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Street Sweeping – Report No. 3
Policy Development
And
Future Implementation Options
For
Water Quality Improvement

Ramsey-Washington Metro Watershed District

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Executive Summary

The Street Sweeping Project is organized into the following three reports:

1. Street Sweeping – Report No. 1, State of the Practice
2. Street Sweeping – Report No. 2, Survey Questionnaire, Results and Conclusions; and
3. Street Sweeping – Report No. 3, Policy Development and Future Implementation Options for Water Quality Improvement

The reports are the information base for the Ramsey-Washington Metro Watershed District to advance efforts to improve water quality within its jurisdictional boundaries. In addition, the reports serve as information sharing tools for members of the Ramsey – Washington Public Works Forum and other public works staff within Minnesota and across the United States and Canada. The Ramsey-Washington Public Works Forum is a monthly discussion group focused on increasing communications and collaboration related to stormwater quality improvement concerns of the city and county governments within the Ramsey-Washington Metro Watershed District.

Report No. 3: Street Sweeping - Policy Development and Future Implementation Options for Water Quality Improvement discusses and incorporates pertinent conclusions from Reports No. 1 and 2. It further examines the street sweeping practice as policy issues are formulated and makes recommendations for the local government units of Ramsey-Washington Metro Watershed District. Conclusions and Recommendations from Report No. 3 are incorporated into the Executive Summary.

Conclusions

1. Survey results in **Report No. 2** indicate a wide disparity by Minnesota respondents in street sweeping equipment types (mechanical brush versus vacuum or regenerative-air) used compared to Greater U.S./Canada respondents. Minnesota respondents are twice as likely (61.8% versus 30.2%) to use mechanical brush sweepers only, rather than vacuum or regenerative-air sweepers. Within the Greater U.S./Canada group where vacuum or regenerative-air are nearly twice as likely to be used (69.8% versus 38.2%) than mechanical sweepers only.

2. Results from **Report No. 1** reveal mechanical brush sweepers are effective at removing coarse materials and gross pollutants, but less effective removing fine materials often associated with various pollutants and may expose such materials to wash-off. High-efficiency street sweepers and associated operations may increase the percent of total solids removal from 30 – 70+%.

3. Street sweeping frequencies in **Report No. 1** were approximately monthly to biweekly and varied depending upon land use and transportation features have been shown as being most effective for pollutant removal.

4. **Report No. 2** indicates street sweeping at low frequencies of twice or three to six times per year for all land-uses and special areas is practiced by a large majority of Minnesota respondents (80%). In contrast, a small minority (33%) of the Greater U.S./Canada group swept the same areas and low frequencies.

5. A subgroup of eight cities from the Greater U.S./Canada group representative of severe winter climate conditions swept streets at similar frequencies as the larger group. To the degree that these eight cities are representative, results suggest climate or reduced operational season is not a valid basis for the observed lower street sweeping frequency in Minnesota.

6. It appears seasonal or climate conditions do not prevent Minnesota local governments from conducting more than two or three-six street sweepings per season.

7. Results of street sweeping frequencies from **Report No. 2**, Question #9 contrasted significantly between the two groups. Minnesota respondents swept streets at a twice (2x) or three - six times per year for arterial streets, commercial/industrial areas and residential areas. Greater U.S./Canada respondents swept arterial streets, commercial/industrial areas and residential areas: three - six times, more frequently than three – six times per year or biweekly. For Central Business Districts, 75% of Minnesota respondents swept twice, three – six times or more frequently per year. In contrast, the Greater U.S./Canada respondents reflected 86% either sweeping more frequently than three – six times per year, biweekly or weekly.

8. Recommending street sweeping frequencies based upon land-use and special area type is a reasonable and defendable approach based upon Reports No. 1 and 2 as well as the WEB survey results in Appendix A. Table 2 below depicts proposed street sweeping frequencies by area.

Table 2 Proposed Street Sweeping Frequencies

Area	Minimum Frequency	Maximum Frequency
Arterials	9 times per year	16 times per year
Commercial	9 times per year	16 times per year
Light Industrial	6 times per year	9 times per year
Heavy Industrial	9 times per year	16 times per year
Residential	6 times per year	9 times per year
Central Business District*	Biweekly	2x/week
"Hot Spot Areas"**	6 times per year	9 times per year

*Frequency dependent upon business community and local government expectations.
**Hypothetically, such implementation frequencies may reduce sweeping in other land-uses.

9. Leaf disposal by pick-up is an inefficient operation, whether private or public from a volume versus weight perspective, thus, specialized equipment may be a more efficient long-term solution to this effort. However, further survey analysis and discussion of leaf pick-up and disposal methods appears to be warranted and recommended by the results.

10. Keeping materials out of a local government's storm sewer system is the basis for conducting a street sweeping program and is recommended this continue as the **primary** reason for a street sweeping program.

11. Establishing a Water Quality Incentive Grant Program will facilitate local governments within the Ramsey-Washington Metro Watershed District to move ahead in amending their street sweeping programs through the purchase of high-efficiency street sweepers.

Recommendations

In completing the 3rd generation Watershed Management Plan, the following policies are recommended as options for the Board of Managers of the Ramsey-Washington Metro Watershed District:

1. Encourage and support the acquisition and use of technologically advanced, high-efficiency street sweepers (vacuum or newer technology) by local governments within its boundaries.

2. Recommend local governments within the District revise existing street sweeping operational programs and adopt the proposed street sweeping frequencies enumerated within Table 2.

3. Work with local governments within the District's boundaries by further examining leaf collection and disposal operations.

4. Recommend local governments within the District's boundaries revise existing local water management plans to identify existing street sweeping operational programs as a high priority for keeping materials out of the municipal separate storm sewer systems and improving water quality.

5. Establish a Water Quality Incentive Grant Program for $750,000 to $1,000,000 allowing local governments within its boundaries to facilitate the purchase of high-efficiency street sweepers.

Introduction

The Ramsey-Washington Metro Watershed District (RWMWD) is a regional government located in the northeastern portion of the Minneapolis – St. Paul Metropolitan Area. RWMWD covers approximately 52 square miles draining into the Mississippi River and includes 5 major creeks, 11 lakes and 750 wetlands. The RWMWD jurisdictional boundary includes all or part of 10 cities in Ramsey and Washington counties: St. Paul, Woodbury, Oakdale, Landfall, North St. Paul, Maplewood, Little Canada, White Bear Lake, Vadnais Heights and Gem Lake.

Resident complaints and inquiries are received by District staff regarding concern over the volume of street sand, leaves, grass clippings, dirt, fertilizer and their impact upon lakes, ponds, streams and wetlands. Local governments in the District face mandates from their governing bodies and the Minnesota Legislature to be more cost efficient ("do more with less") and continue to assure public health, safety and welfare of its citizens.

During the 1990s and early 2000s, state and federal governments began to regulate municipal stormwater under the National Pollutant Discharge Elimination System (NPDES) permit program with the advent of Phase 1 and Phase 2. Looming on the horizon is the need for some local governments to participate as stakeholders in the Total Maximum Daily Load (TMDL) program. The TMDL regulatory program is intended to improve the water quality of impaired waters listed in a state after Section 303(d) of the Clean Water Act through reductions in pollutants discharged. The TMDL process may result in more stringent Phase 1 and Phase 2 - stormwater discharge permits.

Program Goal and Policy Development

The RWMWD in collaboration with the 10 municipalities and 2 counties that comprise the District is interested in gaining knowledge to answer the question and help formulate a District-wide street sweeping management program goal, policies, BMP recommendations and budget.

To achieve the development of the street sweeping management program goal, policies, BMP recommendations and budget requires taking information from Reports 1 and 2 and synthesizing the conclusions along with inserting new materials, as appropriate. Following goal development, each issue will have a corresponding policy assigned providing the process the District will need to review and determine appropriateness.

Program Goal

The proposed goal is as follows:

- **To develop a street sweeping program in the RWMWD that complements existing BMPs and improves lake, wetland or steam water quality.**

Policy Development Discussion

This discussion section involves five issues that when combined affect achieving the Street Sweeping Management Program goal. Each issue discussed in some length is followed by a suggested policy for potential adoption by RWMWD.

1. Equipment Issue

Survey results in **Report No. 2** indicate a wide disparity by Minnesota respondents in street sweeping equipment types (mechanical brush versus vacuum or regenerative-air) used compared to the Greater U.S/Canada respondents. Minnesota respondents are twice as likely (61.8% versus 30.2%) to use mechanical brush sweepers only rather than vacuum or regenerative-air sweepers. However, the reverse is true, within the Greater U.S./Canada group who are nearly twice as likely (69.8% versus 38.2%) to use vacuum or regenerative-air sweepers than only mechanical brush sweepers. Results from **Report No. 1** reveal mechanical brush sweepers are effective at removing coarse materials and gross pollutants. They are less effective removing fine materials often associated with various pollutants and may expose such materials to wash-off. High-efficiency street sweepers and associated operations may increase the percent of total solids removal from 30 – 70+%.

Results from Report No. 2 were analyzed to address whether Minnesota's severe winter climate was perhaps the basis for the dominance in mechanical brush sweeper usage. The rationale for further analysis relates to sand application for winter traction purposes and the primary use of mechanical brush sweepers to remove the material from streets or roadways in the spring. Therefore, it follows that other local governments (without severe winter climate) would not have a spring clean-up issue. A subgroup from the Greater U.S./Canada respondents group with similar northern locations and climatic conditions were examined along with evaluating their sweeper usage.

The subgroup of eight (8) cities all lie within the U.S. Department of Agriculture's Plant Hardiness Zones: 3a, 3b, 4a or 4b (National Arboretum, 2003) the same as Minnesota. These vegetation growth

zones represent geographic areas that experience average annual minimum temperature ranges between ⁻40 and ⁻20 degrees Fahrenheit and thus may have similar winter climate conditions as Minnesota cities. The eight local governments identified by ZIP code response within Report No. 2 results were as follows:

1. Bozeman, Montana
2. Dubuque, Iowa
3. Whitefish, Montana
4. Syracuse, New York
5. Fond du Lac, Wisconsin
6. LaCrosse, Wisconsin
7. Golden, Colorado; and
8. Skowhegan, Maine

A summary of the subgroup cities responses are as follows:
Mechanical brush sweepers were used by 6 of 8 cities with 2 of the 6 using only mechanical sweepers.
Vacuum and/or regenerative air sweepers were used by 6 of the 8 cities with 2 of the 8 using only a regenerative air sweeper or vacuum sweeper.
Mechanical brush and **vacuum sweepers** were used by 4 of the 8 cities.

The eight cities subgroup is not a statistically valid population (i.e. less than 30 members) to compare against the larger Minnesota group of 57 local governments. However, the subgroup's equipment usage reflect similar results as the members of the Greater U.S./Canada group with respect to vacuum or regenerative-air sweeper use. To the degree that these eight cities are representative of severe winter climate conditions, it would seem that mechanical brush sweeper usage would predominate as in Minnesota. Instead, the usage of both mechanical brush and/or vacuum or regenerative air sweepers is reflective in these eight cities. The data analysis suggests severe winter climate is not the sole basis for the primary use of mechanical brush sweepers in Minnesota versus other similar cities.

It follows, therefore that Minnesota local governments should be use more technologically advanced street sweeping equipment, as a general practice. At a minimum, regenerative-air and/or vacuum sweepers should be added to fleet equipment. A long-term fleet equipment objective should include acquisition of high-efficiency vacuum sweepers, especially for those local government whose drainage area includes receiving waters subject to degradation.

***Policy 1*:**

Encourage and support the acquisition and use of technologically advanced, high-efficiency street sweepers (vacuum or newer technology) by local governments within the District's boundaries.

2. Street Sweeping Frequency Issue

Report No. 2 indicates street sweeping at low frequencies of twice or three to six times per year for all land-uses and special areas is practiced by a large majority of Minnesota respondents (80%). In contrast and depicted in Table 1, a small minority (33%) of the Greater U.S./Canada group swept the same areas and low frequencies.

Table 1 Existing Street Sweeping Frequency Percentages

Sweeping Frequency by Area (twice or 3 to 6 times per year)	Minnesota Respondents	Greater U.S./Canada Respondents
Arterials	84%	26%
Commercial/Industrial	81%	38%
Residential	95%	46%
Central Business District	64%	13%
Areas near lakes, rivers, streams	77%	37%
Sediment Accumulation areas	78%	39%
Mean percent	80%	33%
Median percent	79%	37%

Several reasons are possible for this disparity:

- Severe winter climate in Minnesota may provide less time for street sweeping frequencies greater than twice or three to six times per year.
- Revenue is expended on snow removal and deicing operations rather than more frequent street sweeping operations in comparison to non-severe winter climate locations.

Climate Issue

While perhaps two-thirds of the United States geographically, experiences a year-round street sweeping season, those states and Canadian provinces that are considered within the "snowbelt" have their season curtailed to some degree by climate. Minnesota climate generally allows for an eight-month street sweeping season (March 15 through November 15), assuming sweepers using water as a dust suppressant. Street sweeping may be implemented in a "dry mode" during the winter season depending upon snow and ice conditions. However, street sweeper manufacturers and regulatory agencies may not recommend "dry mode" sweeping for some machines, due primarily to fugitive dust emissions relating to the PM_{10} standard (U.S.EPA, 1987) unless the machine is compliant with this criteria. Thus, an eight-month street sweeping season would not automatically limit Minnesota local governments to conducting two or three - six street sweepings per season.

Examining the street sweeping frequency issue further, a subgroup of eight cities with severe winter climate localities from the Greater U.S./Canada group were analyzed. Street sweeping frequency results with respect to specific areas are shown along with frequencies for the Minnesota and Greater U.S./Canada groups shown for comparison.

Minnesota govt.	Weekly		Biweekly		2x/year		3x-6x/year		More frequently		Response Total
Arterial streets	(1)	3%	(3)	8%	**(22)**	**58%**	(10)	26%	(2)	5%	38
Commercial/Industrial areas	(3)	7%	(2)	5%	**(26)**	**62%**	(8)	19%	(3)	7%	42
Residential streets	(2)	5%	(0)	0%	**(31)**	**72%**	(10)	23%	(0)	0%	43
Central Business District	(7)	16%	(4)	9%	**(17)**	**39%**	(11)	25%	(5)	11%	44
Areas near lakes, rivers and streams	(2)	5%	(3)	7%	**(17)**	**42%**	(14)	35%	(4)	10%	40
Sediment accumulation areas	(4)	9%	(0)	0%	(13)	29%	**(22)**	**49%**	(6)	13%	45

Eight Zone 3 & 4 govt.	Weekly		Biweekly		2x/year		3x-6x/year		More frequently		Response Total
Arterial streets	(1)	14%	**(4)**	**26%**	(0)	0%	(1)	14%	(1)	14%	7
Commercial/Industrial areas	(0)	0%	**(3)**	**43%**	(0)	0%	**(3)**	**43%**	(1)	14%	7
Residential streets	(0)	0%	(1)	12%	**(3)**	**37%**	**(3)**	**37%**	(1)	12%	8
Central Business District	**(2)**	**25%**	**(2)**	**25%**	**(2)**	**25%**	(0)	0%	**(2)**	**25%**	8
Areas near lakes, rivers and streams	(0)	0%	**(2)**	**67%**	(0)	0%	(1)	33%	(0)	0%	3
Sediment accumulation areas	(0)	0%	(1)	33%	(0)	0%	**(2)**	**67%**	(0)	0%	3

Greater U.S.& Canada govt.	Weekly		Biweekly		2x/year		3x-6x/year		More frequently		Response Total
Arterial streets	(11)	21%	**(14)**	**26%**	(1)	2%	(13)	24%	**(14)**	**26%**	53
Commercial/Industrial areas	(11)	23%	(8)	17%	(5)	11%	**(13)**	**28%**	(10)	21%	47
Residential streets	(4)	7%	(11)	20%	(10)	18%	**(16)**	**29%**	(15)	27%	56
Central Business District	**(20)**	**37%**	(10)	18%	(3)	6%	(4)	7%	(17)	31%	54
Areas near lakes, rivers and streams	(5)	16%	(5)	16%	(2)	6%	**(10)**	**31%**	**(10)**	**31%**	32
Sediment accumulation areas	(4)	12%	(5)	15%	(1)	3%	**(12)**	**36%**	(11)	33%	33

Except for residential streets and central business district, the eight local governments in Zones 3 & 4 conduct street sweeping more frequently than twice per year. Biweekly (occurring every two weeks) or three to six times per year is the street sweeping frequency most often practiced by these eight cold climate local governments. To the degree that these eight cities are representative of severe winter climate conditions, results suggest climate or length of operational season are not valid reasons for lower street sweeping frequencies observed from the Minnesota respondents.

Snow removal and Sanding Operations

Inquiries about snow removal and deicing operational expenses were not a part of the Report No. 2 survey effort. Thus, it was not possible to determine if operational funds for street maintenance affected street sweeping frequencies in Minnesota versus the Greater

U.S./Canada local governments. Results for the subgroup of eight cities would suggest snow removal and deicing operational expenses do not adversely affect street sweeping frequencies. Sand usage in snow management operations was not a part of the survey questionnaire. Complicating the street sweeping frequency issue is sand application and removal costs as a part of street maintenance operations. While the purchase price of sand ($5 – 8.00/ton, F.O.B.) is relatively low, its effective cost increases dramatically following repeated handling. The effective cost for local governments in Minnesota may be four to six times the purchase price after hauling to storage; truck-sander loading; street application; sweeping; street sweepings hauling for disposal; disposal site cost, and long-term ditch, stream, pond, lake excavation and disposal. In addition, trucking of street sweepings (sand) and disposal site costs are increasing for local governments; thus, street maintenance operational expenses for this purpose are likely significant.

In this regard over the last five years, local governments are beginning to shift away from the extensive use of sand/deicer mix to limited sand/deicer applications and 100% deicer usage. Whether this shift away from sand usage would "free-up" operation funds for increased street sweeping was beyond the discussion in Report No. 2.

Street Sweeping Frequency by Area

As discussed previously, a significant disparity exists with respect to street sweeping frequencies of Minnesota respondents versus Greater U.S./Canada respondents. Report No. 2 indicates a large majority of Minnesota respondents swept arterial streets (58%), commercial & industrial areas (62%) and residential areas (72%) at twice per year frequency. In contrast, a small minority of the Greater U.S./Canada respondents swept arterial streets (2%), commercial & industrial areas (11%), and residential areas (18%) at a frequency twice per year.

It is possible local preference may play a part in selecting a street sweeping frequency. However, the Minnesota survey population is large enough to "mask" or reduce the effect of outliers or unusual circumstances. It should be noted a small minority of Minnesota respondents sweep streets at higher frequencies similar to their Greater U.S./Canada counterparts.

Equally important is the notion of what is an appropriate street sweeping frequency for a particular area (e.g. land-use or transportation feature)? Two approaches are addressed in this regard. The first approach is a study by the City of Livonia, Michigan (2001) in which

maintenance practices for street sweeping and catch basin cleaning were examined in detail to ascertain appropriate frequency levels to reduce pollutant runoff loading. The City's street sweeping frequency in 2001 for residential streets was 4x/year and for arterials 7-8x/year (City of Livonia, Chapter V, page 7). The study used pilot test areas to calibrate the Simplified Particulate Transport Model [SIMPTM] (Sutherland, R.C. and S.L. Jelen, 1998; USGS, 1992) to develop optimal cost-effective street sweeping and catch basin cleaning frequencies.

For residential streets, the Livonia study recommended optimal practices for street sweeping using **high efficiency (vacuum) sweepers** at the following frequencies without catch basin cleaning along with total suspended solids (TSS) removal rates (sweeping season of March 1 – December 1):

1. Sweeping every two months (4x/year), 30% TSS removal
2. Sweeping every month (8x/year), 50% TSS removal, and
3. Sweeping every two weeks (17x/year), TSS 68% removal.

While the optimal cost-effective residential street sweeping frequency is 17 times per year, such a level may not be achievable during a fiscally conservative period for local governments having to "do more with less". Thus, establishing an intermediate goal for residential street sweeping (4 – 8 times per year) would be beneficial in reducing pollutant loading by 30 – 50% to receiving waters. Interestingly in 2002, the City of Livonia increased street sweeping for both residential (5 times per year) and arterial streets (18 times per year), (City of Livonia, 2003).

The second approach involved a WEB search (www.google.com) of 60 cities across the United States for street sweeping frequency information by land-use and transportation area (arterial, central business district and residential areas). The information summarized in Appendix A includes data on roadway mileage as well as length of the street sweeping season, if reported. Information on equipment usage was fairly limited and not recorded. With respect to residential areas, street sweeping frequency was most often implemented on the basis of two to five times per year (2x – 5x/year) [38%] or monthly (8x, 9x – 12x/year) [26%]. Information on arterial streets and central business district areas were recorded and summarized.

Recommending street sweeping frequencies based upon land use area type is both a reasonable and defendable approach with respect to the City of Livonia study and information on the sixty cities surveyed within Appendix A.

Arterials

An arterial is a functional street or roadway classification used by transportation planners and engineers. Defined in various locations, the following provides a useful description (Denver City and County Plan, 2000):

> "Movement of people and goods, also known as "mobility," rather than access to adjacent land uses, is the primary function of an arterial street. Arterial streets serve a local government wide function and are, therefore, designated using a broader perspective. The arterial system interconnects major urban elements such as the Central Business District, industrial facilities, large urban and suburban commercial centers, major residential areas, and other important activity centers. The volumes and capacity of arterials can range from 10,000 vehicles per day on a two-lane arterial to 75,000 vehicles on a six-lane arterial."

Because of their transportation importance and daily traffic counts, an arterial will generate a greater amount of gross and fine pollutants as discussed in Report No. 1. Higher street sweeping frequencies appear warranted based upon the results in Report No. 2, where a majority of the Greater U.S./Canada respondents (76%) swept three – six times, more frequently than three – six times per year or biweekly. Arterial streets were not addressed in the Livonia study. However, they were included within the Appendix A - WEB survey. With respect to the WEB survey results for arterial streets, street-sweeping frequency was most often on a biweekly basis (16x – 24x/year) [30%] or monthly (8x, 9x – 12x/year) [28%].

Street sweeping frequency of arterials should be a minimum of 9 times per year with a long-term goal of biweekly or 16x per year.

Commercial/Industrial

Commercial and industrial land uses function in two different manners with respect to street sweeping. Commercial areas generally experience higher average daily traffic counts similar to arterial streets, depending upon the business mix. Arterial streets often serve both commercial and industrial land-uses; thus, the street sweeping frequency would likely be similar. With respect to pollutant generation, the

California Water Pollution Control Board (2001) recognizes commercial land-use as a potential for the large gross pollutant generation.

> "A number of studies (Walker and Wong, 1999 and Allison, et al 1995) have shown that commercial land use catchments generate more pollutants than residential land use catchments, and as much as three times the amount generated from light industrial land use catchments. It is generally accepted that commercial land uses tend to contribute larger loads of gross pollutants per area compared to residential and mixed land use areas. This is in spite of daily street sweeping in the commercial sub-catchment compared to once every two weeks in residential and mixed land use areas."

Similar results on gross pollutant generation has been borne out in the Los Angeles County report for both land uses in the Bollona Creek and Los Angeles River watersheds (County of Los Angeles, 2004). Commercial parking lot areas were addressed in the Livonia study. The study identified the optimal cost-effective commercial area sweeping frequency to be 17 times per year. Report No. 2 results for the Greater U.S./Canada respondents showed a majority (72%) swept commercial & industrial areas at three – six times, more frequently than three – six times per year or weekly. It would seem reasonable to treat commercial land-use areas similarly to an arterial street. A minimum sweeping frequency of 9 times per year with a long-term biweekly goal of 16x per year is recommended.

Segmenting industrial land-use into light and heavy industrial areas and treat both differently with respect to street sweeping is suggested. Light industrial areas would be swept at a minimum of 6 times per year with a long-term biweekly goal of 9x per year. Heavy industrial areas would be treated the same as an arterial street or commercial area with a minimum of 9 times per year and a long-term biweekly goal of 16x per year is recommended.

Residential Areas

Collector streets or roadways generally serve residential areas and have moderate traffic volumes, typically 5,000 average daily traffic counts. As such, residential areas generate less gross pollutants (County of Los Angeles, Table 5, page 11). However, fine particulate (soils, heavy metals, hydrocarbons, etc.) and organic material (leaves and grass clippings) pollutants are more dependent upon cover vegetation. Report No. 2 results indicated that a majority (76%) of the Greater U.S./Canada respondents swept residential areas at three – six times, more frequently than three – six times per year or biweekly.

With respect to the WEB based survey results (Appendix A), street sweeping frequency was most often two – five times per year (38%) or monthly (26%).

Thus, street sweeping of residential areas is recommended at a minimum frequency of 4 times per year with a long-term goal of 9 times per year.

Central Business District

From a street sweeping perspective, a Central Business District (CBD) presents two important issues. First, a CBD is a very visible area to business owners, visiting public and residents. Aesthetics is the primary basis for street sweeping frequency in concert with the business community and governing body. The second issue relates to average daily traffic counts within a CBD that may be similar to an arterial street, thus acting as a source of gross pollutant generation. The second issue warrants a level of street sweeping commensurate with the pollutant generation. Central Business District areas were not included in the Livonia Study. However, CBD sweeping frequency was addressed within the Appendix A survey. With respect to Central Business Districts, street-sweeping frequency was most often implemented on a weekly basis (34x – 50x/year) [34%] or twice per week (70x – 100x/year) [20%]. Report No. 2 showed 86% of Greater U.S./Canada respondents swept CBDs more frequently than three – six times per year, biweekly or weekly.

Street sweeping frequency for a CBD should be at a minimum of a weekly (34x – 50x/year) basis or a long-term goal of twice per week (70x – 100x/year) depending upon observation of cleanliness with respect to gross pollutant generation.

"Hot Spot" Areas

The final discussion is important as it may lead to street sweeping efficiency, control costs as well as reduce gross pollutant loading. "Hot Spot" areas are defined as those land uses and physical features that may either contribute pollutant loading to a higher degree or be a recipient of pollutant loading impacts. The "hot spots" are divided into four groups:

1. Low areas sometimes known as "bird baths" in the street or roadway where water does not effectively drain leaving both coarse and fine sediments and associated pollutants;
2. Areas that can be characterized as "washon" locations. "Washon" is the result of runoff of sediment into the gutter from moderate to steep slopes with reduced vegetative cover. The phenomenon occurs primarily after rainfall events; and

3. Land-use areas (industrial or commercial sites and/or parking lots draining directly onto publicly owned streets or discharging into municipal separate storm sewer systems.
4. Immediate drainage areas near sensitive receiving waters.

Such "hot spot" type areas can be surveyed (**G**lobal **P**ositioning **S**urvey, mapping instrument) and mapped in a local government's **G**eographic **I**nformation **S**ystem (GIS). Sweeping sediment accumulation areas serves to increase efficiency in the volume and tonnage of materials removed and perhaps reduce the amount of sweeping along curb lanes that are not warranted. Similarly, over time public works staff may identify land-use zones contributing materials to public streets from their sites or parking lots for required special sweeping operations. Implementing this approach across the local government's system seems logical although this approach and its effectiveness have not been studied. Report No. 2 identified "hot spot" areas (areas near lakes, rivers and streams; sediment accumulation areas) being swept three - six times or more frequently than three – six times per year by a majority (62 - 69%) of the Greater U.S./Canada respondents.

Identification of "hot spot areas" should be the first priority. Street sweeping of "hot spot areas" should be across all land-uses and implemented a minimum of six times per year or more frequently depending upon the number of such source areas and their relative severity. A long-term goal of 9 times per year or more may well be necessary. Implementing this approach may serve to reduce street sweeping in some areas (lower pollutant generation), but increase it in others areas (high pollutant generation).

The Proposed Street Sweeping Frequencies are summarized within Table 2.

Table 2. Proposed Street Sweeping Frequencies

Area	Minimum Frequency	Maximum Frequency
Arterials	9 times per year	16 times per year
Commercial	9 times per year	16 times per year
Light Industrial	6 times per year	9 times per year
Heavy Industrial	9 times per year	16 times per year
Residential	4 times per year	9 times per year
Central Business District*	Biweekly	2x/week
"Hot Spot" Areas**	6 times per year	9 times per year

*Frequency dependent upon business community and local government expectations.

**Implementation frequency may reduce other land-use sweeping frequencies.

***Policy 2*:**

Recommend local governments within the District's boundaries revise existing street sweeping operational programs and adopt the street sweeping frequencies enumerated within Table 2.

3. Leaves Issue

The results from Question 11 (Street Sweeping – Report No. 2) relate to the pick-up and handling of leaves with results from both groups repeated below for discussion purposes.

11. If you answered Yes to Question 10, how do you address the challenge of leaf pick-up? (check all that apply)

	Minnesota	%	Greater U.S./Can.	%
Conduct normal sweeping	39	78%	38	77%
Residents take leaves to city or county compost facility	18	36%	8	16%
Residents bag leaves for collection program	8	16%	21	43%
Use specialized pick-up equipment	7	14%	20	41%
Other (comments - see below)	8		6	

The much higher response rate for residents taking leaves to city or county compost facility would appear to be an expense saving to Minnesota local governments. However, compost facilities require periodic maintenance by public works staff. Respondents from Greater U.S./Canada appear to have more expensive leaf disposal programs. While residents are requested or required to bag leaves, the city or a contractor presumably must pick them up. In addition, these respondents more often use specialized equipment for leaf pick-up at a much higher rate (41% versus 14%) than the Minnesota group.

The Minnesota and Greater U.S./Canada leaf disposal programs are not mutually exclusive. Both the Minnesota and Greater U.S./Canada respondents emphasize leaf removal before the materials end up in the street/gutter. There is a shared responsibility by the local government and residents particularly with respect to trees within the right of way (ROW). Tree ownership in the ROW contrasted with required maintenance is not clear and separate responsibility. The questionnaire results do not provide enough information to determine the best approach.

However, it would seem that leaf disposal by pick-up is an inefficient operation from a volume versus weight perspective, whether conducted by private or public entities. Further survey, analysis and discussion of leaf pick-up and disposal methods appears warranted by the results.

***Policy 3*:**

Work with local governments within the District's boundaries by further examining leaf collection and disposal operations.

4. Street Sweeping Objectives Issue

Results from both groups identified keeping materials out of the storm sewer system as the most important reason (average: 97%) for a street sweeping program in contrast with Phase I or II permit requirements being least important (average: 85%). However, keeping materials such as gross pollutants out of the storm sewer system can be a critical permit compliance issue as noted with the "zero discharge" TMDL requirement in the Los Angeles River Watershed (California Regional Water Quality Board, 2001). While both the Minnesota and Greater U.S./Canada groups recognize permit compliance and water quality as important issues, respondents recognize keeping materials out of the storm sewer system is important for a variety of reasons:

- less material to remove in the future from catch basins, pipes, ditches, ponds, etc.;
- customer satisfaction;
- water quality will improve; and
- permit compliance.

Thus, keeping materials out of a local government's storm sewer system is the overwhelming reason for conducting a street sweeping program.

***Policy 4*:**

Recommend local governments within the District's boundaries revise existing local water management plans to identify existing street sweeping operational programs as a high priority for keeping materials out of the municipal separate storm sewer systems and improving water quality.

5. Street Sweeping Cost Issue

Clearly, street-sweeping expense is the most difficult issue to analyze because of a number of complicating factors, notwithstanding local government preference. Street sweeping has not

reached the level of having operational standards or performance criteria. Thus, elected officials through public works staff may increase or reduce street sweeping budgets, short of a public backlash (i.e. trash in the streets or public health hazard). However, the day may arrive when regulatory agencies establish performance standards for street sweeping frequency and/or efficiency.

Driving street sweeping expenses are capital equipment cost, operation & maintenance expenses and sweeping frequency objectives. Report No. 2 survey results did not produce the level of detail for street sweeping expenses to allow definitive answer for this public works operation. In addition, the skew for both the Minnesota respondents and Greater U.S./Canada distributions meant that further expense analyses may not produce usable results. Assuming the use of more efficient street sweeping equipment and increased street sweeping frequencies are directly related to higher expenses, it follows the Greater U.S./Canada respondents are spending proportionately more on this public works operation than Minnesota respondents.

Notwithstanding Minnesota local governments possible long-term shift away from high sand applications to more deicer use, it is worthy of future discussion whether this will "free-up" operation funds for increased street sweeping in Minnesota. However, information did not definitively identify winter operational expenses as an impediment to increased street sweeping frequency. However, Report No. 1 provided an update to generally observed street sweeping costs and is repeated within Table 3 below.

Table 3. Sweeping Costs Based Upon Frequency ($/curb-mile/year) [2005 dollars]

Sweeper Type	Sweeping Frequency					
	Weekly	Bi-weekly	Monthly	Four times per year	Twice per year	Annual
Mechanical	$2,235	$1,120	$520	$170	$90	$45
Vacuum	$1,260	$630	$290	$100	$50	$25

Street Sweeper Incentive Grant Program

Street sweeping costs presented in Report No. 1 suggest high-efficiency sweepers while having a higher initial capital-cost, have lower operating costs and longer operational life as shown in Table 4 below.

Table 4 Street Sweeper Cost Data [2005 dollars]

Sweeper Type	Life (years)	Purchase Price($)	Operation and Maintenance Costs ($/curb-mile)
Mechanical	5 years	$100,000	$40
Vacuum	8 years	$200,000+	$20

During a period of reduced expenditures by local governments, the RWMWD should consider establishing a Water Quality Incentive Grant Program to assist local governments in complying with the street sweeping options and future similar issues (e.g. other integrated BMP approaches). The grant program would initially target the purchase of high-efficiency street sweepers by local governments. A grant program budget of $750,000 to $1,000,000 could facilitate purchase of such street sweepers with the District incentives by each local government. Grant funding to eligible recipients would be up to 50% or $100,000 whichever is less per each high-efficiency sweeper. Local governments would be limited to not more than two grant-funded sweepers purchased over a five-year period. A Water Quality Incentive Grant Program would encourage cities to "step up to the plate" and provide the funds necessary to move these policy changes ahead in a more timely fashion.

***Policy 5*:**

Establish a Water Quality Incentive Grant Program budget of $750,000 to $1,000,000 allowing eligible local governments within its boundaries to facilitate the purchase of high-efficiency street sweepers.

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Appendix A – Street Sweeping Frequencies

	City	State	Sweeping Season	Street Miles	FREQUENCIES		
					Arterial[1]	Central Business District[2]	Residential[3]
1	Oakland	CA	Year-round*		Daily		Biweekly
2	San Diego	CA	Year-round*	2,700		Weekly	Monthly
3	San Leandro	CA	Year-round*				Monthly
4	Long Beach	CA	Year-round*		Weekly	Weekly	Weekly
5	Mountain View	CA	Year-round*	170			Biweekly
6	San Jose	CA	Year-round*		Biweekly	Biweekly	Monthly
7	La Mesa	CA	Year-round*		2x/week	2x/week	Monthly
8	Sunnyvale	CA	Year-round*				Monthly
9	Union City	CA	Year-round*	121	Biweekly	Biweekly	Biweekly
10	Danville	CA	Year-round*		Monthly	Monthly	Monthly
11	Dublin	CA	Year-round*			Weekly	Biweekly
12	Elk Grove	CA	Year-round*		Monthly		3x/year
13	Santee	CA	Year-round*		Weekly	Weekly	Biweekly
14	Greeley	CO		358	Biweekly	Weekly	5x/year
15	Fort Collins	CO		383		2x/week	2x/year
16	Denver	CO	Apr. – Nov.			Biweekly	8x/year
17	Thornton	CO			Biweekly		1x/year
18	Arvada	CO			6x-7x/year	6x –7x/year	6x-7x/year
19	Tampa	FL	Year-round*	710	Weekly	Weekly	6x/year
20	Gainsville	FL	Year-round*		Monthly	2x/week	9x/year
21	Urbandale	IA		600	3x/year	3x/year	3x/year
22	Iowa City	IA		300	Monthly	Weekly	Monthly
23	Sioux City	IA			5x/year	5x/year	5x/year
24	Overland Park	KS	Mar. – Dec.	800	7x/year	Monthly	3x/year
25	Hanover Park	IL	Apr. – Oct.		8x/year	8x/year	8x/year
26	Evanston	IL	Apr. – Nov. 30		Biweekly		4x/year
27	Elgin	IL			Biweekly	2x/week	6x/year
28	Burr Ridge	IL			9x/year	9x/year	9x/year
29	Champaign	IL				Daily	8x/year
30	.Fort Wayne	IN			Biweekly	Weekly	4x/year
31	Cambridge	MA	Mar. - Nov. 30		Biweekly		9x/year
32	Salem	MA	Apr. – Nov. 30				9x/year
33	Saco	ME	Mar. - Nov. 30		Biweekly		9x/year

34	Kansas City	MO	Apr. – Jan.		4x/year	Weekly	4x/year
35	St. Joseph	MO			2x/year	2x/year	2x/year
36	Great Falls	MT		275	Biweekly	Daily	4x/year
37	Lincoln	NE					3x/year
38	Manchester	NH			Monthly	2x/week	3x/year
38	Albuquerque	NM			Biweekly	2x/week	Biweekly
40	Rochester	NY			2x/week	Daily	Biweekly
41	Albany	NY			Weekly	Weekly	Weekly
42	Toledo	OH			9x/year	2x/week	9x/year
43	Fairfield	OH			Biweekly	Weekly	5x/year
44	Macedonia	OH			2x/year	2x/year	2x/year
45	Marysville	OH	Year round		Weekly	Weekly	Monthly
46	Tulsa	OK			8x/year		4x/year
47	Albany	OR			Biweekly	Weekly	Monthly
48	Eugene	OR		415	Weekly	2x/week	Monthly
49	Pittsburg	PA	Apr. – Nov. 30		Weekly	2x/week	2-4x/year
50	Town of Lower Marion	PA		205	3x/year		3x/year
51	Knoxville	TN				Weekly	Monthly
52	San Antonio	TX			4x/year		2x/year
53	Dallas	TX			Monthly	Daily	None
54	El Paso	TX			Biweekly	Daily	4x/year
55	Austin	TX				Daily	6x/year
56	Ogden	UT			3x/year	3x/year	3x/year
57	Hampton	VA			Monthly		Monthly
58	Janesville	WI				5x/year	4x/year
59	Eau Claire	WI			3x/year	3x/year	3x/year
60	Milwaukee	WI				Weekly	Monthly
	Totals:				**46**	**45**	**60**
	% responses				**Biweekly (30%)**	**Weekly (34%)**	**2x-5x/year (38%)**
	% response				**Monthly (28%)**	**2x/week (20%)**	**Monthly (26%)**
	*Presumed						

[1.] Arterial frequencies: Biweekly, 16 – 24 times per year depending on season length. Monthly, 6 - 12 times per year depending on season length.

[2.] Central Business District frequencies: 2x/week, 70 – 100 times/year depending on season length. Weekly, 34 – 50 times per year depending on season length.

[3.] Residential frequencies: 2x – 5x/year, two to five times per year. Monthly, 9 – 12 times per year depending on season length.