U-8 STREET CLEANING PRACTICES

PRACTICE AT A GLANCE

- Most Bay communities do not currently sweep streets or clean storm drains for water quality purposes. The technology used in most sweeper fleets is old, and most streets are not swept frequently enough to provide a meaningful water quality benefit.
- Streets do represent a significant fraction of total impervious cover in the Chesapeake Bay watershed and street cleaning may be an excellent strategy to reduce the toxic inputs from urban watersheds, given the high level of toxic contaminants found in both street solids and sweeper wastes.
- Nearly all Bay communities operate some kind of street sweeping program in order to improve aesthetics and meet public demand. With some adaptations, these existing sweeping programs can provide a modest water quality benefit to help meet the Bay pollution diet.
- Nutrient and sediment reductions can also be achieved by removing solids directly from catch basins, from within storm drain pipes, or by capturing them at stormwater outfalls. A subsequent fact sheet provides additional information on storm drain clean-out practices.

PRACTICE DESCRIPTION

Street Cleaning refers to the use of street sweepers to pick up solids from the street surface that could otherwise end up in our streams and rivers and ultimately the Chesapeake Bay. There are several different types of sweeper technologies, and they are not all created equal.

Mechanical broom sweepers provide little or no nutrient reduction benefit. Despite the large street solid loads that are picked up by mechanical sweepers, researchers have found that while they are effective in picking up coarse-grained particles, they leave behind fine-grained particles that are subject to future wash-off. Consequently, mechanical broom sweepers are useful in removing gross solids, trash, and litter from streets but have very limited capabilities to reduce nutrients and sediments.

However, two advanced street cleaning technologies show much more promise in picking up solids from the street surface:

Regenerative-Air Sweepers are sweepers equipped with a sweeping head which creates suction and uses forced air to transfer street debris into the hopper.

Vacuum Assisted Sweepers are sweepers equipped with a high power vacuum to suction debris from street surface.

Research has shown that these advanced sweepers pick up all particle sizes from the street surface, which makes them more effective at reducing nutrient and sediment loads.

OTHER BENEFITS OF STREET CLEANING

Street cleaning practices can also provide other important benefits to a community. For example, they can:

- Pick up trash, litter, road salt, sand and organic matter that would otherwise reach the stream
- Remove toxic pollutants and harmful bacteria before they reach local waterways
- Make streets safer for bikes, motorcyclists and pedestrians, especially after the winter months
- Create more attractive streetscapes in commercial areas and downtown revitalization projects

Vacuum Assisted Street Sweeper

WHERE TO FIND THE BEST OPPORTUNITIES IN YOUR COMMUNITY

Nearly all communities in the Chesapeake Bay watershed operate some kind of street sweeping program. For most communities, aesthetics and public safety are the main drivers for sweeping local streets. Key factors that determine which streets are swept include traffic volume, commercial areas, central business districts and fall leaf collection on residential streets.

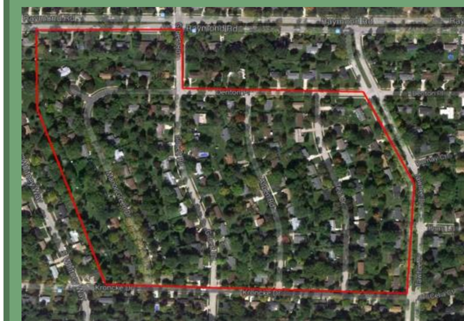
With only a few adjustments, communities have the potential to use their existing sweeping programs to also achieve nutrient and sediment removal.

GENERAL COST INFORMATION

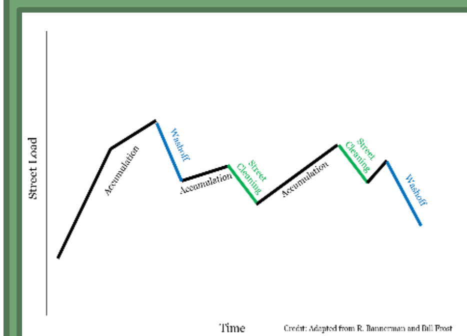
The cost of street sweeping programs is highly variable and is largely dependent upon how frequently streets are swept. However, since many communities across the Chesapeake Bay watershed already operate street sweeping programs, these programs can be leveraged to cost-effectively achieve decent nutrient and sediment reductions.

The bulk of municipal sweeping budgets pays for labor costs, although initial equipment purchase and ongoing maintenance costs can be significant.

TIPS FOR GETTING STARTED IN YOUR COMMUNITY



GIS software can help optimize sweeping efforts



Frequent street sweeping prevents accumulated sediment from washing off in rain events.

Experienced operators can help maximize sweeper pickup efficiency.

Check out what type of technology is used in your sweeper fleet to make sure it is eligible to earn pollutant reduction credits. If it is not, consider investing in advanced sweeper technology when you upgrade your sweeper fleet.

Understand your current sweeping effort in your community. It is helpful to know the details for individual sweeping routes, including the number of lane miles swept, how frequently they are swept, and the type of street and their dominant land use.

If possible, try to incorporate these street factors into your local Geographic Information System (GIS) so that you can optimize your sweeping effort to maximize overall pollutant reduction. Combining GIS data with route optimization software and water quality models like WINSLAMM can be very helpful and can greatly reduce the time and effort needed to report the practice.

Work with your sweeper operators to craft improved standard operating procedures for documenting local sweeper efforts during the year (e.g., land miles swept, hopper loads, record keeping quality control). It is also a good idea to provide ongoing training to sweeper operators on how to improve their overall pick up efficiency to increase pollutant reduction. For example:

- Sweeping researchers frequently note that real world factors such as the number of parked vehicles along a street can sharply reduce sweeper pick-up efficiency. The main reason is that parked cars limit sweeper access to the curb and gutter where many of the particles are located.

- Sweeper pickup efficiency can be influenced by the skills of sweeper operators. How close they get to the curb, how quickly they can avoid cars and the speed at which they drive the sweeper can each have impacts. Experienced operators also know which street routes are the dirtiest and require extra attention.

- Timing can also be critical in determining the effectiveness of a street sweeping program. More frequent sweeping results in greater water quality benefits because it mitigates the impact of the natural wash off of street sediments during rain events.

- That said, there are practical reasons for reducing the frequency of street cleaning in the winter. Sweeping is not feasible during snowy or extremely cold weather, since sweeper water lines freeze, street surfaces are covered by ice and snow and operators are re-assigned to drive snow plows. Fortunately, the effect of the winter sweeping shutdown on pollutant reductions is minor in most parts of the Chesapeake Bay watershed.

COMPUTING THE POLLUTANT REMOVAL CREDIT

The street cleaning credit computes sediment and nutrient reductions associated with different street cleaning practices (SCPs). Removal rates are provided for eleven different street cleaning practices, most of which use advanced street cleaning technology at different frequencies (See Table 1).

The standard street cleaning unit is the number of curb miles swept. In general, one impervious acre is equivalent to one curb-lane mile swept, assuming they are swept on one-side only. Credit is also provided for cleaning municipal and commercial parking lots (in this case, the acres of parking lot swept are reported, and converted to lane miles using the one acre = one curb lane mile rule of thumb).

Table 1. Street Cleaning Practices Available for Credit [1]

	Practice #	Description [2]	Passes/Yr (apx)[2]	% TSS Removal	% TN Removal	% TP Removal
Advanced Sweeping Technology	SCP-1	2 passes per week	~100	21	4	10
	SCP-2	1 pass per week	~50	16	3	8
	SCP-3	1 pass every 2 weeks	~25	11	2	5
	SCP-4	1 pass every 4 weeks	~10	6	1	3
	SCP-5	1 pass every 8 weeks	~6	4	0.7	2
	SCP-6	1 pass every 12 weeks	~4	2	0	1
	SCP-7	Seasonal scenario 1 or 2	~15	7	1	4
	SCP-8	Seasonal scenario 3 or 4	~20	10	2	5
Mechanical Broom Technology	SCP-9	2 passes per week	~100	1.0		
	SCP-10	1 pass per week	~50	0.5		
	SCP-11	1 pass every 4 weeks	~10	0.1		

[1] While there are many variations of street cleaning programs, only the street cleaning scenarios described are eligible for credit.
[2] Seasonal scenarios are defined as follows:
S1: Spring – One pass every week from March to April. Monthly otherwise
S2: Spring – One pass every other week from March to April. Monthly otherwise
S3: Spring and fall – One pass every week (March to April, October to November). Monthly otherwise
S4: Spring and fall – One pass every other week during the season. Monthly otherwise

Communities that want to compute the pollutant reduction associated with their local street cleaning program can estimate the credit, based on lane miles that are swept by each street cleaning practice using the following three-step process:

Step 1. *Determine which street cleaning scenario your program falls under.*

For this example, if you sweep 25 curb lane miles once per month using a regenerative air sweeper, according to Table 1, your program would be credited using SCP-4.

Step 2. *Calculate loading rate associated with the impervious area swept.*

Multiply the curb lane miles swept by the nutrient and sediment loading rates for urban impervious cover for your state. For this example, we will use the average values provided in Table 3.

- TN load = 25 x 15.5 = 387.5 lb/year
- TP load = 25 x 1.93 = 48.25 lb/year
- TSS load = 25 x 0.65 = 16.25 ton/year

Step 3. *Calculate your load reductions.*

Multiply the loading rate by the removal rate percentage for SCP-4 in Table 1.

- TN Reduction = 387.5 x 0.01 = 3.875 lbs/year
- TP Reduction = 48.25 x 0.04 = 1.93 lbs/year
- TSS Reduction = 16.25 x 0.06 = 0.975 tons/year (1,950 lbs/year)

Table 2 shows the estimated reductions in a Bay community that relies mostly on advanced street cleaning technology at different frequencies across its 300-mile road network each year.

Table 2. Example of Estimating Pollutant Reduction by a Local Street Cleaning Program

Lane Mile or Acres	SCP	Removal Rate (%) [1]			Mass Removed (lbs) [2]		
		TSS	TN	TP	TSS	TN	TP
150	SCP-2	16	3	8	31,200	69.8	23.16
50	SCP-7	7	1	4	4,550	7.8	3.8
25	SCP-4	6	1	4	1,950	3.8	1.9
75	SCP-9	1	0	0	975	0	0
300 miles	Total for Community				**38,675**	**81.4**	**28.86**

[1] From Table 1, and assume one curb mile equals an acre
[2] Assume annual load from impervious cover of 1,300 lbs/ac/year (sediment), 15.5 lbs/ac/yr (nitrogen) and 1.93 lbs/ac/yr (phosphorus) --Table 4

By contrast, if the same road network was swept by a fleet of older mechanical broom sweepers, the sediment and nutrient reduction credits would be trivial. For this reason, communities are encouraged to use the street cleaning planning tools in the Resources section in order to optimize which combination of street cleaning practices can maximize pollutant reduction within their jurisdiction at the least cost.

Table 3. Loading Rates Associated with Urban Impervious Cover in the Chesapeake Bay Watershed[1]	
Average TN Load	15.5 lbs/ac/yr
Average TP Load	1.93 lbs/ac/yr
Average TSS Load	0.65 tons/ac/yr
[1] Derived from the Chesapeake Bay Watershed Model, Version 5.3.2 NOTE: These are average values; actual values are regionally variable across the watershed. Check with your state to see if they have different loading rates they recommend using.	

HOW TO REPORT THE PRACTICE TO THE STATE

The street cleaning credit is an annual practice, so communities must report the number of curb miles swept for each of their qualifying street cleaning practices every year.

Localities should check with their state stormwater agency for specific data reporting requirements. The following information is recommended:

- Total qualifying lane miles swept in the community each year and their corresponding SCP category
- Location: Provide general lat/long coordinates for one of the following:
  a) Centroid of jurisdiction, or
  b) Midpoint of sweeping route, or
  c) 12 digit Hydrologic Unit Code (HUC) watershed address

Under this approach, communities may need to keep accurate records to substantiate their actual street cleaning operations so that the state MS4 regulatory agency can verify the credit. Record-keeping requirements, however, should not be so onerous that localities spend more time on paperwork than cleaning their streets. Recommended documentation may include:

1. Actual sweeper routes (and type of road)
2. Total curb miles swept on each route
3. Average parking conditions and controls along the route (optional)
4. Sweeper technology used (AST or MBT)
5. Number of sweeping passes per year on each qualifying route

WHAT IS REQUIRED TO VERIFY THE PRACTICE OVER TIME

Annual verification protocols are helpful to document local street cleaning efforts over time and provide quantitative data on sweeper waste characteristics. Localities are advised to collect one high quality street sweeper waste sample on one route for each unique SCP they report for credit every year. The single sample is used to characterize the mass and quality of sweeper waste picked up along a single route by a single sweeper that is disposed at a landfill or a solid waste transfer station (and is not mixed with any other waste source). More details on sampling protocols to verify street cleaning can be found in Table 4.

Table 4. Optional Street Cleaning Verification Protocols

It is recommended that one high quality street sweeper waste sample be collected from one route for each unique SCP reported for credit every year.

For the annual sample, the MS4 should measure or estimate the following parameters:

- Volume of sweeper waste collected in the hopper, truck or dumpster (in cubic feet)
- Total wet mass of the sweeper waste (measured)
- Number of curb-miles swept over the entire route
- Sweeper conditions (i.e., date swept, weather, days since antecedent rainfall, street type, parking conditions and any other operational notes)

A sub-sample of the overall sweeper waste sample should be collected and sent to a laboratory to measure the:

- Actual dry weight of the wet sweeper waste
- Particle size distribution of the sweeper waste
- Average carbon, nitrogen and phosphorus content of the sweeper waste

These measurements can be used to better estimate the:

- Acreage dry weight solids load collected over the route (lbs/curb mile)
- Wet mass to dry weight conversion factor
- Sweeper waste nutrient enrichment ratios

RESOURCES

The following resources are available for help with all aspects of this practice:

Type of Resource	Title of Resource	Web link
Expert Panel Report	Recommendations of the Expert Panel to Define Removal Rates for Street and Storm Drain Cleaning Practices (2016)	http://chesapeakestormwater.net/wp-content/uploads/dlm_uploads/2016/05/FINAL-APPROVED-Street-and-Storm-Drain-Cleaning-Expert-Panel-Report-Complete2.pdf
Archived webcast on Street Cleaning Practices	Crediting Street Sweeping & Storm Drain Cleaning in the Bay Watershed Webcast (2016)	http://chesapeakestormwater.net/events/webcast-street-sweeping/
Credit Planning Tools	Chesapeake Assessment Scenario Tool (CAST)	http://www.casttool.org/default.aspx?AcceptsCookies=yes
More Tools & Resources	Multiple Resources	http://chesapeakestormwater.net/training-library/urban-restoration-techniques/street-sweeping/