CSN TECHNICAL BULLETIN NO. 7

Stormwater Pollution Benchmarking Tool

for Existing Industrial, Federal and Municipal Facilities in the Chesapeake Bay Watershed

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INTRODUCTION

This Technical Bulletin presents a visual method to assess the need for stormwater pollution practices, retrofits and stewardship at existing industrial, institutional, federal and municipal facilities. Tens of thousands of these facilities exist across the Chesapeake Bay watershed, each of which has the potential to be severe stormwater hotspots, which are defined as a site that generates higher loads of pollutants and toxics, and/or has a higher risk of leaks, spills or illicit discharges. Despite the impact of stormwater hotspots on the receiving waters of the Bay, they have not been effectively regulated or managed for several reasons.

While as many as 30,000 facilities in the Bay are technically regulated under EPA's industrial or municipal stormwater permit programs, most individual permits do not contain specific monitoring requirements or numeric limits on effluent quality. Thus, at many sites, all that is needed to comply with the permit is to make sure you have a paper document known as a stormwater pollution prevention plan present on your site. The chances that a local or state regulator will inspect your site are vanishingly small (National Research Council, 2008). Even if sites are inspected, the permits ldo not require any site-specific or quantitative measurements to determine whether runoff is dirty or reasonably clean, which makes it difficult to trigger enforcement actions.

A second key issue is that many property managers and environmental compliance officers simply don't understand that much about stormwater, in comparison with more traditional environmental health and workplace safety issues they must deal with every day (e.g., hazardous waste storage and disposal and spill response). Few good training materials have been developed on site-based stormwater pollution prevention techniques, and even fewer tools exist to diagnose the actual stormwater pollution problems present at a site. Consequently, there is a strong need for a quantitative diagnostic tool to assess stormwater pollution problems and identify site-specific and cost-effective solutions.

In the last year, however, there has been growing recognition about the need to expand pollution prevention activities, particularly at federal facilities (DOD, 2009 and EPA, 2009). These new stormwater initiatives seek to respond to the 2009 Executive Order 13805 on Enhancing Restoration of the Chesapeake Bay watershed. For example, DOD (2009) conservatively estimated that existing federal facilities comprised nearly 85,000 acres of developed land in the Bay watershed, and that there was a need for a comprehensive tool to evaluate pollution prevention, retrofitting and stewardship opportunities at individual facilities. In addition, the first guidance and assessment tools for managing runoff from municipal stormwater hotspots has just been released (CWP, 2009).

The Evolution of the Benchmarking Tool

The current version of the stormwater benchmarking tool presented here has rapidly evolved in the last five years. It began with the release of the Hotspot Site Investigation or H.S.I. (CWP, 2005) which was a simple checklist to confirm whether a site could be classified as potential, moderate or severe stormwater hotspot, based on visual analysis of site conditions. The H.S.I. has been extensively tested over the last five years at hundreds of different sites around the country, and has been found to be a robust tool. Its main weakness, however, is that while it can discriminate between dirty and clean sites, it cannot

measure how green the facility is (i.e.,, has it gone beyond the minimum to build on-site stormwater retrofits, enhanced land management or foster greater watershed stewardship.

To bridge this gap, CSN developed a more comprehensive stormwater benchmarking tool, in cooperation with Coca-Cola North America and the World Wildlife Fund. The H.S.I was extensively modified to provide a benchmarking score for individual Coca Cola bottling facilities. The new tool was tested from 2007 to 2009 and refined based on comments from plant managers and environmental compliance officers at five different bottling facilities in the Southeastern US. Simultaneously, CSN developed a similar benchmarking tool for three large port facilities in the Port of Houston, though a cooperative agreement between the Conservation Law Foundation and the Port Authority.

Based on this experience, CSN concluded that it was possible to produce a generic stormwater benchmarking tool that could be applied to existing individual industrial, municipal, federal, corporate or institutional facilities less than 50 acres in size within the Bay watershed. The new tool provides a quantitative score to measure whether a facility is dirty, clean or green and helps the users come up with action list of pollution prevention, stormwater retrofit, land management and watershed stewardship practices to implement at the site..

1.0 Objectives and Outcomes for Stormwater Benchmarking

Stormwater benchmarking involves a rapid office and field survey to identify correctable stormwater pollution problems at individual industrial or municipal facilities. The benchmarking tool is a comprehensive assessment that rates each facility against 22 performance benchmarks and identifies simple low cost pollution prevention actions that can be undertaken at each facility to improve its stormwater runoff quality. Each benchmark is associated with the completion of 1 to 4 individual tasks or practices that can improve stormwater quality.

The recommended goal for stormwater benchmarking is to attain a minimum total facility score of 95 or greater (out of a total of 100 points). Once the on-site team has completed its work, they tabulate the total score, and interpret it using the guidance provided in Table 1. The assessment team should document their work with digital photos to show both good practices and existing stormwater problems, and incorporate these directly into employee training programs.

Based on the benchmarking, the user can rank each facility among its peers, and provide detailed information to update stormwater pollution prevention plans that are legally required at many facilities. In addition, benchmarking can improve employee understanding about stormwater runoff, watersheds and community stewardship. In most cases, the initial scores will be rather low, but the tool helps identify a series of immediate, short-term and mid-term action items to complete at the facility in ensuing years.

The benchmarking tool has been designed to apply to a wide range of facility types. If it turns out that you do not engage in the indicated activity or practice for a specific benchmark, you can award yourself full points (e.g., no refueling occurs at your facility so this benchmark does not apply to you). If it turns out that more than a third of the benchmarks do not apply to your facility, you probably have a unique facility category, and

may want to customize the tool by adding/subtracting benchmarks or changing the weight of points awarded among the benchmarks

The basic idea is to go beyond the minimum at every facility so that it is not only clean but green, such that a wide range of low cost practices are used or installed to ensure it has the least possible impact to the Chesapeake Bay.

Table 1 : Interpreting Your Initial Score		
Score	**Rating**	**Comments**
95 to 100	**Excellent**	**Congratulations…**Your activities and practices make you an industry leader in stormwater compliance…you go way beyond the minimum and deserve recognition in your community
85 to 94	**Good**	**Great Start…**You run a good clean operation and only have a handful of areas for improvement to meet the goal
75 to 84	**Fair**	**Needs Work…**Although you are doing a lot of things right, there are many areas where you can do more
65 to 74	**Poor**	**Not so Good.** Your site is probably a hotspot for stormwater pollution….and your team needs to get cracking to get the work done to meet the standard.
35 to 64	**Very Poor**	**Shame on You:** Your site is probably a severe hotspot and you are almost certainly noncompliant with your stormwater permit. The team and plant manager need a real action plan
Less than 35	**Unacceptable**	**Shred the Evidence (just kidding):** Your site is truly bad and you are exposing your company to regulatory risks, fines and citizen suits! Improving your score should be an immediate facility wide priority

2.0 Getting Started

The stormwater benchmarking exercise is designed to be completed in four hours or less, although some implementation activities may take longer. To get started, the environmental compliance officer should familiarize themselves with the benchmarking tool and read the pollution prevention resources provided in Appendix A. Benchmarking should be done by a team of at least two individuals, and it may be helpful to involve other facility employees (especially maintenance staff) to enhance its training value. The assessment team doesn't need a lot to get started, as shown below:

- Standard Safety gear (blaze orange vests if there is a lot of truck traffic)
- Clipboard with notes
- Access to internet
- Digital Camera
- Site Map to Scale

3.0 Description of the Stormwater Benchmarks:

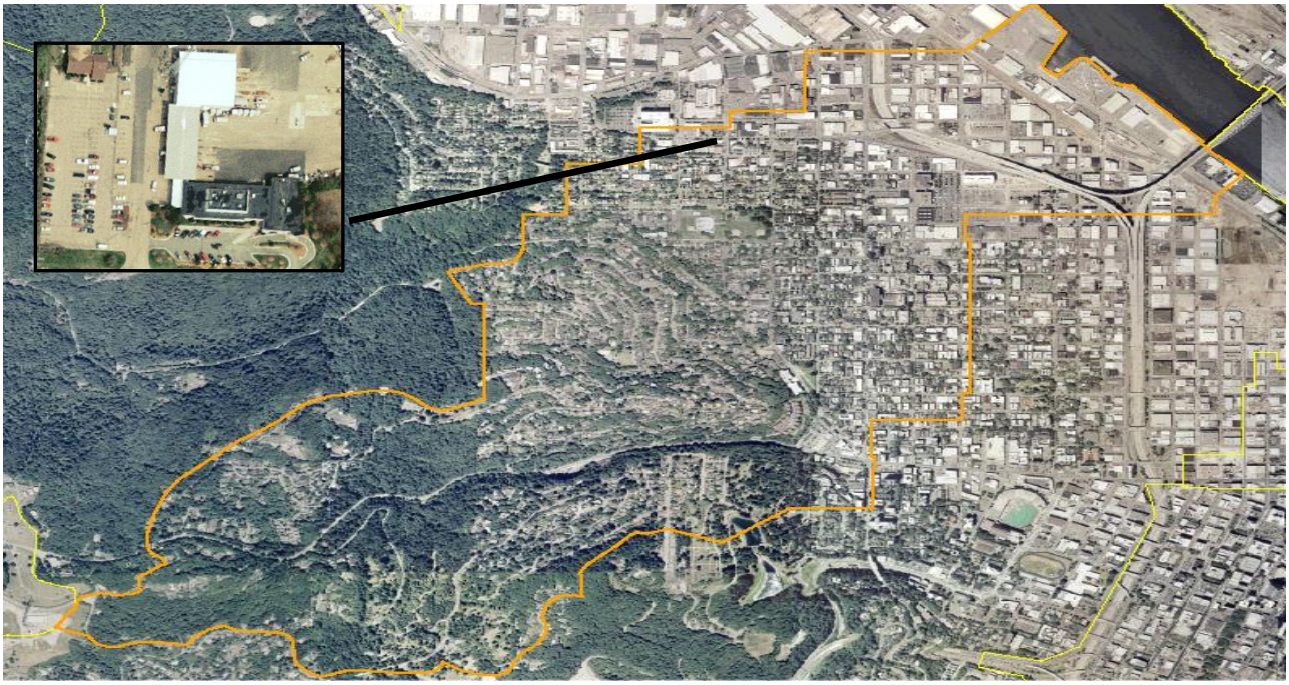
The team assesses benchmarks inside the building, outside of the building and along the stream or receiving water that the facility discharges to. The ensuing section outlines how to assess and score each benchmark through 22 profile sheets. Each profile sheet shows:

- The specific conditions to look for at the site
- Photographs that show how the indicated activity or operation can enhance or degrade stormwater runoff quality. These help show the survey team what is good or bad practice at their facility
- A specific description of the one to four different tasks that must be completed to earn points under each benchmark
- Guidance on how to score each benchmark
- Tips for evaluating each benchmark at your facility, including the recommended resources to learn more about best practices for your facility

The team should review the profile sheets carefully so they can better "see" the correctible stormwater problems present at the site, and then identify the most cost-effective solutions to address them.

Benchmark 1.
Define Your Watershed Address

What to Look For: The team uses the internet (Google Earth or other mapping) to determine the stream to which the facility ultimately drains to, as well as the larger watershed in which it resides.



Knowing the local watershed in which your facility resides provides important context for how and why you manage stormwater runoff

Tasks. Four specific tasks are completed to meet this benchmark:

1. Google Earth to find location of the facility in relation to nearest named stream
2. Determine the larger watershed in which it resides
3. Do a web search to identify local or regional groups working to protect or restore the watershed and get basic contact information
4. Contact the groups to learn more about the key water quality and habitat issues that are a problem in your watershed.

Scoring: **Total of 4 points**. One point is awarded for each task completed.

Tip:

- Several handy websites in **Appendix A** can quickly help you find your watershed address by simply entering the zip code of your facility. Other websites can help you find your local watershed group, and learn about the key pollutants of concern

Benchmark 2.
Derive a Stormwater Profile for Your Facility

What to Look For: Analyze the land cover present on the site plan to estimate site area and impervious cover so that you can quickly compute the annual stormwater runoff volume and pollutant load generated by your facility.

- Site Area = 24.1 acres
- % Impervious = 92%
- Average Annual Runoff = 50 inches
- Total Phosphorus = 56 lbs/yr
- Sediment = 8.7 tons/year
- Total Nitrogen = 452 lbs/yr
- Oil and Grease = 865 lbs/yr = 104 gallons/yr
- Zinc = 43 lbs/year

Try to express annual stormwater runoff volumes in terms that your employees can easily understand, such as cases of product shipped or the number of standard forty foot shipping containers each year. This facility was surprised to learn that the equivalent of nearly two 55 gallon drums of oil and grease washed off the facility every year. Once employees understand the magnitude of their stormwater pollution footprint, they are more likely to take action.

Tasks. Four specific tasks are completed to meet this benchmark:

5 Analyze the site plan to estimate total site area, impervious cover and its runoff coefficient.

6 Determine average annual rainfall at the site (find at http://maps.howstuffworks.com/united-states-annual-rainfall-map.htm

7 Compute the annual stormwater runoff volume produced at your site, and compare it to the volume of your annual production

8. Compute the annual phosphorus, zinc, and oil/grease load generated from your facility

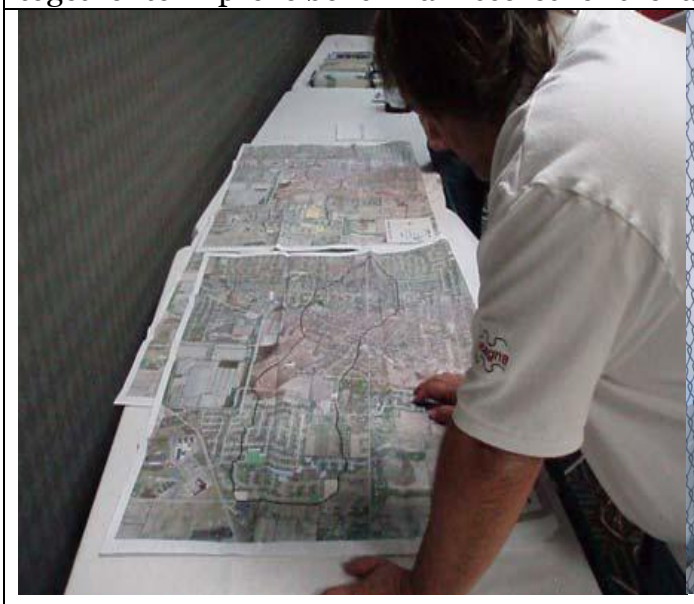
Scoring: **4 points total**. One point is awarded for each task completed

Tips:

- Consult ***Appendix B*** to learn how to compute the annual runoff volume and pollutant load that washes off your site using the Simple Method.

Benchmark 3.
Improve Your On-site Employee Training Efforts

What to look For: Use the stormwater benchmarking tool to train employees to "see" stormwater runoff problems and opportunities across the site and then create a team to work together to improve benchmark scores for the facility.



The best training involves hands-on assessment out in the facility. Many employees are initially not aware of how stormwater travels through their site and the potential for pollutants to wash-off into local streams. Experience has shown that" outside the building training" using the benchmarking method is an extremely effective learning tool.

Tasks. Four tasks are completed to meet this benchmark

9. Involve key employees in stormwater benchmarking exercise and discuss results with them and the plant or facility manager. Current stormwater benchmark scores should be posted in a prominent location in the facility
10. Customize a basic stormwater pollution prevention training program with site data
11. Use the new training program with all employees at least once a year
12. Include tips on watershed stewardship that all employees can practice at home or in their community

Scoring: **5 points total.** Two points are awarded for the task 9, and one each for tasks 10 through 12.

Tips:

- Some guidance on employee training can be found in Profile Sheet MO-10 "Employee Training" from Manual 9 of the Small Watershed Restoration Manual Series
- A great resource to find posters and brochures on stormwater pollution and watershed stewardship to post in the employee lunch or meeting rooms is EPA's Nonpoint Source Outreach Tool Box, which has more than 800 posters, brochures, and other watershed educational tools, and can be found at www.epa.gov/nps/toolbox

Benchmark 4
Update Your Stormwater Pollution Prevention Plan

What to Look For: Check your files to see if you have an existing Stormwater Pollution Prevention Plan (SWPPP) for your site, if required by EPA's industrial or municipal stormwater NPDES permit regulations. If you can't find one, do some internet research to determine the regulatory status of your site.

The objective of benchmarking is to develop an action plan that reflects your site-specific problems and opportunities. At this facility, the action plan included one immediate corrective action, five actions to implement in the next ninety days, and 12 more by the end of the year. Five more actions that require capital funds or more detailed engineering were scheduled in next three years

Tasks. Three tasks are required to meet this benchmark:

13. Find and review your existing stormwater pollution prevention plan (if your facility is regulated under the NPDES stormwater permit program. If not, find a good quality site plan or aerial photograph of your facility
14. Designate a lead staff to conduct annual stormwater benchmarking and to implement the SWPPP
15. Create an annual workplan or punch list outlining new practices and retrofits to improve future benchmark scores.

Scoring: **5 points**. One each for the first two tasks, and three for the annual workplan

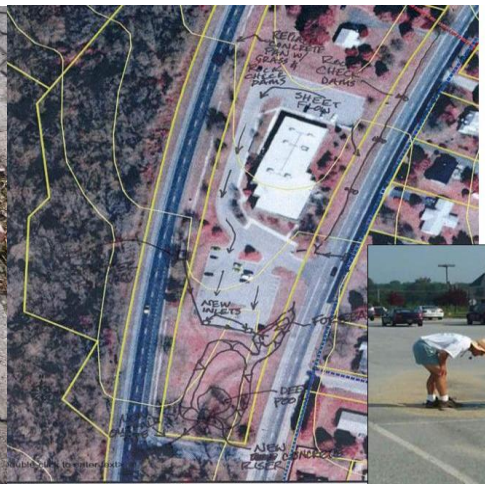
Tips:

- If you are not sure if your facility is covered by industrial stormwater regulations, then click http://cfpub.epa.gov/NPDES/stormwater/indust.cfm to learn more.

- Many municipal and federal facilities do not meet the strict definition of "industrial" but still contain operations or activities that can make them a stormwater hotspot. Check out Manual 8 "Source Control Practices" and the web links in Appendix A to learn more about stormwater pollution prevention.

Benchmark 5.
Understand the Stormwater Plumbing at Your Site

What to Look for: After carefully analyzing the facility plan, walk around to discover the pathways by which stormwater runoff flows across and, sometimes underneath, the site. The basic idea is to proceed from the roof (the highest point) to the lowest point where stormwater is discharged from the site. The team should trace how runoff flows from roof leaders, across pavement, into stormwater inlets, and then into channels or storm drain pipes. The pathway of stormwater flows can be complex at many facilities, particularly given the presence of sanitary sewer and drinking water pipes that are also present at the site.



*The survey is best done when it is raining, and should also pinpoint the location of storm drain outfalls which may be located off the site (**right**). Once you are done with the survey, make sure to mark all storm drain inlets "Keep pollutants out- drains to X stream or river" (**left**)so that employees understand that they are stormwater inlets and are not connected to the wastewater treatment plant.*

Tasks. Four specific tasks are required to meet this benchmark.

16 Walk site with plan to determine actual stormwater flow paths
17 Confirm locations of sanitary, stormwater and water pipes
18 Mark actual locations on site plan or aerial photographs
19. Provide permanent markers at each storm drain inlet

Scoring: **Total of 5 points**. One point for the first three tasks, and two points for task 19

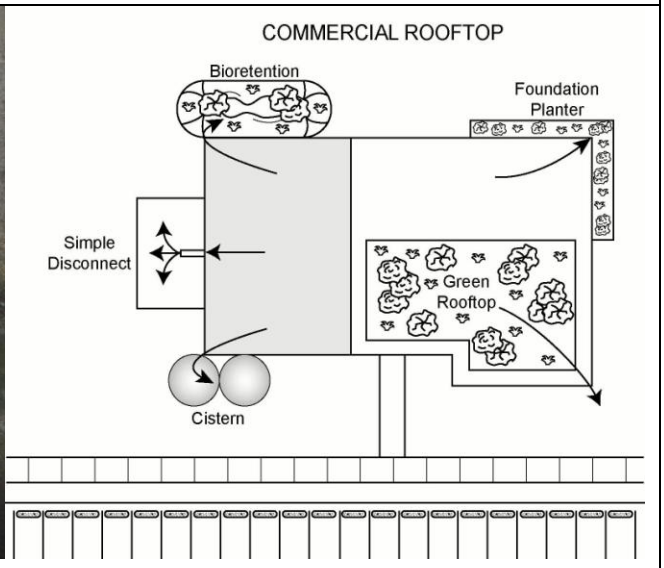
***Tips*:**

- Your survey should locate where underground stormwater, wastewater and drinking water pipes are currently going. Often, the pipes can be quickly identified by looking at the markings on surface manhole covers. If you are in doubt, simple dye testing may be needed to confirm which pipes are used to carry sewage, drinking water or stormwater.

- Guidance on storm drain marking can be found in Profile Sheet N-16 of Manual 8 Small Watershed Restoration Manual Series or from an EPA fact sheet which can be accessed at http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=browse&Rbutton=detail&bmp=15

Benchmark 6.
Look for Opportunities to Reduce Rooftop Runoff

What to Look For: Survey the perimeter of the building to find the points where rooftop runoff discharges to the ground (known as downspouts or roof leaders). Check to see which ones can be diverted to adjacent pervious or turf areas where the runoff can be filtered or infiltrated into the ground.



*The **left panel** shows a typical roof downspout that discharges to a paved surface and then into a storm drain. These directly connected downspouts do not allow for any treatment of stormwater before it is discharged to the stream. The **right panel** shows a wide range of options for disconnecting and treating roof runoff, from simple disconnection over a pervious area to rain tanks that reuse stormwater and increase plant water efficiency.*

Tasks. Three specific tasks are required to meet this benchmark:

20. Evaluate every downspout to determine if it can be safely disconnected to filter runoff over an adjacent pervious area
21. Evaluate feasibility of rain tanks or re-use of stormwater in landscaping
22. Retain an engineering consultant to design a roof retrofit

Scoring: **5 points total**. One point for task 20, and two points each for tasks 21 and 22

Tips:

- Guidance on retrofitting rooftops can be found in Profile Sheet OS-10 of Manual 3 in the Small Watershed Restoration Manual Series

- Simple disconnections may involve using flexible pipes from the roof leader to divert runoff several feet to a more appropriate discharge. If this is not possible, an engineering consultant can recommend the most cost-effective roof retrofit option for your facility, such as a green roof, foundation planter, bioretention area or rain tank.

Benchmark 7.
Investigate Loading and Unloading Areas

What to Look For: Nearly every facility has a distinct area where bulk inputs are delivered and products are shipped out. Spills and leaks are common at these loading and unloading areas, which are compounded by the fact that they are usually located near an outdoor storm drain inlets. Consequently, spilled pollutants can enter the storm drain during a storm or be carried in wash-water when loading and unloading areas are cleaned.

*The **left panel** shows a truck loading and unloading area that is covered to prevent rainfall from washing away spilled products, whereas the **right panel** shows an uncovered loading area with a high potential for pollutant wash-off into the adjacent storm drain system*

Tasks. Two specific tasks are required to meet this benchmark:

23. Keep loading areas clean by regular sweeping (never by hosing to a storm drain)
24. Make sure loading areas are covered or redesigned to send any runoff to the sanitary sewer

Scoring: **4 points total**. Two points for successfully completing each task

Tips:

- Some best practices for loading and unloading areas are described in Profile Sheet H-5 in Manual 8 of the Small Watershed Restoration Manual Series.

- The team should look for outdoor water spigots in close proximity to the loading area which often means that employees hose down the area to keep it clean. This practice should be avoided unless it is clear that the wash-water goes into the sanitary sewer system. The alternative practice is to manually sweep or vacuum the loading area and ensure solids are disposed properly

Benchmark 8
Prevent Pollution from Parking Lots

What to look For: Walk all the employee and fleet parking lots to assess their condition, and look for the presence of obvious pollutants such as trash, oil stains and sediment deposits. Based on how dirty the lots are, the team can change current parking lot maintenance practices to improve the quality of parking lot runoff. Often the dirtiest parking lots occur when vehicles or heavy equipment are parked or stored for a long time

Top left*: Monthly sweeping of the parking lot helps reduce wash-off of pollutants in storm water.*
Bottom left*: Trash and debris can often accumulate in parking lots so that good housekeeping in the form routine trash and litter pickup can sharply reduce trash loading delivered to nearby streams.*
Top right*: Oil and hydraulic fluid leaks can be a problem in long-term parking lots, but can easily be remedied with spot applications of adsorbents.*
Bottom right:*: Unpaved parking lots can be a major source of sediment, and should either be stabilized or protected with erosion and sediment controls*

Tasks. Two specific tasks are required to meet this benchmark

25 Walk the lot monthly to find and fix fluid leaks
26 Weekly trash and litter pickup and sweep at least once a month with vacuum sweeper. Stabilize un-paved lots to prevent erosion and exercise special care in routine pavement maintenance activities such as power-washing and seal-coating.

Scoring: **5 points total.** Two points for the task 25, and three points task 26

Tip: Best practices for parking lot maintenance can be found in Profile Sheet H-11 of Manual 8 in the Small Watershed Restoration Manual Series

Benchmark 9
Prevent Spills and Runoff From Fueling Areas

What to Look For: Check to see if there are any vehicle fueling areas at the site. If they are present, carefully inspect them to see if there is any risk that petroleum products can spill or wash into the storm drain system

*This fueling area on the **left** has been designed with a cover to keep rainwater away from any spilled diesel, and also has a spill response kit. Contrast this with the uncovered fueling area on the **right**, with obvious petroleum stains that reach the storm drain system*

Tasks. Three specific tasks are required to meet this benchmark

27 Cover fueling islands to prevent rainwater contact
28. Ensure that dry spill response kits are readily available
29. Redesign flow paths to prevent "runon" or runoff from the fueling area into the storm drain system

Scoring: **4 points total**. One point each for tasks 27 and 28, and two points for task 29

Tips:

- Best practices for vehicle fueling areas are described in Profile Sheet H-2 in Manual 8 of the Small Watershed Restoration Manual Series
- Just because a fueling area is covered does not automatically mean that it will be clean. Stormwater from adjacent paved areas can "runon" to the fueling area and wash-off petroleum products into the storm drain system, so it is important for the team to find these adjacent storm drains and make sure they are protected by storm drain inserts that can capture hydrocarbons.

Benchmark 10.
Deal with Outdoor Wash-water and Winter Deicing Operations

What to Look For: Locate all outdoor water spigots and identify what, if any, seasonal outdoor washing operations occur at the site. Find out where outdoor wash-water is directed, to make sure it is disposed in the sanitary sewer system and **not** in the storm drain system. Assess winter de-icing operations at the facility to ensure salt is safely stored and excess chlorides are cleaned up in the Spring.

*Wash-water from outdoor plant sales in this big box store is sending nutrient-rich water directly into the storm drain **(left).** The large pile of un-covered road salt at this facility sends a toxic pulse of high salinity water into the nearby stream during every rainfall event **(right**). Better storage and management of road salt can prevent this problem.*

Tasks. Two specific tasks are required to meet this benchmark:

30 Ensure that seasonal outdoor washing operation do not enter storm drain inlets. This can be done by shifting them to pervious areas, or temporary closing off storm drain inlets to prevent the entry of wash-water

31 Assess winter deicing operations to reduce entry of sediment and chlorides into the storm drain system. This typically involves a spring cleanup of excess salt, spot re-vegetation, and environmentally safe storage of salts and deicers.

Scoring: **4 points total**. Two points each for successfully completing tasks 30 and 31

Tips:

- Best practices for vehicle washing are described in Profile Sheet H-3 in Manual 8 of the Small Watershed Restoration Manual Series
- Operations at a site vary from season to season, so it may be a good idea to interview long-term workers to get a better handle of the range of operations during the course of a year and then design effective pollution prevention practices
- Best practices for managing road salt piles can be found at http://cfpub1.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=factsheet_results&view=specific&bmp=106

Benchmark 11.
Keep Rain and Runoff Away from Vehicle Repairs

What to Look For: Investigate all indoor and outdoor areas where vehicles and equipment are maintained or repaired to ensure fluids and wash-water cannot enter the storm drain system. Check to make sure that used batteries, vehicle fluids, solvents and tires are recycled properly and stored in manner where they are never exposed to rainfall

This indoor truck maintenance area keeps pollutants away from rainfall and stormwater. The shop drain is connected to the sanitary sewer system rather than the storm drain system, and has proper storage for used fluids, rags, solvents and other materials.

Tasks. Three specific tasks are required to meet this benchmark:

32 No outdoor vehicle maintenance or repairs
33 Ensure that indoor shop drains are not connected to the storm drain system (they should drain to the sanitary sewer)
34 Properly store and recycle all used fluids so they are not exposed to rainfall or runoff (e.g., oil, solvents, batteries, hydraulic fluids, etc.)

Scoring: **4 points total**. Two points for task 32 and one each for tasks 33 and 34.

Tips:

- Guidance on best practices for vehicle maintenance and repair can be found in Profile Sheet H-1 in Manual 8 of the Small Watershed Restoration Manual Series
- Interview a few long term workers to find out if, when and where any outdoor repairs are made at the site. Also, look for where used fluids, batteries, tires and other products are stored. Both should be inside, or be designed in such a manner where they are fully covered and disconnected from the storm drain system

Benchmark 12
Evaluate Spill Control and Response

What to Look For: Walk the facility to identify the specific areas with the greatest risk of spills or leaks. Then create an unannounced "training spill" (using water and green dye) and critically analyze how quickly employees respond to finding and fixing it.

Even small spills of oil, diesel, paint, solvents or other fluids can have a dramatic impact on local streams. Although most facilities have some kind of spill response plan, many employees may not be aware of it, or know who to contact to make sure it is rapidly cleaned up and reported to the appropriate authority

Tasks. Three specific tasks are required to meet this benchmark:

35 Make sure dry spill kits are readily available at all high risk areas
36 Update emergency contact numbers and procedures and distribute as a business card
37 Achieve a rapid and effective response to the training spill

Scoring: **5 points total**. Two points each for tasks 35 and 37 and one point for task 36.

Tips:

- Best practices for spill prevention and response are described in Profile Sheet H-7 in Manual 8 of the Small Watershed Restoration Manual Series
- One facility created a simple business card for employees to carry in their wallets so they would know the correct internal and external people to notify, and quickly understand the company's spill response procedures

Benchmark 13.
Prevent Runoff From Materials Stored Outside

What to Look For: Walk the outside of the facility to look for any materials that are temporarily or permanently stored outside that could come into contact with rainfall or runoff. Outdoor storage may change seasonally and or even from day to day.

Left panel: *When it rains next, this mulch mountain will send polluted runoff into the storm drain at far left.*
Right panel: *This restaurant has poor storage of cooking grease which leaks into the storm drain system. Simple best practices can prevent materials stored outside from becoming a stormwater runoff problem*

Tasks. Three specific tasks are required to meet this benchmark:

38 Outdoor materials are placed on pallets to stay above runoff
39 Storage areas are covered or have secondary containment
40 Storage areas are located in a manner to reduce entry into storm drain (as indicated by lack of streak or stain lines)

Scoring: **4 points total**. One point for tasks 38 and 39 and two points for task 40

Tips:

- Best practices for outdoor storage are described in Profile Sheet H-6 in Manual 8 of the Small Watershed Restoration Manual Series
- Key practices include a) temporary or permanent covers, b) storing material on pallets or raised surfaces c) providing secondary containment to capture any fluids before the reach the storm drain, and d) changing the location of where materials are stored to maximize increase the distance to the storm drain

Benchmark 14.
Prevent Dumpster and Compactor Juice

What to Look For: Walk the site to locate any outdoor dumpsters, compactors or solid waste receptacles to ensure that overflowing wastes or leaking "dumpster juice" cannot reach the storm drain system. Dumpsters can be problematic if they handle fluids or are exposed to rainfall

Top left: *The over-flowing dumpster is a source of both trash and fluids to the storm drain*
Bottom left*: Note the stain lines between the open dumpster containing used metal products and the storm drain inlet.* ***Top right:*** *The direct leakage of dumpster juice into the storm drain could have been prevented by simply moving it to another site location.* ***Bottom right****: Compactors that compress materials with fluids can be a chronic problem when connected to the storm drain system*

Tasks. Two specific tasks are required to meet this benchmark:

41 Dumpsters and compactors are covered, have lids, are in good condition, and are watertight

42 Dumpsters are located in areas that are disconnected from the storm drain system

Scoring: **4 points total**. Two points each for successfully completing task 41 and 42

Tips:

- Best practices for dumpster management are described in Profile Sheet H-8 in Manual 8 in the Small Watershed Restoration Manual Series
- Work with your solid waste contractor to make sure dumpsters are water tight, frequently emptied and are located well away from the storm drain inlets.

Benchmark 15.
Improved Turf Management and Conversion

What to Look For: Evaluate every area of un-utilized turf and landscaping within the boundary of the facility to look for ways to convert existing turf cover into native forest or meadow, or modify turf so that it more effectively filters and treats stormwater runoff from adjacent impervious areas.

*Turf can generate high runoff rates and nutrient and pesticide loadings to streams **(left)** so check to see if any turf areas can be converted to forest or meadow through planting and soil restoration, or utilized as a rain garden **(pictured right)** or filter strip. As much as 20% of the area of many industrial and institutional sites are in turf cover, so this can be a cost-effective strategy that also reduces ongoing turf maintenance costs*

Tasks. Two specific tasks are required to meet this benchmark:

43 Evaluate all turf areas present at the site to look for alternatives to turf cover or to enhance its ability to filter and infiltrate runoff.

44 Implement reduced mowing, soil restoration, reforestation, filter strips, or rain gardens on existing turf cover

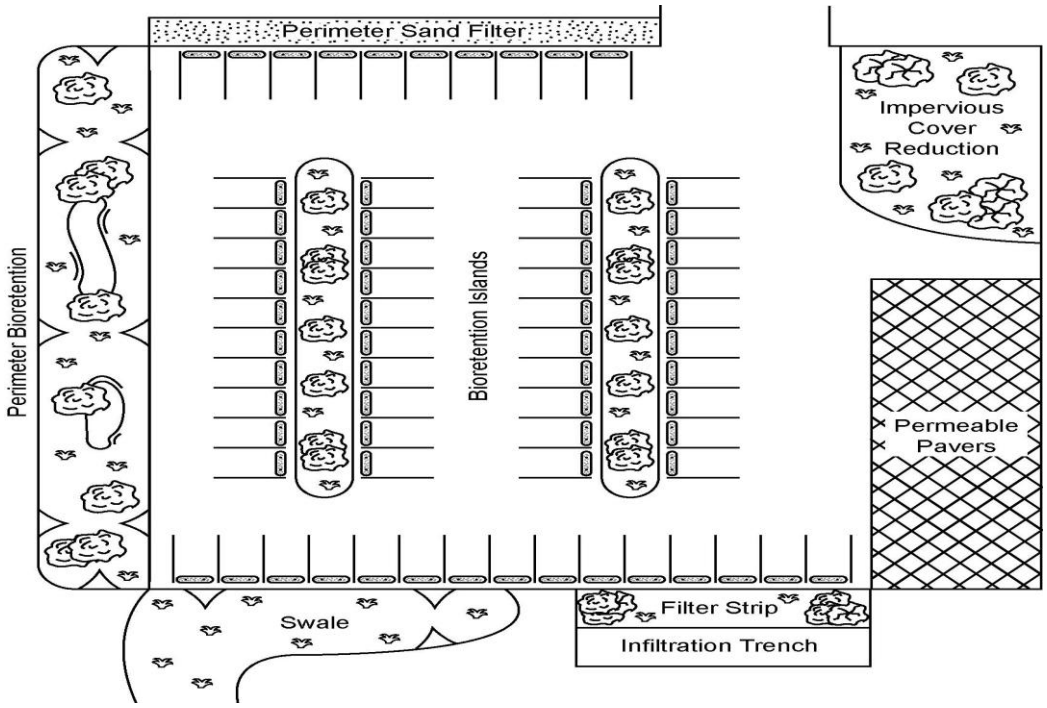
Scoring: **10 points total**. Three points are awarded for the initial turf cover evaluation (task 43), and then one point is awarded for each 5% increment of existing turf converted at the site (task 44; up to a maximum of seven total points)

Tip:

- The urban watershed forestry manual series produced by the Center for Watershed Protection can be accessed at www.cwp.org. Bay-wide design specifications for soil restoration, filter strips, bioretention and rain gardens can be accessed from the CSN website at www.chesapeakestormwater.net.

Benchmark 16.
Investigate Feasibility of Parking Lot Retrofits

What to Look For: Walk around your parking lot to determine where it sends stormwater to find for possible locations to treat runoff from all or part of the lot. Open areas in close proximity to the lot that are about 3 to 5% of lot area are excellent candidates for retrofits. If these exist, retain an engineering consultant to assess the feasibility and cost of building them.



The graphic above shows the many different retrofit options available to treat the quality of stormwater runoff within or along the margins of a typical parking lot, including filter strips, swales, perimeter or island bioretention, sand filters and impervious cover reduction.

Tasks. Two specific tasks are required to meet this benchmark:

45 Identify potential candidate retrofits to treat parking lot runoff.
46 Retain engineering consultant to assess their feasibility and cost

Scoring: **5 points total**. Two points for task 45 and three points for task 46.

Tips :

- The tips and tricks for retrofitting large and small parking lots are succinctly described in Profile Sheets SR-6 and OS-7 in Manual 3 in the Small Watershed Restoration Manual Series.
- There may be several small drainage areas within each parking lot that discharge to different points. It is often quite easy to shoehorn a retrofit into the landscaping setbacks or unutilized turf found at these discharge locations

Benchmark 17.
Adopt Green Landscaping Practices

What to Look For: Inspect all remaining turf and landscaping areas present at the site and work with landscaping contractors to reduce fertilization, pesticide application and irrigation and apply best practices to keep clippings and leaves out of the storm drain system.

*The clean fence line and dead vegetation are a sure sign that herbicides are being used (**pictured left**), weed-whackers are a better method. Proper management of lawn clippings and leaves is also important so they are not washed or blown into the storm drain (**pictured right**)*

Tasks. Three specific tasks are required to meet this benchmark:

47 Review and modify all landscaping contracts to minimize fertilizer use and chemical inputs (or train employees, if they perform this function)
48 Utilize native species in all landscaping areas present at the site
49 Avoid using herbicides along fence-lines (weed-whack instead)

Scoring: **5 points total**. Two points each for completing tasks 47 and 48 and one point for completing task 49.

Tips :

- Several useful best practices for better turf management and landscaping can be found in Profile Sheets H-12 and H-13 of Manual 8 in the Small Watershed Restoration Manual Series
- These profile sheets can be attached to landscaping contracts or provided to landscaping and grounds maintenance crews
- The landscaping at your facility should reflect the native plant species found in the Chesapeake Bay watershed, several excellent guides can be accessed at http://www.acb-online.org/project.cfm?vid=85 *or* http://www.nps.gov/plants/pubs/Chesapeake/toc.htm

Benchmark 18.
Check for Dry Weather Flows in Stormwater Outfalls

What to Look For: Follow your storm drain pipe(s) until they discharge into a ditch or stream channel, and check for the presence of dry weather polluted flows (or past evidence they have occurred), and do the necessary detective work to stop them.

All storm drain pipes that daylight from the facility should be checked for suspicious flows during dry weather ***(left).*** *Even small diameter storm drain pipes can be a source of episodic or transitory illicit discharges of pollutants* ***(right)***

Tasks. Two specific tasks are required to meet this benchmark

50. Check for dry weather flows at storm drain outfalls at least four times a year
51 If flows exist, perform an Outfall Reconnaissance Investigation (ORI) at all stormwater outfalls to find and fix the problem

Scoring: **3 points total**. One point for task 50 and two points for task 51. If no dry weather flows are detected over the course of a year, give yourself the 2 points for Task 51.

Tips:

- Some simple detective methods to evaluate dry weather flows can be found in the Outfall Reconnaissance Investigation and Field Sheet, Chapter 11, Illicit Discharge Detection and Elimination Manual available on-line from the Center for Watershed Protection at www.cwp.org
- In many cases, the flows from large diameter storm drain pipes are derived from high ground water so that the flows are relatively clean. More detailed investigations are triggered if the crew notices suds, stains, odors, or turbid or discolored waters

Benchmark 19.
Regularly Maintain Your Stormwater Infrastructure

What to Look For: Inspect all storm drain inlets, sumps and stormwater best management practices present at your facility for excessive sediment accumulation, and clean them out on a regular basis to keep sediment and other pollutants from reaching local streams and the Bay.

*By removing trapped sediments in your storm drain infrastructure you keep these pollutants from eventually reaching the stream **(left).** Storm drain inlets and stormwater practices should be visually inspected at least once a year to identify any maintenance tasks that are needed to assure the continued performance and longevity of the stormwater infrastructure **(right)***

Tasks. Two specific tasks are required to meet this benchmark

52. Perform an annual maintenance inspection of the your stormwater infrastructure
53. Clean out storm drain inlets (and any stormwater management practices) at least once a year

Scoring: **5 points total**, two points for task 52 and three points for performing task 53

Tips:

- If your facility was built in the last two decades, there is a strong probability that there is some kind of stormwater best management practice present at your site, usually some kind of detention or retention pond. If these are present, you may want to consult the Pond and Wetland Maintenance Guidebook, available at www.cwp.org to assess its maintenance condition and determine which specific maintenance tasks are needed.
- Sediments that accumulate in storm drain inlets can be removed manually or using a vactor truck. Make sure to properly dispose of these polluted sediments in a landfill or other approved facility

Benchmark 20.
Natural Area Conservation and Restoration

What to Look For: Many facilities contain small fragments of forest, wetlands, floodplains steep slopes or buffers that have been reserved for environmental protection. Over time, the habitat quality of these natural areas may be degraded by invasive species, clearing, disease or poor soils. The team should walk through natural areas to assess their condition and diversity, and identify conservation and restoration practices that can improve their function and diversity.

This is a typical natural area remnant at an industrial site. This small fragment has been degraded by illegal dumping, encroachment, growth of invasive species of wetland plants, vines and trees, poor soils and unauthorized clearing. Some simple restoration practices can greatly increase it conservation value

Tasks. Two specific tasks are required to meet this benchmark:

54 Inventory the condition of any natural areas present at the site (e.g., forests, wetlands, meadows and buffers)

55 Implement conservation and restoration practices to improve the function and diversity of the natural areas.

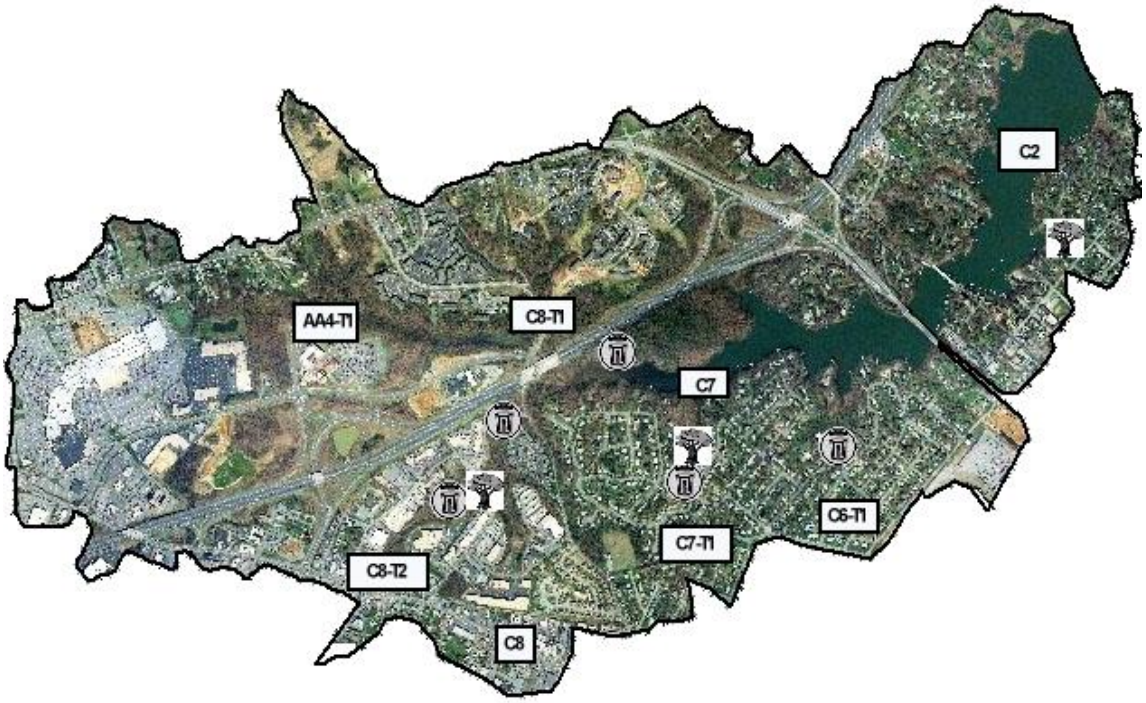
Scoring: **5 points total.** Two points for the inventory, and three for implementation of conservation practices. If no natural areas are present at site, than give yourself the 5 points

Tips:

- Several resources can be consulted for the habitat assessment, including articles in the Wetlands and Watershed Series and Urban Watershed Forestry Manuals, both of which can be accessed on-line at www.cwp.org.
- For guides on how to identify and manage invasive plant species, please consult http://www.fws.gov/chesapeakebay/bayscapes/bsresources/bs-invasives.htm or http://plant-materials.nrcs.usda.gov/technical/invasive.html

Benchmark 21.
Become a Local Watershed Partner

What to Look For: Meet with a local or regional watershed group (identified in Benchmark 1) to find ways to strengthen their efforts through volunteer work, product donations, board service or other measures.



Hundreds of watershed groups exist in the Bay watershed, and it is very likely one is located very near your facility. These groups are your local connection to the Bay watershed, and are an important source for watershed education and stewardship. Many of them exist on a shoe-string, and are deserving of your support. After you have identified your local watershed groups, you can gradually develop a strong supportive relationship

Tasks. Two specific tasks are required to meet this benchmark:

56 Meet at least once with the local or regional watershed group
57 Provide tangible evidence of support to the group in first year

Scoring: **4 points total**. Two points each for successfully completing tasks 56 and 57

Tips:

- What is tangible support? It can be as simple as attending a few board meetings, serving on a board of directors, becoming a corporate sponsor, encouraging your employees to make tax deductible donations, or donating surplus office equipment. One Coca-Cola bottler in Baltimore stored plastic syrup barrels in an old truck and made them available for free to local watershed groups to help make rain barrels
- To find out which watershed organizations are active in your area, you can click on this directory of Bay watershed groups http://www.chesapeakebay.net/findabaygroup.aspx?menuitem=14797 or find it using a Chesapeake Bay Map http://archive.chesapeakebay.net/georss/WatershedOrgsMap.kmz

Benchmark 22.
Support Local Stream Cleanup

What to Look For: Take a stream walk down the closest thousand feet of stream to your facility (that has safe access from public property) to see if it needs stream cleanup or adoption, in partnership with the local watershed group.

Most watershed organizations offer a wide range of volunteer opportunities for your employees to have fun, make a difference and demonstrate your commitment to community involvement

Tasks. Two specific tasks are required to meet this benchmark:

58 Take a stream walk at the nearest accessible and safe stream segment downstream of the plant to better understand the waters that you discharge to

59. Participate in a stream cleanup or other watershed restoration activity conducted by a local or regional watershed organization

Scoring: **4 points total**. One point for task 58, and three points for task 59

Tips:

- The Unified Stream Assessment (USA) is an excellent tool to document urban stream problems and identify restoration opportunities. It is available on-line as Manual 10 in the Small Watershed Restoration Manual Series from CWP.

- Some helpful guidance on how to conduct a stream cleanup or adopt a stream can be found in Profile Sheets C-1 and C-2 of Manual 4 in the Small Watershed Restoration Manual Series

- Most watershed groups offer many different opportunities for you and your employees to engage in a watershed restoration activity throughout the year.

4.0 The Benchmarking Tool Score Sheet

This section provides a simple score sheet to keep track of your facility benchmarking exercise.

STORMWATER BENCHMARKING TOOL SCORING SHEET FOR SURVEY			
Benchmark No.	**Description of Benchmark**	**Maximum Points**	**Points Awarded**
1. DEFINE YOUR WATERSHED ADDRESS			
1	Google Earth to find stream closest to facility	**1**	
2	Determine which major watershed it drains to	**1**	
3	Identify the major watershed groups in it	**1**	
4	Learn the key water quality and habitat issues	**1**	
	Subtotal	**4**	
2. DERIVE A STORMWATER PROFILE FOR THE SITE			
5	Analyze land cover on site plan	**1**	
6	Determine your annual rainfall	**1**	
7	Compute annual runoff from site	**1**	
8	Compute annual pollutant loads for site	**1**	
	Subtotal	**4**	
3. REVIEW PAST EMPLOYEE TRAINING			
9	Involve key employees to discuss benchmarks	**1**	
10	Customize stormwater training for the site	**1**	
11	Train all employees once a year/post scores	**2**	
12	Give employees personal stewardship tips	**1**	
	Subtotal	**5**	
4. YOUR STORMWATER POLLUTION PREVENTION PLAN			
13	Find and review existing SWPPP	**1**	
14	Designate lead staff responsible for it	**1**	
15	Full update of SWPPP and annual workplan	**3**	
	Subtotal	**5**	
5. UNDERSTAND THE PLUMBING AT YOUR SITE			
16	Walk the site to trace stormwater flows	**1**	
17	Confirm water, wastewater, and stormwater	**1**	
18	Produce final site plan showing each	**1**	
19	Stencil or mark all storm drain inlets	**2**	
	Subtotal	**5**	
6. REDUCE RUNOFF FROM THE ROOF			
20	Check for downspout disconnection potential	**1**	
21	Evaluate feasibility of rain tank or water reuse	**2**	
22	Retain consultant to design system	**2**	
	Subtotal	**5**	
7. INVESTIGATE LOADING & UNLOADING AREAS			
23	Keep loading areas clean by sweeping	**2**	
24	Cover loading docks or redesign drainage	**2**	
	Subtotal	**4**	
8. PREVENT POLLUTION FROM PARKING LOTS			
25	Walk areas monthly to find and fix fluid leaks	**2**	
26	Weekly trash & litter pickup, monthly sweeping	**3**	

STORMWATER BENCHMARKING TOOL SCORING SHEET FOR SURVEY			
	Subtotal	**5**	
9. PREVENT SPILLS FROM FUELING AREAS			
27	Cover fueling islands	**1**	
28	Install dry spill response kits	**1**	
29	Redesign flows to prevent storm drain entry	**2**	
	Subtotal	**4**	
10. DEAL WITH SEASONAL OPERATIONS AND OUTDOOR WASHWATER			
30	Assess seasonal operations (e.g., salting)	**2**	
31	Keep outdoor wash-water out of storm drains	**2**	
	Subtotal	**4**	
11. KEEP RAIN AND RUNOFF AWAY FROM VEHICLE REPAIRS			
32	No outdoor vehicle repairs	**2**	
33	Make sure indoor shop drains go sanitary	**1**	
34	Indoor storage of used fluids/batteries	**1**	
	Subtotal	**4**	
12. EVALUATE SPILL CONTROL AND RESPONSE			
35	Provide spill kits at high risk areas at site	**2**	
36	Update emergency contact numbers	**1**	
37	Adequate response during training spill	**2**	
	Subtotal	**5**	
13. PREVENT RUNOFF FROM MATERIALS STORED OUTSIDE			
38	Place materials on pallets	**1**	
39	Temporary covers or secondary containment	**1**	
40	No streak or stain lines on way to storm drain	**2**	
	Subtotal	**4**	
14. EXTERIOR DUMPSTER MANAGEMENT			
41	Dumpsters covered, have lids or are watertight	**2**	
42	Dumpsters disconnected from storm drains	**2**	
	Subtotal	**4**	
15. TURF MANAGEMENT			
43	Evaluate all turf areas at site for alternative mgmt	**3**	
44	Implement reduced mowing, soil restoration, reforestation, filter strips or rain gardens on existing turf (1 pt per 5% of turf)	7	
	Subtotal	**10**	
16. PARKING LOT RETROFITS			
45	Identify candidate retrofit projects at lot	**2**	
46	Retain engineer to investigate feasibility	**3**	
	Subtotal	**5**	
17. ADOPT GREEN LANDSCAPING PRACTICES			
47	Modify contracts to reduce chemical inputs	**2**	
48	Use native species in landscaping areas	**2**	
49	Avoid use of herbicides along fence lines	**1**	
	Subtotal	**5**	
18. CHECK FOR DRY WEATHER FLOWS AT STORM DRAIN OUTFALLS			
50	Check for dry weather flow in storm drains	**1**	
51	If flows exist, perform outfall investigation	**2**	
	Subtotal	**3**	

STORMWATER BENCHMARKING TOOL SCORING SHEET FOR SURVEY			
19. REGULARLY MAINTAIN YOUR STORMWATER INFRASTRUCTURE			
52	Perform semi-annual maintenance inspection	**2**	
53	Clean out storm drain inlets annually	**3**	
	Subtotal	**5**	
20. NATURAL AREA CONSERVATION			
54	Assess condition of existing forests/wetlands	**2**	
55	Implement conservation/restoration practices	**3**	
	Subtotal	**5**	
21. BECOME A LOCAL WATERSHED PARTNER			
56	Join a local watershed group	**2**	
57	Provide tangible evidence of support	**2**	
	Subtotal	**4**	
22. ORGANIZE A LOCAL STREAM CLEANUP			
58	Conduct employee walk on nearest stream	**1**	
59	Participate in cleanup or other activity	**3**	
	Subtotal	**4**	
	GRAND TOTAL	**100**	

Scoring Notes

5.0 References

Center for Watershed Protection (CWP). 2005 Unified Subwatershed and Site Reconnaissance: A User's Manual. Urban Subwatershed Restoration Manual 11. Ellicott City, MD.

CWP. 2006 Pollution Source Control Practices. Urban Subwatershed Restoration Manual 8. Center for Watershed Protection. Ellicott City, MD

CWP. 2009.: Municipal Pollution Prevention/Good Housekeeping Practices. Urban Subwatershed Restoration Manual 9. Center for Watershed Protection. Ellicott City, MD

National Research Council (NRC). 2008. Urban Stormwater Management in the United States. National Academies Press. Washington, DC.

Department of Defense (DOD). 2009. Stormwater management at federal facilities and federal lands in the Chesapeake Bay Watershed. A report prepared to fulfill Section 202-c of Executive Order 13508. U.S. Environmental Protection Agency. Annapolis, MD

U.S. Environmental Protection Agency (EPA). 2009. Technical guidance on implementing the stormwater runoff requirements for federal projects under Section 438 of the Energy Independence and Security Act. EPA-841-B-09-001. Office of Water. Washington, DC.

Appendix A
Handy Internet Links to Find Your Watershed Address and Learn More about Watersheds and Stormwater Pollution Prevention

1. Find Your Watershed Address

EPA has two handy websites to help find your watershed address by simply entering the zip code of your facility:

http://cfpub.epa.gov/surf/locate/index.cfm

http://www.ctic.purdue.edu/KYW/glossary/whatiswsaddress.html

2. Learn More About Watersheds

To find out which watershed organizations are active in your area, you can click on this directory of Bay watershed groups:

http://www.chesapeakebay.net/findabaygroup.aspx?menuitem=14797

or find organizations by zooming into a Chesapeake Bay Map as found at

http://archive.chesapeakebay.net/georss/WatershedOrgsMap.kmz

Several websites provide excellent information about watersheds including:

BAY PROGRAM:	http://www.chesapeakebay.net/index.aspx?menuitem=13853
USEPA	http://www.epa.gov/owow/watershed/
CWP	http://www.cwp.org
RN	http://www.rivernetwork.org

3. Pollution Prevention Resources

- Urban Subwatershed Restoration Manual 11: Unified Subwatershed and Site Reconnaissance: A User's Manual (Center for Watershed Protection, 2005) http://www.cwp.org/Store/usrm.htm
- Urban Subwatershed Restoration Manual 10: Unified Stream Assessment: A User's Manual (Center for Watershed Protection, 2005) http://www.cwp.org/Store/usrm.htm
- Urban Subwatershed Restoration Manual 9: Municipal Pollution Prevention/Good Housekeeping Practices (Center for Watershed Protection, 2008) http://www.cwp.org/Store/usrm.htm
- Stormwater Phase II Final Rule Fact Sheet 2.8: Pollution Prevention/Good Housekeeping (US EPA, 2005) http://www.epa.gov/npdes/pubs/fact2-8.pdf

- Stormwater Fact Sheet No. 5: Municipal Pollution Prevention Planning (Land of Sky Regional Council (NC), 1994)
  http://h2o.enr.state.nc.us/su/PDF_Files/Land_of_Sky_factsheets/FactSheet_5.pdf

- Model Urban Runoff Program: A How-To-Guide for Developing Urban Runoff Programs for Small Municipalities (California Coastal Commission, 2002)
  http://www.coastal.ca.gov/la/murp.html

Source Control Practices General Resources

- National Menu of Stormwater Best Management Practices: Pollution Prevention/Good Housekeeping (US EPA, 2007)
  http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm

- Urban Subwatershed Restoration Manual 8: Pollution Source Control Practices (Center for Watershed Protection, 2005) http://www.cwp.org/Store/usrm.htm#8

- California Stormwater Best Management Practice Handbook: Municipal (California Stormwater Quality Association, 2003) http://www.cabmphandbooks.org/municipal.asp

- Stormwater Management for Industrial Activities: Developing Pollution Prevention Plans and Best Management Practices (US EPA, 1992)
  http://cfpub1.epa.gov/npdes/docs.cfm?document_type_id=1&view=Policy%20and%20Guidance%20Documents&program_id=6&sort=name

- King County (WA) Stormwater Pollution Prevention Manual (King County (WA) Department of Natural Resources and Parks, 2005)
  http://www.kingcounty.gov/environment/waterandland/stormwater/documents/pollution-prevention-manual.aspx

Vehicle Operations

- Auto Repair and Fleet Maintenance Pollution Prevention Website (US EPA Region 9, 2007)
  http://www.epa.gov/region09/waste/p2/autofleet/

- Vehicle and Equipment Wash Water Discharges Best Management Practices Manual (Washington State Department of Ecology, 2007) http://www.ecy.wa.gov/pubs/95056.pdf

Outdoor Materials

- Stormwater Management Fact Sheet: Spill Prevention Planning (US EPA, 1999)
  www.epa.gov/owm/mtb/spillprv.pdf

- Community Partners for Clean Streams Fact Sheet 1: Housekeeping Practices (Washtenaw County (MI), 1996) http://www.ewashtenaw.org/content/dc_drnbmp1.pdf

Turf/Landscaping Areas

- Integrated Pest Management Manual (US Department of the Interior National Park Service, 2003) http://www.nature.nps.gov/biology/ipm/manual/ipmmanual.cfm

- Best Management Practice Fact Sheet: Landscape and Grounds Maintenance (Alameda County (CA) Clean Water Program, 1998) http://www.cleanwaterprogram.org/land_ground_main.pdf

Appendix B

A. Estimating Annual Pollutant Load for Your Facility Using the Simple Method

The Simple Method estimates the annual pollutant load exported in stormwater runoff from small urban catchments (Schueler, 1987). The Simple Method sacrifices some precision for the sake of simplicity and ease of use, but is a reasonably accurate way to predict annual pollutant loads. The annual pollutant load exported in pounds per year from the contributing drainage area of a plant can be determined by solving the equation provided in Table B.1. Each of the terms in the equation can be extracted from data contained in a facility plan.

Table B.1: Pollutant Load Export Equation

$$L = [(P)(Pj)(Rv) \div (12)] [(C)(A)(2.72)]$$

Where:
L = Average annual pollutant load (pounds)
P = Average annual rainfall depth (inches)
Pj = Fraction of rainfall events that produce runoff
Rv = Runoff coefficient, which expresses the fraction of rainfall that is converted into runoff
C = Event mean concentration of the pollutant in urban runoff (mg/l)

Depth of Rainfall (P)

P represents the depth of precipitation that falls on the contributing drainage area of the retrofit site during the course of a normal year. Annual rainfall data for select U.S. cities can be obtained from local rainfall gages with reliable, long-term (> 20 years) records. For most of the Chesapeake Bay watershed, an annual value of 42 inches can be used.

Adjustment for Minor Storms (Pj)

Some of the storms that occur during a given year are so minor that they generate no stormwater runoff. The rainfall from these small storms produce is stored in surface depressions and either evaporates into the air or infiltrates into the ground. To account for these storms, the correction factor (Pj) is used. The design team can analyze local rainfall-runoff patterns to determine the value of Pj or simply use prior analyses from the Washington DC area indicate Pj is approximately 10% of the annual rainfall depth (Schueler, 1987). The default value for Pj should be 0.9 unless local rainfall-runoff analyses are available.

The Runoff Coefficient (Rv)

The runoff coefficient (Rv) is a useful measure of a development site's response to rainfall events. In theory, it is calculated using the equation provided in Table B.2.

Table B.2: Calculating the Runoff Coefficient

$$Rv = 0.05 + 0.009(I)$$

Where:
I = The amount of impervious cover on the site, expressed as a percentage of the total site area. "I" should be expressed as a whole number within the equation (i.e. a site that is 75% impervious would use I = 75 when calculating Rv)

The designer is trying to solve the equation for R and does not know the value of Rv. A study of rainfall/runoff relationships for many small watersheds across the U.S. showed that Rv has a distinctly linear relationship with impervious cover (Schueler, 1987). The runoff coefficient increases in direct proportion to the percent impervious cover (I) present in a catchment. The resulting equation shown in Table B.2 can be used to estimate Rv for the contributing drainage area of the bottling facility.

Contributing Drainage Area (A)

The contributing drainage area (A, in acres) can be directly obtained from the drainage area provided in the site plan

Event Mean Pollutant Concentration - C

The last input data needed is the event mean concentration (EMC) for five different pollutants. Designers can consult national stormwater quality monitoring databases that define event mean concentration statistics derived from a large population of runoff monitoring samples. The National Stormwater Quality Database (NSQD) is an extremely helpful tool to define expected EMCs for a wide range of different stormwater pollutants (Pitt *et al.,* 2004). Table B.3 summarizes EMCs for five common pollutants as measured for industrial land uses in the NSQD.

Table B-3. National Average for Event Mean Concentrations for Industrial Land Uses

Pollutant	Concentration (mg/l)
Total Suspended Solids	81.0
Total Nitrogen	2.09
Total Phosphorus	0.26
Oil and Grease	4.0
Zinc	0.20

B. Estimating the Annual Runoff Volume Generated by Your Facility

Many of the same parameters can be used to determine the annual runoff volume generated by your facility. The annual volume of stormwater runoff per acre of impervious cover at your facility is calculated by:

$$ARI = [(P)(Pj)(Rv) \div (12)]$$

Where

ARI = annual runoff volume in acre-feet produced from one acre of impervious cover (i.e., one foot of water depth over an acre)
and P, Pj and Rv as previously defined.

The total annual stormwater runoff volume produced by your facility can be quickly computed as:

$$TAR = (ARI)\ (IA)$$

Where
TAR = total annual runoff volume (in acre feet) produced by the entire facility
ARI = annual runoff volume per impervious acre (from first equation)
IA = number of impervious acres at your facility

The final TAR number you calculate will be a big number, but is hard for most people to comprehend. So the next step is to convert it to gallons or runoff.

$$Gallons = (TAR)(3.259 \times 10^5)$$

At a bottling facility, the standard unit of production is a case of soda, which comprises about 2.25 gallons per case. Over a course of a year they shipped 12 million cases of soda, and also generated 12 million "cases" of stormwater runoff.

A Bay port facility measures it production in the number of standard forty foot shipping containers it moves each year. Assuming about 18,500 gallons per container, a single impervious acre of port facility in the Bay watershed produces the equivalent of more than 50 shipping containers of runoff each year.

By converting annual runoff into gallons and then comparing it to a common measure of site capacity, it is possible to educate employees about the scope of their runoff problems