumps quickly	11
		Educate and inform volunteers	12
		Establish hazardous waste handling procedures	13
Wall & slope maintenance		Dispose of wastes properly	14
		Contain sand blast grit	15
		Protect storm drain inlets	16
		Limit use of chemical cleaners	17
Pedestrian traffic areas maintenance		Avoid the use of water	18
		Require sidewalk contractors to follow agency procedures	19
Guardrail & fence repair		Contain of wastes properly	20
		Contain sand blast grit	21
		Protect storm drain inlets	22

Vegetation management

Description:

Vegetation along roadside areas, while attractive, can be a maintenance nuisance. Traffic safety considerations preclude frequent mowing and pruning, so most agencies use self-sustaining native vegetation as much as possible. Management measures include irrigation, pesticide/herbicide application and vegetation removal by hand.

Clean Water Tips:

1. Use native vegetation. Where possible, use native plants and trees, which can require less water, chemical, and fertilizer use. This will help to keep pollutants out of the storm sewers.
2. Contain plant and grass clippings and recycle as compost for use elsewhere.
3. Use only covered roll-off trucks and drop boxes for temporarily storage of vegetative waste. This will prevent rainfall and street runoff from leaching nutrients out of the stockpiled materials to the storm sewers.
4. Limit irrigation water by installing low-flow automatic sprinkler systems. This will help reduce the volume of water discharged to the storm sewers.
5. Don't kill all the vegetation. If chemicals are being applied to roadside areas to keep vegetative growth down, use them sparingly and make sure that some vegetation is maintained to stabilize slopes. Vegetation is one of the most cost-effective erosion controls available.
6. Follow application guidelines on all chemical products. Do not apply chemicals near sensitive waterways or small streams.

Erosion and sediment control

Description:

In roadside areas with exposed soils, erosion control is needed to stabilize the area and keep the soils in place. If sediments are mobilized, it will be necessary to install sediment controls to keep the sediment from entering the storm sewers.

Clean Water Tips:

7. Apply erosion controls. Stabilize exposed soil areas to prevent soil from eroding during rain events. This is particularly important on steep slopes. The best and generally most cost-effective choice is to vegetate the area, preferably with a mulch or binder that will hold the soils in place while the vegetation is establishing. There are several good commercially-available products to choose from, and native vegetation should be used if possible. If vegetation cannot be installed right away, apply temporary erosion control mats/blankets, should be a comma straw, or use gravel as appropriate.


Figure 1: Turf Reinforcement Matting


Figure 2: Erosion Control Matting

8. Use sediment controls. Once sediment is already eroded and mobilized, steps must be taken to keep it out of the storm sewer system or waterways. There are a variety of temporary controls which are commercially available that should be considered for roadside areas. These products slow down the flow of water (to halt erosive processes and allow sediment to drop out) and hold the sediment back. These include: sediment control fences, fabric covered triangular dikes, gravel-filled burlap bags, and biobags or hay bales staked in place.

Litter control

Description:

Agencies collect litter from roadway areas in order to provide clean and safe traffic and pedestrian areas. These activities help to keep litter, debris, and infectious material (e.g., food waste, drug paraphernalia) out of the storm sewers and streams. Most agencies rely on citizen volunteers or low-cost inmate crews to supplement the work of staff.

Clean Water Tips:

9. Properly contain and dispose of waste materials. Consider recycling materials (e.g., wood scraps, leaf and plant materials) whenever possible.
10. Use only covered roll-off trucks and drop boxes to temporarily store debris and litter. This will prevent rainfall and street runoff from carrying the debris to the storm sewers.
11. Deal quickly with illegal dumps. Establish an agency procedure for quickly dealing with illegally dumped materials discovered by volunteers and staff conducting litter pick-up.
12. Educate and inform volunteers about agency procedures for waste disposal.
13. Establish hazardous waste handling procedures for crews to follow when hazardous waste is encountered in the field.

Wall and slope maintenance

Description:

These activities involve maintaining walls and paved slopes in roadside areas to restore or protect structural integrity of the structures. Cleaning generally involves removing trash and debris, graffiti removal using spray cleaners, pressure washing with a chemical or baking soda solution, painting over the graffiti, and sand blasting.

Clean Water Tips:

14. Properly contain and dispose of waste materials and washwater. Consider recycling materials whenever possible. See Chapter 4, Tip #14 for tips about containing and disposing of washwater.
15. Contain sand blast grit and pressure wash residue/debris. See Chapter 4 under Bridge Maintenance for tips.
16. Protect storm drain inlets during maintenance activities. See Chapter 4 under Roadway Repair for tips.
17. Limit the use of chemical cleaners for graffiti removal, or apply chemicals sparingly with rags or concentrated spray to minimize water quality pollution. Properly handle and dispose of any chemical cleaner waste and empty containers.

Pedestrian traffic areas maintenance

Description:

Maintenance of pedestrian areas generally involves inspection, cleaning and repair as needed of sidewalks, elevated vaulted walkways, transit malls and city center areas. These activities are designed to provide clean and safe pedestrian areas in designated high traffic locations. Cleaning and repair may be done by contractors. Various cleaning methods are as follows:

- Flushers (tank trucks) manually flush debris to gutter areas,
- Backpack gas-powered blowers move debris to gutters, or
- Pressure washing forces built-up debris off paved surfaces and into gutters.

Once the debris is in the gutters, it is picked up by street sweepers. Repair of pedestrian facilities involves one or more of the following: break out and removal of existing defective surface material (e.g., concrete, asphalt or stone), addition and compaction of base material, and forming of the new pavement. Painting may also be done for vaulted walkways.

Clean Water Tips:

18. Avoid the use of water. Consider dry methods for cleaning, including backpack blowers and sweeping, or alternatives, which generate less water, such as pressure washing. Refer to Tip #14 in Chapter 4 for more advice regarding washwater.
19. Manage activities of sidewalk contractors. Require sidewalk contractors to follow your agency procedures for protecting water quality, including collection of construction water, dust control during sawcutting, inlet protection and proper waste disposal/recycling.

Guardrail and fence repair

Description:

Guardrails and fences along the roadside are maintained for public safety reasons and appearance. Cleaning generally involves removing trash and debris, graffiti removal using a spray cleaner, pressure washing with a chemical or baking soda solution to remove graffiti, painting over the graffiti, and sand blasting or pressure washing for general cleaning. Painting may take place occasionally. This may involve pressure washing or sand blasting to remove built-up grit and flaking paint before painting.

Clean Water Tips:

20. Properly contain and dispose of waste materials. Consider recycling materials whenever possible.
21. Contain sand blast grit and painting operations, and collect and dispose of residues properly. See Chapter 4 under Bridge Maintenance for tips.
22. Protect storm drain inlets during maintenance activities. See Chapter 4 under Roadway Repair for tips.

Chapter 6
Keeping a Clean Maintenance Shop/Yard

Maintenance shops and equipment yards play an important role in a public works department, just as they do in any industry. However, maintenance and storage of vehicles and equipment involves many substances that are extremely harmful to the environment. Fuel, solvents, metal shavings, lubricants, and other materials cause toxic effects if they are allowed to enter stormwater runoff. Also, bulk storage of materials such as hazardous wastes, fuels, emulsified oil, asphalt, concrete, and sand can contribute to stream pollution if the materials are not managed and contained properly.

The facility audit

How clean is your agency's maintenance yard? The best way to answer this question is to conduct a self-audit of your facility. Use the checklist provided on the next page or a standard checklist designed for industrial stormwater inspections. The audit should take no longer than three hours for an average-sized facility. Or, conduct the audit in phases. When the audit is completed and the checklist is filled out, your agency will have a good sense of what improvements should be made to better protect stormwater quality.

Maintenance Yard Audit Checklist

Use this checklist of clean water tips as a guide for conducting water quality-friendly maintenance practices. Refer to the rest of this chapter for details regarding each clean water tip.

Practice	Done √	Clean Water Tip	Tip #
Prevent exposure		Perform maintenance indoors	1
		Provide dead-end sump	2
		Wash in a contained area	3
		Cover bulk materials	4
		Label & store containers properly	5
		Disconnect process drains	6
Provide containment		Use drip pans for parked vehicles	7
		Drain fluids from vehicles	8
		Contain large fuel tanks	9
		Contain uncovered bulk materials	10
		Store containers on pallets	11
		Use dumpsters with lids	12
		Clean up spills promptly	13
		Regrade site to divert stormwater	14
Remove pollutants		Provide oil & grease controls	15
		Apply erosion control	16
		Use sediment controls	17
		Install stormwater filters	18
		Build stormwater detention	19
Other steps		Don't generate additional water	20
		Educate staff	21
		Reduce chemical use	22
		Recycle wastes	23
		Consider alternative products	24
		Prepare site drainage map	25
		Inspect storm sewers monthly	26
		Keep water out of dumpsters	27

Clean water tips for a clean shop/yard

Keeping a clean shop/yard in large part involves common sense measures. The easiest way to minimize pollutants in runoff is to prevent exposure to stormwater in the first place. The next best measure is to provide containment so the pollutant(s) doesn't come in contact with stormwater runoff. The least desirable, and most expensive way to protect stormwater quality is to remove pollutants after they are in the runoff. The following are some tips for keeping a clean facility:

Prevent Exposure to Stormwater.

Take the following steps to keep all potential pollutants within areas of the site where they do not come into contact with rain water, stormwater runoff, or washwater from other site activities:

1. Perform vehicle/equipment maintenance in a single, designated covered facility. Four walls are not always necessary. Often just a roof will suffice if runoff is routed around the facility.
2. Provide a dead-end sump in maintenance areas for collecting all spills and leaks. Clean out the sump regularly and recycle or dispose as hazardous waste.
3. Perform vehicle/equipment washing in a single, designated covered facility. Recycle wash water and/or discharge to the sanitary sewer system.
4. Store bulk materials under cover (e.g., roof or tarps).
5. Make sure all containers are labeled and stored correctly.
6. Store indoors whenever possible, and routinely check for leaks.
7. Make sure that building drains or drains in outside storage or processing areas do not discharge to the storm sewer system. Process areas should be graded or bermed to minimize stormwater run-on to drains. The drains should then be connected to the sanitary sewer system or an on-site recycling or treatment unit.

Provide Containment.

If maintenance or storage cannot be done indoors or under cover, follow these suggestions:

8. Use drip pans and other containment devices to prevent spills while servicing vehicles, or for vehicles and equipment parked for extended periods.
9. Drain fluids out of equipment and vehicles that sit idle for more than a month.
10. Enclose fuel tanks and other large liquid containers within secondary containment. Include valves that can be closed to prevent a large spill from traveling offsite. Follow other regulations to properly size the tank containment area.
11. For bulk materials stored without cover, provide containment berms or walls and install inlet protection on nearby storm sewer drains. Sweep or vacuum accumulated material behind the inlet controls regularly. Since these uncovered areas can collect rainwater, install values that allow drainage but can be closed to prevent spills from traveling to the rest of the site.

12. For containers stored without cover, make sure they are labeled and stored correctly within secondary containment areas. See Tip #10 about the need for a valve in uncovered containment areas.
13. Use dumpsters with lids for storage of waste materials and garbage.
14. Clean up spills promptly. Use absorbent material, such as kitty litter, to clean up liquid spills. Provide materials to cover drains until spills are cleaned up. Install spill kits in areas where accidents can occur (e.g., fueling areas).
15. For new or remodeled facilities, consider ways to grade the site so that stormwater is diverted away from fueling, storage and disposal areas. Also, grade and construct berms on the entire site so that all stormwater runoff stays within the property boundaries. Keep clean water away from all potential sources of pollution.

Remove pollutants from runoff.
When stormwater runoff contains pollutants, consider the following methods for cleaning the water before it's discharged from the maintenance facility to the storm sewer or drainage course. This is a brief overview only, so be sure to consult other handbooks and manuals for other types of devices and information about pollutant removal effectiveness.

16. Apply oil and grease controls. Use oil/water separators, booms, skimmers or other commercially-available devices to eliminate or minimize oil and grease pollution of stormwater runoff. Keep in mind that all of these devices require frequent inspection and maintenance or they will cease to be effective.
17. Control erosion. Stabilize exposed soil areas to prevent soil from eroding during rain events. This is particularly important on steep slopes. The best and generally most cost-effective choice is to vegetate the area, preferably with a mulch or binder that will hold the soils in place while the vegetation is establishing. There are several good commercially-available products to choose from, and native vegetation should be used if possible. If vegetation is not an option, apply temporary erosion control mats/blankets or use gravel as appropriate.
18. Install sediment controls. Once sediment is already eroded and mobilized on a site, steps must be taken to keep it out of the storm sewer system or waterways. There are a variety of temporary controls commercially available that should be considered, for both slowing down the flow of water (to allow sediment to drop out) and holding the sediment back. These include sediment control fences, fabric-covered triangular dikes, gravel-filled burlap bags, biobags or hay bales staked in place, and sediment detention ponds.
19. Consider stormwater filters. Stormwater filters rely on vegetation, compost, sand or other filter media to filter out pollutants in stormwater. Generally, vegetative controls can be incorporated easily into site landscaping and will require very little maintenance if native plants are used. Popular choices for stormwater filters include grassed swales and filter strips, compost filters, and

sand filters. A variety of temporary storm drain inlet filter inserts are also available.

20. Consider stormwater detention ponds and wetlands. For larger maintenance yards, consider installing detention ponds or wetlands to treat site runoff before it is discharged to the storm sewer system or waterways. Refer to design documents listed in Chapter 10 for specifics about designing and constructing these types of facilities. Ponds and wetlands allow larger sediment particles to settle out, and therefore, accumulated silt must be cleaned out periodically. Dredged sediments should be tested to determine proper disposal options.

Other steps.

21. Don't generate additional water. Sweep, vacuum or mop floors, sidewalks, and pavement rather than hosing them down. Dispose of swept materials properly. Use absorbent to soak up leaks and spills.
22. Educate staff. Make sure all facility workers understand how their actions can affect stormwater quality. This includes those agency staff using the facility on a periodic basis, to deliver or pick up materials and supplies. At a minimum, staff should know proper procedures to deal with spills and leaks. There are various ways to educate and inform people, including presentations at safety meetings, posting signs, showing videos and providing training sessions.
23. Reduce chemical use whenever possible. Consider adopting new practices that use less or no chemicals, as a way to save money and protect the environment.
24. Recycle wastes. Recycle used oil, solvent, grease rags, washwater, and other spent liquids. Recycling often saves money (after an initial investment in some cases). Store materials awaiting recycling under cover with secondary containment. Also follow proper waste management requirements set up by the EPA and/or the local fire department.
25. Consider alternative products. Consider using less harmful materials, such as non-phosphorus soaps and cleaners without petroleum solvents.
26. Prepare a site drainage map. Make a copy of an existing site map for the maintenance facility, or draw a simple map with building and property outlines. Indicate the locations of all storm drain inlets and pipes, as well as all points where the site discharges to the municipal storm sewer system or a nearby waterway. Draw arrows on the map to indicate the direction of surface water flow. Use the drainage map as a planning tool to understand how water travels across the site and where there is the potential for stormwater to contact stored materials and maintenance activities. Educate facility workers using the map.
27. Inspect the storm sewer system. On a monthly basis, and after major storms, inspect stormwater control structures, drain inlets, outfalls to streams and stormwater treatment devices. Check for sediment build-up and remove accumulated material. Also look for signs of pollution (e.g., oil sheen, discolored water or foul odor). If a problem is noted, track down the source of the pollution and eliminate it right away.

28. Keep water out of dumpsters. Install lids on dumpsters to keep rainwater from contacting garbage and leaching out to the ground surface.

Chapter 7
Storing and Disposing of Waste Materials

Types of waste materials

Maintenance practices generate waste materials, such as catch basin sludges and street sweeping debris. This chapter of the Toolbox reviews the various types of wastes produced and discusses recycling options to reduce costs and help the environment. Also described are ways to protect stormwater quality during waste dewatering process. Virtually all maintenance practices generate waste by-products. Typical wastes include:

- Concrete, asphalt, and slurry from road repair and resurfacing activities and right-of-way utility work.
- Road fill and base material and gravels from road base and shoulder repair activities.
- Sludges, sediment, and debris from streets, parking lots, catch basins, and storm drain lines which are picked up with mechanical sweepers, vacuum/air sweepers, vacuum equipment, or by hand.
- Dredged sludge materials from channel, stream and detention pond maintenance.
- Dropped leaves that are collected seasonally.
- Other vegetation such as grass clippings, woody debris and dead plants and shrubs, that are collected by crews maintaining streamside areas, roadsides, medians, parks and other vegetated public areas.
- Deicing sands and gravels from road and bridge snow and ice control operations.

Recycling

Currently there are several options for recycling some of the waste materials described above. Leaf and other vegetative debris can be made into compost for use at public park facilities, or sold to suppliers in the local area. Sand and gravels can be collected and washed for reuse as deicing materials, or used "as-is" for trench backfill and for road base and shoulder material.

Dewatering practices

Dewatering is commonly used by most agencies to reduce the volume and weight of debris to be recycled or landfilled. Dewatering facilities should be contained (e.g., concrete pad, berms and roof if possible) and should be plumbed to the sanitary sewer system, not to the storm sewer or nearby streams.

At this time, agencies with dewatering facilities are landfilling the dried materials. To reduce costs, smaller agencies may want to consider partnering with other agencies and/or larger municipalities in the region to share a dewatering facility.

Chapter 8
Educating Maintenance Staff about Stormwater Quality

Employee education should be one of the first steps taken to improve the maintenance program. There are several easy, cost-effective ways to get the word out and increase awareness about how everyday maintenance practices affect stormwater quality:

Make presentations at safety meetings.
Prepare brief informative presentations on various topics, and invite other agency departments, other local agencies, or product manufacturers to speak to your key managers. Possible topics for safety meetings include: erosion control during roadway repair activities, safe alternatives to pesticides applied to right-of-ways, the latest technologies for inlet protection, and upcoming regulations that will affect maintenance activities.

Conduct training.
Consider developing a brief educational video or obtaining slide shows, videos, and other materials already produced by other agencies.

Develop tools for maintenance crews.
Prepare laminated cards describing notification procedures for spill incidents and place one in each town maintenance truck. Follow the Town of Warrenton's, Virginia DEQ's lead and develop small kits for all trucks, so that maintenance staff members have the materials to immediately address small spill situations and protect the storm sewers.

Post signs at maintenance facilities and yards.
Post good housekeeping signs wherever there is a chance that spills and leaks can occur. Make items such as drip pans and spill kits readily available at these locations to prevent spills and leaks from coming in contact with stormwater runoff.

Involve the maintenance staff in the planned improvements.
Once staff are informed, ask them for their ideas and solutions. Involve them in designing the improvements and empower them to take action immediately when they notice a stormwater quality problem in the field. Use maps to locate the areas of the system where they've observed the most problems and question them about the type of recordkeeping forms that would be most practical while providing the most value.

Recognize staff accomplishments.
Consider a recognition program for staff who regularly practice environmental stewardship, teach others by their actions and are active in developing pollution prevention solutions.

Chapter 9
Educating and Informing the Public about Stormwater Quality

Often the job of maintenance personnel is more difficult because of public actions that result in wastes and other pollutants being spilled or dumped into storm sewers and streams. For several years, agencies have been identifying ways to make residents aware of how their actions are harming the environment. One of the most effective means of increasing public awareness from a maintenance aspect is first educating the agency staff themselves. Once this is accomplished, crews can be supplied with informational flyers to pass out to the public, or with door hangers that can be distributed in neighborhoods or industrial areas where problems are being observed. The flyers or door hangers should include a description of the actions creating the problems, suggestions for what should be done differently, and a list of names to call for more information or to report dumping problems. The door hanger approach has been used with great success in other areas of the country. Other easy tools that work well for getting the word out include articles in local newspapers, town or neighborhood association newsletters, utility inserts, and direct mailers.

Chapter 10
Other Sources of Information and Toolbox References

Where to Go For More Information

Web sites:

For information on other studies and research related to maintenance and stormwater quality, begin your search with the following web sites. Many of these sites have an index or search engine built in:

1. American Society of Civil Engineers http://www.asce.org/
2. Federal Highways Administration http://www.fhwa.dot.gov/environment/
3. Ohio Environmental Protection Agency, Division of Surface Water http://www.epa.state.oh.us/dsw/
4. Ohio Department of Transportation, Local Technical Assistance Program http://www.dot.state.oh.us/DIVISIONS/LTAP/
5. U.S. Department of Transportation's National Transportation Library http://www.bts.gov/ntl/
6. U.S. Environmental Protection Agency http://www.epa.gov/epahome/
7. Oregon Association of Clean Water Agencies http://www.oracwa.org/ Original toolbox (http://www.oracwa.org/downloads/or-municipal-stormwater-toolbox/)
8. Chesapeake Stormwater Network http://chesapeakestormwater.net/

Reference Documents

California Regional Water Quality Control Board. "Erosion and Sediment Control field Manual". November 1996. (510) 286-1043.

City of Portland, Bureau of Environmental Services. "Naturescaping for Clean Rivers". January 1996.

City of Portland Pollution Prevention Outreach Team. "Keep Your Shop in Tune". (503) 823-5230.

Gray and Sotir. "Biotechnical and Soil Bioengineering Slope Stablilization: A Practical Guide for Erosion Control." John Wiley and Sons, Inc. 1996.

Horner, Richard and Brian Mar. "Guide for Water Quality Impact Assessment of Highway Operations and Maintenance". A Report Prepared for the Washington State Department of Transportation Highway Runoff Water Quality Research Project. Report No. 14 (WA-RD-39.14). September 1982.

King County. "Surface Water Design Manual." November 1992 (with more recent updates).

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Santa Clara Valley Nonpoint Source Pollution Control Program. "Best Management Practices for Automotive-Related Industries". (408) 265-2600.

Terrene Institute and U.S. EPA. "Urbanization and Water Quality: A Guide to Protecting the Urban Environment". March 1994.

USDA Natural Resource Conservation Service. "Streambank and Shoreline Protection, Part 650, 210-EFH, of the "Engineering Field Handbook". 1996.

U.S. EPA. "Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters". January 1993.

Washington State Department of Transportation. "Highway Runoff Manual". March 1997.

Washington State Department of Transportation. "Stormwater Management Plan". March 1997.