Department of Community Services
MULTNOMAH COUNTY OREGON

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Benjamin Benninghoff
Oregon Department of Environmental Quality
Headquarters Office
811 SW 6th Avenue
Portland, OR 97204-1390

June 22, 2011

SUBJECT: Catch basin cleaning and street sweeping criteria

Dear Mr. Benninghoff,

The Multnomah County NPDES MS4 Phase I permit Stormwater Management Plan identifies two related best management practices (BMPs) for pollutant removal from roadways: Catch Basin Cleaning (OM-2) and Street Sweeping (OM-3). The measurable goals for these BMPs identified the need to develop criteria to establish the frequencies of each activity to maintain effective pollutant removal, by July 1, 2011.

The attached paper describes the relationship between these activities and identifies a strategy to collect sediment accumulation data and evaluate results. The criteria for adaptively managing these activities are also included. By following the tasks and evaluation process, we attempt to increase efficiency and effectiveness of these BMPs, to ensure that our program meets the "maximum extent practicable" standard. There are many variables that must be considered and further adaptive management may be needed to fine tune this pilot strategy in the future, however, we are certain that our efforts will improve the current program and meet the stated goals.

If you have any questions regarding this analysis and the options given, please contact Roy Iwai, Water Resources Specialist, at (503) 988-5050 ext 28031, or by email at roy.iwai@multco.us. We look forward to discussing this element of the County's program as well as the overall adaptive management process in the future.

Sincerely,

Kim Peoples
Road Services Manager

Catch Basin and Street Sweeping Frequency Criteria

Issue: *Incorporate sediment accumulation and removal rates from street sweeping and catch basin cleaning into an adaptive approach to improve BMP effectiveness.*

Goal: *Develop a strategy to determine the appropriate street sweeping and catch basin cleaning frequency to balance the performance of the catch basins with efficiencies in the maintenance tasks.*

Background

Catch basins are not designed to efficiently trap roadway sediment, however, they do provide significant reductions of sediment and associated pollutants if properly maintained. Studies have shown that sediment trapping efficiency of a catch basin can approach 75% when they are cleaned out on a semi-annual or annual basis. The removal rates decrease by about 50% when the catch basin reaches 50% capacity. A catch basin loses its effectiveness in capturing sediment when it reaches 60% of its capacity. Catch basin cleaning frequency must therefore consider how full a catch basin is to maintain the performance of the device.

Street sweeping provides a water quality benefit by removing a range of particle sizes from the roadway. Vacuum sweepers are capable of capturing fine particles (silt and fine sand) that often are associated with metals, PAHs and other pollutants, as well as the medium and coarse (sand) fractions of road sediment. Althought vacuum sweeping is conducted largely for road safety and aethetic reasons, it serves to capture a sediment fraction which catch basins are not designed to trap, and can potentially reduce catch basin cleaning frequency by removing sediment that would otherwise be directed into a catch basin.

Studies show that very frequent street sweeping (weekly) and catch basin cleaning (monthly) can remove more total sediment than less frequent cleaning, despite that the sediment removed during each maintenance event decreases with increased frequency. The costs associated with such an intense level of maintenance, however, are not practicable with the current budgeting for Multnomah County Road Services. Reducing pollutants to the *maximum extent practicable* means that Road Services must achieve a balance of all road maintenance tasks and contracts to achieve the best results with the avaiable staff and equipment resources. A strategy to maximize the pollutant reduction within the means of the current structural system and resources is needed to improve the program in an adaptive approach.

The current County catch basin maintenance program calls for cleaning catch basins twice a year. This level of maintenance is conducted uniformly across the County catch basins in the NPDES permit area without considering differences in sediment input, traffic, land use, or other metrics at a detailed level. However, in certain locations where known chronic problems occur, catch basin cleaning is done more often – up to six times a year. Measures of the total amount of debris collected has been recorded in the past, but this figure has not been useful to better understand the catch basin network and improve the program. A fine tuning of both catch basin cleaning paired with street sweeping can be achieved using new technologies, including GPS tracking, on-board computing, and GIS mapping software.

Goal and hypthesis

The goal for the program is to identify a catch basin frequency that ensures that cleaning is done before the catch basin reaches 60% capacity, and if possible, to clean before a sump reaches 50% capacity.

The hypothesis is that current program of sweeping (approximately 20-times per year) and catch basin cleaning (twice per year) achieves this goal.

Maintenance tasks

1. *Determine the capacity of each catch basin*

   The depth of the catch basin, measured from the bottom of the catch basin to the outlet pipe (*a*), is used as a surrogate to the volume (capacity) of sump (Fig.1). This depth was measured after the catch basin was cleaned during the summer of 2010. To facilitate estimation of catch basin fullness when sediment obscures the bottom of the sump, a measurement from the catch basin grate to the bottom of the sump was also recorded (*b*). These data are stored in a GIS map of catch basins.

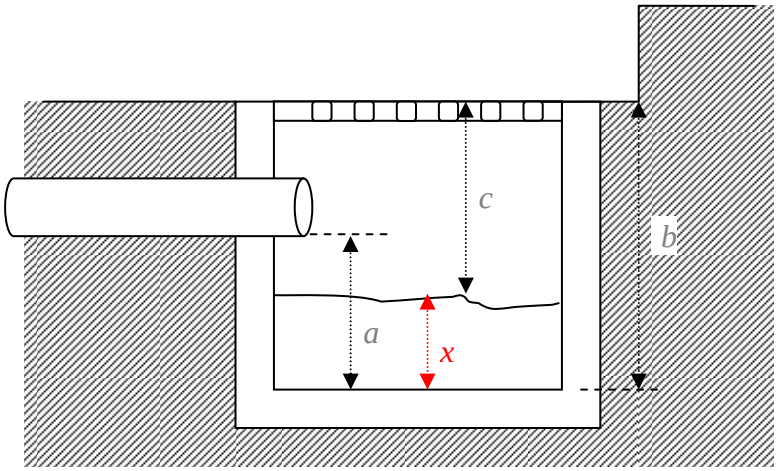

Figure 1. Measurements in the catch basin used to determine the rate of sediment accumulation and estimates of fullness.

2. *Determine the amount of sediment accumulation during the dry and wet months*

   Catch basins are typically cleaned during April/May and September/October. Prior to each cleaning a measurement from the catch basin grate to the top of accumulated sediment (*c*) is recorded (Fig. 1). The depth of accumulated sediment (*x*) is calculated by subtracting the measurement to the top of accumulated sediment (*c*) from the total depth from the grate to the bottom of the sump (*b*). This depth of accumulated sediment is a surrogate for sediment accumulation.

3. *Maintain a set sweeping schedule*

   Sweeping is conducted approximately 20 times per year. There is a regular frequency (approximately twice a month), and additional sweeping occurs after sanding material is applied during storm events. The number of sweeping passes will be recorded for each road segment.

Data evaluation

1. *Determine the rate of sediment accumulation*

   The rate of sediment accumulated in the catch basin is calculated from the sediment depth divided by the number of months between cleaning. The mean sediment accumulations rate per month will be estimated per road segment. Road segments will be identified on a GIS map.

2. *Estimate how full the catch basin becomes between cleanings*

   The fullness of the catch basin is calculated as the ratio of sediment depth and the height of the outlet pipe, calculated as a percentage. The mean catch basin fullness and range will be estimated per road segment.

3. *Test hypothesis*

   Compare the mean and range of fullness to the 30% and 60% fullness criteria for each road segment. Compare the rate of sediment accumulation and forecast fullness at the time of the next cleaning.

4. *Determine follow up actions based on results*

   Using the following table as a guide, determine the appropriate changes to catch basin and street sweeping frequency.

		Sept/Oct catch basin cleaning		
		< 30% full	*30-60% full*	*> 60% full*
Apr/May catch basin cleaning	*< 30% full*	Reduce catch basin cleaning frequency to once in Sept/Oct	Reduce catch basin cleaning frequency to once in Apr/May. Increase sweeping frequency in dry months	Maintain semi-annual catch basin cleaning. Increase sweeping frequency in dry months
	30-60% full	Reduce catch basin cleaning to once in Sept/Oct. Increase sweeping frequency in wet months	No change	Maintain semi-annual catch basin cleaning. Increase sweeping frequency in dry months
	> 60% full	Maintain semi-annual catch basin cleaning. Increase sweeping frequency during wet months.	Maintain semi-annual catch basin cleaning. Increase sweeping frequency during wet months.	Increase catch basin cleaning to 3 times per year. Increase sweeping frequency during wet months.

Discussion

The relationship between sweeping and catch basin accumulation varies because of many variables including depth of catch basin, sediment trapping efficiency rates, sediment composition, rain volume, timing of cleaning, and sediment sources. It is therefore not possible to quantify or estimate the effect of sweeping on catch basin cleaning frequency by looking at the total street sweeping debris. Previous data of total catch basin sediment and sweepings has a wide range. Some of this variability can also be attributed to the difficulty in cleaning or sweeping all or every portion of a road segment for practical reasons, particularly parked cars.

The height of the catch basin outlet pipe is key determinant of catch basin capacity. About 1/3 of the County's catch basins have the outlet pipe set at the bottom of the catch basin, hence these have no apparent capacity. However, outlet pipes set at the bottom are more prone to clogging with debris and trash, and ironically, clogged pipes create a sort of filter that causes these catch basins to rapidly fill up with sediment. These catch basins (and potentially other very shallow catch basins) will be reviewed as a separate category from other more typical catch basins which average 16" of sump depth (to the outlet pipe). Follow up inspections and increased cleaning or potential retrofits may occur depending on the condition of the catch basin.

Catch basin sediment accumulation will naturally vary, and we will consider the range as well as the mean in the evaluation. New grouping and subgrouping of catch basins may result from the evaluation. Some flexiblity will be used in applying the guidelines in the table to accomodate efficiencies in conducting the maintenance. Catch basins with chronic or unusual problems will be handled in a separate category, like those with outlet pipes at the bottom, very large/deep catch basins, or catch basins located at the bottom of slopes, and inspection and cleaning strategies will be adjusted as needed.

The impact of lateral clogging is another variable that is difficult to assess. Lateral cleaning will occur once a year concurrently with catch basin cleaning. Broken laterals of other maintenance needs will be reported and repaired as they arise. Determining whether to include or exclude catch basins with maintenance needs will be done on a case by case basis.

A GIS mapping system will allow us to track catch basin cleaning and sweeping in a new way. The GIS mapping will help with developing work orders that target specific catch basins, as well as sets of catch basins on a road segments. A fine tuning of the maintenance schedule is possible with this data, so that follow up work can be assigned in an strategic manner. In the forthcoming adaptive management approach, we intend to use watersheds and subwatersheds to assign a priority scheme for maintenance using the health of the aquatic resources and the risks associated with stormwater on those resources as criteria. Work orders may be tailored to consider all of these factors to most effectively conduct this work.

Conclusion

Developing a strategy to create more efficient work plans and pollutant removal through street sweeping and catch basin cleaning will require program development, mobile computer resources, and good observations from staff. Given the variability in the stormwater system, there will be challenges to summarize and evaluate the sediment accumulation data. This paper outlines the strategy to collect data and established the criteria that will be used to evaluate the program. As more information is collected, additional questions are certain to arise and further adaptive management will be needed to develop the program.