Stormwater Best Management Practice

Parking Lot and Street Sweeping

Minimum Measure: Pollution Prevention/Good Housekeeping for Municipal Operations
Subcategory: Municipal Activities

Description

Streets, roads, highways and parking lots accumulate pollutants that, when combined with stormwater, can lead to water quality impacts. Street sweeping can minimize some of these pollutants, including sediment, debris, yard waste, trash, deicing materials and trace metals. It can also improve the aesthetics of municipal roadways, control dust and reduce the frequency of catch basin or storm drain cleaning. An effective municipal street sweeping program can meet regulatory requirements, assess street sweeping effectiveness, and minimize pollutants in roadways.

Applicability

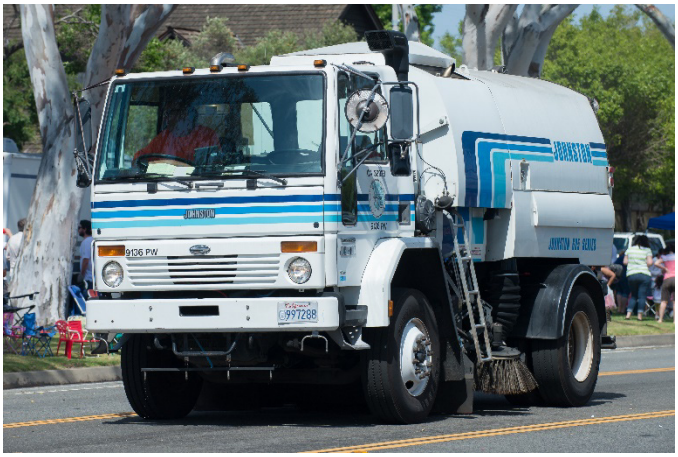
Most urban areas sweep their streets, often as an aesthetic practice to remove trash, built-up sediment and large debris from curb gutters and increasingly as a water quality practice to reduce stormwater pollutant loadings. Effective street sweeping programs can remove several tons of debris a year from city streets (Franklin Soil and Water Conservation District, 2017) minimizing pollutants in stormwater. In colder climates, street sweeping during the spring snowmelt can reduce pollutants in stormwater from deicing materials, sand and grit.

Implementation

A municipality should account for several factors when designing and implementing an effective municipal street sweeping program.

Schedule and Reporting

Creating (and following) a schedule can increase the efficiency of a street sweeping program. A successful program should be flexible to accommodate climate conditions and areas of concern. Municipalities should base their identification of areas of concern on traffic volume, land use, field observations of sediment and trash accumulation, and proximity to surface waters (MPCA, 2017). They should develop up-to-date maps and impervious surface inventories to help find and designate these areas. They may want to increase street sweeping and amend schedules for areas of concern. Schedules should include sweeping at least once a year. In cold climates prone to snowfall, the Connecticut Department of Energy and Environmental Protection recommends, municipalities should conduct street sweeping as soon as possible after the snow melts (DEEP, 2007). Removal of the accumulated sand, grit and debris from roads after the snow melts reduces the amount of pollutants that subsequent storms can mobilize.



Street sweepers, such as the one shown above, can be used to clean roadways on a regular schedule.
Photo Credit: Mark Mauno/Wikimedia

To evaluate the effectiveness of their street sweeping programs, municipalities should keep accurate logs of the number of curb-miles they sweep and the amount of waste they collect. They can measure monthly or yearly intakes (per ton) per district, road, season or mile. This information can inform a written plan, schedule and periodic re-evaluation that would target the following (Curtis, 2002):

- Roadways with contributing land uses (high imperviousness, high industrial activity) indicating high pollutant concentrations.

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- Roadways that have consistently accumulated more materials (in pounds per mile swept) between sweeps.

Municipalities can present gross intake amounts to regulatory agencies and finance directors to measure performance. The City of Dana Point, California, reported a monthly debris intake of 23 tons when it conducted sweeping twice a month. Dana Point then moved to weekly sweeping and the monthly total increased to between 45 and 80 tons of debris (Franklin Soil and Water Conservation District, 2017). Some municipalities also try to estimate the types of trash typically swept to tailor other aspects of their stormwater programs, including the public education and outreach component.

Parking Lots

Parking lot cleaning is similar to standard street sweeping with a few important exceptions. Like streets, parking lots need regular inspections and maintenance to identify specific areas of concern or times of high activity (e.g., fairs, farmers markets, special events). For privately owned parking lots, property owners and municipal staff should coordinate to limit pollutant discharge to public storm drains. In many cases, property owners can contact their municipal public works departments or private street sweeping companies to coordinate regular cleanings (Pace Partners, 2018).

Street Sweepers

There are three common types of street sweepers available to municipalities: mechanical, regenerative air and vacuum. Each type of street sweeper has its advantages and disadvantages involving pollutant removal effectiveness, traveling speed and noise. Each targets large debris, though regenerative air and vacuum cleaners are much more effective at removing particles down to 10 microns in diameter (also known as PM_{10}). The three types differ in price, noise and maintenance requirements. A municipality should choose the most appropriate type according to its budget, local climate, street type, noise ordinances and major pollutants of concern. It may find it best to have a complement of each type of street sweeper in its fleet (CASQA, 2003).

Mechanical broom sweepers are typically the least expensive and are well suited to picking up large-grained sediment particles and cleaning wet surfaces. They tend to create more dust, however, potentially increasing atmospheric emissions as well as the amount of fine sediment that travels to surface waters. Some newer models can use water to suppress dust (Kuehl et al., 2008). Regenerative air and vacuum sweepers are more efficient, particularly with respect to fine-grained sediment, but are more expensive. Using a mechanical sweeper for large particles followed by a regenerative air cleaner can be an effective strategy (MPCA, 2017).

Street Sweepings Storage, Disposal and Reuse

Street sweeping material often includes sand, deicing materials, leaves and miscellaneous debris. Often, the collected sweepings contain pollutants and the municipality should test them before disposal or reuse to determine if they are hazardous. Miller et al. (2016) provides a comprehensive review of studies that have analyzed pollutants of concern (heavy metals and petroleum hydrocarbons) in sweepings. Municipalities should adhere to all federal and state regulations that apply to the disposal and reuse of sweepings.

Municipalities should develop comprehensive management plans for the handling of sweepings. A critical aspect of a management plan is choosing a location for storing and processing street sweepings. Storage locations should have secondary containment and possibly overhead coverage to prevent stormwater from contacting the piles of sweeper tailings. It is also best to cover the piles of sweepings with tarps to prevent the generation of excessive dust. Storage locations should be large enough to completely contain the disposed sweepings.

To reduce disposal costs and prevent the landfilling of reusable material, some state and local regulations may allow the reuse of sweepings for general fill, parks, road shoulders and other applications. To reduce the chance of human or environmental exposure to pollutants, some states require municipalities to assess sweepings heavy metals and petroleum compounds before reuse; other states do not require assessment of materials that are not visibly contaminated (Miller et al., 2016). Municipalities should find beneficial reuse opportunities for street sweeping material and should follow all applicable local, state or federal regulations.

Parking Policies

Parking policies can increase the effectiveness of street sweeping programs. They often have the following components:

- Restriction of parking in problematic areas during periods of street sweeping.
- Posting of permanent street sweeping signs (or temporary signs, if installing permanent ones is infeasible) in problematic areas.
- Inclusion in community newsletters or posting flyers on nearby poles notifying residents of upcoming street sweeping schedules.
- Municipalities can set parking policies as city ordinances.

Operation and Maintenance Program

A municipality should dedicate time for daily and weekly equipment maintenance. Regular maintenance and daily startup inspections ensure that street sweepers are in good working condition. It is vital for municipalities to inventory and properly stock parts to prevent downtime and decreased productivity. They should also replace old sweepers with new, more advanced sweepers, preferably modern versions that maximize pollutant removal (CASQA, 2003). Installing an automatic greasing system on sweepers can decrease maintenance time and reduce wear on critical parts, which can keep the sweeper on the job longer with fewer unscheduled maintenance hassles. Maintaining surfaces through more frequent sweeping may also reduce the frequency necessary for catch basin cleaning (MPCA, 2017).

Cost Considerations

Staffing and equipment are the largest expenditures associated with street sweeping programs (CASQA, 2003). The capital cost for a conventional street sweeper can range from $60,000 for a small mechanical sweeper to more than $250,000 for a newer vacuum or regenerative air sweeper, with make, model and specifications all affecting cost (Kuehl et al., 2008; MPCA, 2017). Street sweepers have an average life span of 4 to 8 years (though more modern street sweepers sometimes last longer). Municipal programs should budget for capital expenditures on equipment replacement depending on expected life spans. Municipalities can save costs by acquiring equipment with multiple uses. For example, the City of Jordan, Minnesota, purchased a sweeper that converts to a sander and snowplow in the winter (MCPA, 2017).

The following tables show street cleaning program cost estimates from nine surveyed cities.

Table 1. Spending and staffing for street cleaning: eight surveyed cities and San Francisco, fiscal year 2016-17.

City	Population	Area (Square Miles, Land)	Street Cleaning Spending [a]	Spending per Capita	Street Cleaning FTE Count
Chicago	2,704,958	227.3	$8,548,428	$3.16	71
Long Beach	470,130	50.3	$5,313,421	$11.30	15
Minneapolis	413,651	54.9	$8,800,000	$21.27	54
Portland	639,863	133.0	$7,461,034	$11.66	30
Sacramento	501,334	97.9	$936,292	$1.87	7
San Diego	1,406,630	325.2	$3,282,000	$2.33	40
San Jose	1,015,785	177.5	$6,320,000	$6.22	18
Seattle	713,700	83.9	N/A	N/A	N/A
Median	**639,863**	**97.9**	**$ 8,004,731**	**$8.76**	**40**
San Francisco	864,816	46.9	$34,988,059	$40.46	302

Source: Adapted from City and County of San Francisco, 2018

[a] Figures do not include overhead costs for cities.

Table 2. Curb miles swept and expenditures per curb mile, seven surveyed cities and San Francisco, FY 2016-17.

City	Curb Miles Swept	Street Sweeping Expenditures [a]	$ per Curb Mile Swept
Chicago	251,429	$7,005,120	$27.86
Long Beach	141,132	N/A	N/A
Portland	14,780	$2,973,149	$201.16
Sacramento	150,000	$936,292	$6.24
San Diego	106,000	N/A	N/A
San Jose	67,295	$3,520,000	$52.31
Seattle	27,360	$2,588,400	$94.61
Median	**120,333**	**$3,744,878**	**$52.31**
San Francisco	158,974	$6,367,200	$40.05

Source: Adapted from City and County of San Francisco, 2018

[a] Figures do not include overhead costs for cities.

Effectiveness

Street sweeping can be an effective way to reduce sediment loadings to downstream waterbodies. This can be important, not just because of sediment export concerns, but because sweepings can have variable and sometimes high concentrations of heavy metals, petroleum hydrocarbons and nutrients. For example, Miller et al. (2016) compiled results from a literature review and an online survey of municipal street sweeping programs and found reported concentrations of lead and heavier petroleum hydrocarbons (e.g., motor oil) that were sometimes in excess of Ohio beneficial reuse standards.

The effectiveness of street sweeping varies considerably depending on geographic location, sweeping frequency and equipment used:

- In a survey of three towns in Ohio, Miller et al. (2016) found that over 3 years, collection rates (influenced by type of sweeper, traffic counts, precipitation, frequency, surrounding land use) varied from 44 to 7,550 pounds per mile, with median rates ranging from 332 to 938 pounds per mile. A similar study in Maryland found that for a program that swept about 14,373 miles of roadway, the overall collection rate was 343 pounds per mile (Curtis, 2002).
- Sweeper type is an important factor, especially when pollutant removal (as opposed to bulk sediment and debris removal) is the goal. Many studies are finding that pollutants are predominantly associated with finer particles (Miller et al., 2016) and that mechanical sweepers not only cannot effectively remove fines but often dislodge fines in cracks and crevices, resulting in minimal and sometimes negative removal rates for target pollutants (Miller et al., 2016; Schueler et al., 2016). Vacuum and regenerative air sweepers are more effective. Using a combination of previously published collection data and modeling, Schueler et al. (2016) found that for sweeping frequencies of six to 100 passes per year, removal efficiencies were 4–21 percent for total suspended solids, 0.7–4 percent for total nitrogen and 2–10 percent for total phosphorus.
- Traffic counts and surrounding land use (industrialized areas) are also important factors influencing elevated concentrations of total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAHs) and heavy metals in sweepings. In urban areas with high traffic counts, higher concentrations of heavy metals, TPH, and PAHs are expected in collected sweepings (Washington Department of Ecology, 2005). Irvine, et al, 2009 confirmed that heavy metals concentrations are elevated in street sweepings collected from urban roads with high traffic counts

and in industrialized areas. Both zinc and copper concentrations were higher in areas with high traffic counts, while manganese and iron concentrations were higher in industrialized Final Report 5 areas (Irvine, et al, 2009). Depree, 2008 found that PAH concentrations in street sweepings collected from arterial streets were approximately two times higher than those collected from non-arterial roads, while copper and lead concentrations were three times higher on high traffic volume roads than low traffic volume roads (Depree, 2008).

A street sweeping program can be an effective tool for municipalities for pollutant removal and good housekeeping. Using modern efficient street sweepers may reduce the need for other structural stormwater controls. Municipal stormwater managers should compare potential benefits and costs of street sweeping, especially in more urbanized areas with greater areas of pavement.

Additional Information

Additional information on related practices and the Phase II MS4 program can be found at EPA's National Menu of Best Management Practices (BMPs) for Stormwater website

References

California Stormwater Quality Association (CASQA). (2003). *Stormwater best management practice handbook: Municipal*.

City and County of San Francisco. (2018). *Comparative street cleaning costs: San Francisco and 11 Other Cities*.

Connecticut Department of Energy and Environmental Protection (DEEP). (2007). Guideline for municipal management practices for street sweeping and catch basin cleanings. Retrieved from https://portal.ct.gov/DEEP/Waste-Management-and-Disposal/Solid-Waste/Solid-Waste-Home

Curtis, M. C. (2002). *Street sweeping for pollutant removal*. Department of Environmental Protection, Montgomery County, Maryland.

Depree, C. (2008). Contaminant characterisation and toxicity of road sweepings and catchpit sediments: Towards more sustainable reused options. Land Transport NZ.

Franklin Soil and Water Conservation District. (2017). Street Sweeping. *The Urban Review Stormwater and Erosion Control Newsletter, 15:2, p. 6.*

Irvine, K., Perrelli, M., Ngoen-klan, R., and Droppo, I (2009). Metal levels in street sediment from an industrial city: spatial trends, chemical fractionation, and management implications. Journal of Soils and Sediments 9:328–341.

Jang et al. (2009). Characterization of pollutants in Florida street sweepings for management and reuse. Journal of Environmental Management 91: 320-327.

Kuehl, R., Marti, M., & Schilling, J. (2008). *Resource for implementing a street sweeping nest practice*. Minnesota Department of Transportation.

Miller, C. M., Schneider, W. H., IV, & Kennedy, M. J. (2016). *Procedures for waste management from street sweeping and stormwater systems.* Ohio Department of Transportation.

Minnesota Pollution Control Agency (MPCA). (2017). *Street & parking lot sweeping*.

Pace Partners. (2018). *Stormwater BMPs: Municipal parking lot maintenance*.

Schueler, T., Giese, E., Hanson, J., & Wood, D. (2016). *Recommendations of the expert panel to define removal rates for street and storm drain cleaning practices*.

Washington Department of Ecology (2005). Stormwater Management Manual for Western Washington Volume IV Source Control BMPs.

Disclaimer

This fact sheet is intended to be used for informational purposes only. These examples and references are not intended to be comprehensive and do not preclude the use of other technically sound practices. State or local requirements may apply.