SWEEP before you treat

Street sweeping: More than just a cosmetic practice

By Roger Sutherland, P.E.

In the early 1980s, a test of the effectiveness of street sweepers was conducted as part of the Nationwide Urban Runoff Program (NURP) studies. The inconclusive results it reached about the value of street sweeping as a best management practice (BMP) for storm water runoff pollution have dogged the sweeping industry since.

In recent years, however, the mandates of National Pollutant Discharge Elimination System (NPDES) Phase I and II storm water permits and the increasing need for practical total maximum daily load (TMDL) implementation plans have spurred a number of studies that make it clear that sweeping deserves a more central role. In fact, street sweeping should be an important part of the management strategies for any urban storm water NPDES-driven runoff program or TMDL implementation plan.

Many jurisdictions are now imposing storm water runoff fees and spending considerable dollars in an attempt to reduce runoff pollution. Paradoxically, many have also cut back on sweeping efforts. The only rational reason can be that they lack knowledge about the cost-effective impact a well-planned environmental sweeping program can now attain.

Street cleaning has the greatest potential for reducing storm water pollution in the urban environment, and it can do so at a relatively affordable cost. That's because half of all of the rain that falls on impervious surfaces goes onto pavement that is directly connected to an urban storm water collection system. In the past five years, sweepers that pick up even the finest particulate fractions have entered the market.

Another plus of street sweeping, since it picks up polluted material prior to its dilution into the runoff stream, is that it can remove soluble pollutants such as metals and nutrients that generally thwart structural BMPs, except media filters.

Sweeper Options

There are three basic types of sweeping technology, all of which employ gutter brooms, or curb brooms. They sweep material located in gutters into the path of the sweeper, where it can be removed.

Mechanical broom sweepers. The technology tested during NURP, these pick up debris via a horizontal main broom that is deployed across the sweeping path. The broom throws the accumulated material onto a conveyer belt that, in turn, transports it to the hopper.

Regenerative air sweepers. These types have a "sweeping hood" that spans the width of the sweeper and features rubber flaps that maintain an air seal with the pavement. A powerful fan directs an air blast onto the pavement underneath one side of the hood in order to entrain debris. A corresponding suction system on the other side transports the material to the machine's hopper.

Pure vacuum sweepers. Sweepers of this sort use only suction to transport debris to the hopper. A positive attribute of this system is that its suction is usually strong and generally can maintain a consistent seal with the pavement.

All of today's machines are much more efficient than the older mechanical broom sweepers tested in the NURP studies. And because the majority of sweeping jurisdictions still have older sweepers, a switch to any of the newer machines can bring about significant improvements.

Every sweeping program where Clean Water Act compliance is required—which includes more than 6,000 communities nationwide—should conduct an evaluation of the sweeper type best suited for the job. In some cases, a modification in sweeping frequency may be called for, and in others a shift from mechanical broom to air sweepers may make sense.

The least cost per pound of pollutant removed during some seasonal conditions may actually be achieved via tandem sweeping—typically mechanical broom sweepers followed by an air machine. Where needed, the tandem sweeping operation is still likely to cost less than a structural retrofit.

The inner workings of a regenerative air sweeper.

In any event, sweeping program designers must stop thinking of sweeping as strictly a practice cosmetic. Instead, they need to learn about the cost-effective role newer sweepers can have in removing pollutants from the runoff stream.

Crunching Numbers

The California Department of Transportation (Caltrans) recently completed an assessment of the cost of

Vehicle removal can improve street sweeping effectiveness.

pollutant removal from urban highway runoff using structural BMPs. Caltrans' conclusion was that the average cost of removing one pound of total suspended solids (TSS) from the runoff stream ranged from $10 to $60 depending on the device.

In contrast, several detailed studies I have completed with my business partner, Seth Jelen, show that today's air sweepers do the same job for $2 to $5 per pound. The latest crop of mechanical broom machines weigh in between $5 and $10 per pound. And with sweepers, no real estate needs to be purchased and there is minimal lag time needed for deployment.

In a 2001 study of the water quality benefits of street sweeping in Livonia, Mich., Jelen and I computed TSS reduction costs for regenerative air sweeping of residential streets that ranged from $1.80 to $3.20 per pound removed. The cost differential was dependent upon cleaning frequency, which, in this instance, ranged from once every two months to once every two weeks.

Does this make street sweeping the new "silver bullet" for storm water pollutant runoff? Unfortunately, sweeping is not ready for that label; however, it does mean that jurisdictions should be evaluating the overall costs and benefits of street sweeping prior to investing in considerably more costly end-of-pipe infrastructures or retrofits.

Suitable Sweeping

The fact is that many municipalities and jurisdictions are still sweeping for cosmetic reasons, with sweeping intervals set at whatever frequency has been determined to keep citizen complaints at bay. Others either abandoned or greatly reduced their sweeping programs in the 1980s when the conclusions of the NURP studies were made public.

Instead, all of these communities should be utilizing pavement sweeping as the vanguard of their fight against runoff pollution. Every city and county that now has or will have a storm water permit needs to engage in an analysis of its sweeping program. The analysis should identify an optimal cleaning program based on cost-effectiveness comparisons with other practices, such as treatment. Most will discover that an

optimal program involves an increase in sweeping frequency.

For example, the Livonia study found the optimal frequency (during the nine months when sweeping can generally occur in snow belt areas, since sweeping rarely occurs from December through February) for residential areas was about once every three weeks. Every two weeks is typically reasonable for higher-density residential and general commercial districts. In major traffic areas, like arterials, optimal sweeping was determined to be once per week.

Optimal frequency depends on the accumulation of contaminated material typically called "street dirt." Monitoring street dirt accumulation can be of great value, as well as determining its particle size distribution and chemical component.

For more information on the various types of sweepers and any other aspect of the power sweeping industry, I highly recommend www.worldsweeper.com. This is the best source of dependable and tractable information on the topic of power sweeping in the U.S., if not the world.

At a May 2006 seminar sponsored by the Web site, I discovered that even in California, where nonpoint source pollution requirements are at the forefront, about half of the agencies www.worldsweeper.com surveyed indicated they still were not requiring vehicle removal on sweeping days.

Although somewhat of a political hot potato, mandated vehicle removal can help pay for a city's sweeping program. Because of maneuverability issues when cars are left on the street, the sweeper misses about three car lengths of curb line for each car it has to swerve around.

Get Swept Away

Because of sweeping's now-demonstrated lower cost per pound of pollutant removal, jurisdictions under NPDES Phase I or II mandates clearly should develop an optimal sweeping frequency designed to minimize the overall cost of meeting nonpoint pollutant reduction goals.

Only by comparing sweeping to end-of-pipe solutions—like sedimentation tanks and filters, grassy swales, detention ponds and other emerging infrastructure-based solutions—can the most cost-effective mix of sweeping and other technologies be attained. SWS

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