Article 121

Technical Note #103 from Watershed Protection Techniques. 3(1): 601-604

New Developments in Street Sweeper Technology

At one time, street sweepers were thought to have great potential to remove stormwater pollutants from urban street surfaces, and were widely touted as a stormwater treatment practice in many communities. Street sweeping gradually fell out of favor, largely as a result of performance monitoring conducted as part of the National Urban Runoff Program (NURP). These studies generally concluded that street sweepers were not very effective in reducing pollutant loads (USEPA, 1983).

The primary reason for the mediocre performance was that mechanical sweepers of that era were unable to pick up fine-grained sediment particles which carry a substantial portion of the stormwater pollutant load. In addition, the performance of sweepers is constrained by that portion of a street's stormwater pollutant load delivered from outside street pavements (e.g., pollutants that wash onto the street from adjacent areas or are directly deposited on the street by rainfall).

Street sweeping technology, however, has evolved considerably since the days of the NURP testing. Today, communities have a choice in three basic sweeping technologies to clean their urban streets:

- Traditional mechanical sweepers that utilize a broom and conveyor belt
- Vacuum-assisted sweepers
- Regenerative-air sweepers

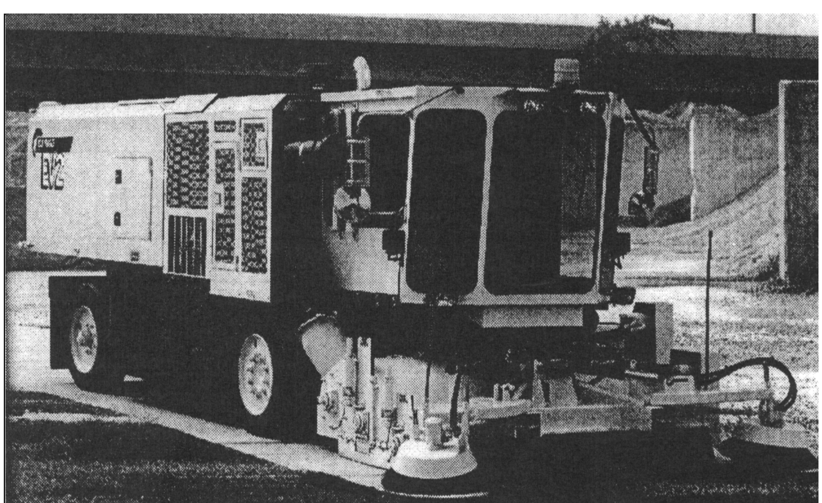

Figure 1: A Modern Waterless Vacuum-Assisted Street Sweeper

Traditional mechanical and vacuum-assisted sweepers use brushes to disturb street particles and a fine mist to moisten the pavement for dust control. Mechanical sweepers rely on a conveyor belt to carry the collected debris to a hopper. Vacuum-assisted sweepers suck up the loosened street particles with a vacuum and send them directly to the hopper. The most recent innovation has been a vacuum-assisted dry sweeper that uses a dry broom to loosen particles at the same time that a high-powered vacuum picks up nearly all particulate matter (Figure 1). The vacuum assisted dry sweeper, developed by Enviro Whirl Technologies, has the ability to pick up a very high percentage of even the finest sediment particles under dry pavement conditions and, unlike other sweepers, may work effectively in wet or frozen conditions (FHA, 1997). Regenerative air sweepers blast air onto the pavement surface to loosen particles and quickly vacuums them into a hopper. Sweeping can also be done in tandem—two successive passes are made over the street, the first by a mechanical machine followed by a vacuum-assisted or regenerative air machine.

The question naturally arises whether any of these technological improvements might actually translate into greater reductions of stormwater pollutants. Roger Sutherland and his colleagues have been assessing alternative sweepers in recent years in an attempt to answer this question. Roger has resorted to a modeling approach, since it is extremely difficult to design a controlled monitoring design in the field (i.e., while one can measure pollutant concentrations in runoff after sweeping, it is very hard to determine what the pollutant concentrations would have been if sweeping had never taken place).

As a surrogate, they employed a computer model, known as the Simplified Particulate Transport Model (SIMPTM), to evaluate potential sweeper performance. SIMPTM is a continuous stormwater model that simulates the accumulation and washoff of sediment and associated pollutants from urban land surfaces. Sutherland calibrated sediment accumulation and washoff rates for SIMPTM and used the model to estimate load reductions associated with street sweeping. Overall sweeper efficiency was derived in the model by multiplying a sweeping efficiency factor by the difference between the accumulated sediment and the residual sediment on the pavement after sweeping. This