Stormwater Best Management Practice

Stormwater Inlet Controls

Minimum Measure: Post Construction Stormwater Management in New Development and Redevelopment
Subcategory: Other

Description

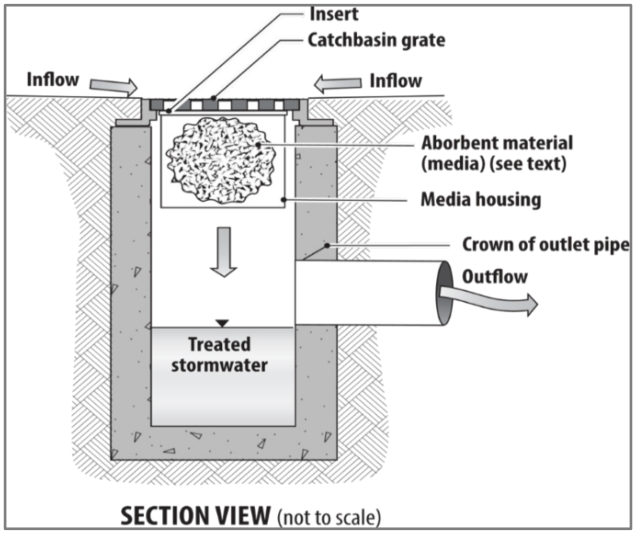
Stormwater inlets—also known as storm drain inlets, curb inlets or catch basins—are inlets to storm drain systems. Communities can use a range of stormwater controls for these inlets: products that capture floatable and settleable pollutants such as oil, grease, trash and coarse sediments at the inflow. These controls are typically pretreatment devices, removing pollutants that would pose clogging or maintenance problems for downstream stormwater controls.

There are two common types of stormwater inlet controls:

- **Catch basin inserts.** A catch basin insert accumulates sediment and debris and provides an easy means of regular collection and disposal. Some inserts drop directly into existing catch basins, while others may call for retrofit construction. They can be a low-cost alternative to more costly ways to clean catch basins and sewers, such as vacuum pumping.
- **Hydrodynamic separators.** A hydrodynamic separator, or swirl separator, is a modified traditional oil-grit separator. It contains a cylindrical chamber with an internal component that creates a swirling motion as stormwater flows through it, which separates the sediment from the stormwater. It may also have other compartments or chambers to trap oil and other floatables. There are several types of proprietary separators, with slightly different designs.

Applicability

Stormwater inlet controls work best in highly impervious sites where trash, sediment or other coarse pollutants regularly overload existing stormwater inlets. They perform variably and are not effective at removing nutrients and bacteria. This means they are best, not on their own, but as pretreatment for other downstream stormwater controls. Catch basin inserts may be more suitable when available land is limited, such as in urbanized areas. Swirl separators tend to need more space than catch basin inserts but can still function when space is limited.



The typical design of a catch basin insert is a set of filters that are specifically chosen to address the pollutants expected at that site.

Credit: King County, 2016

Limitations

Stormwater inlet controls have two major limitations:

- They have variable and limited effectiveness at removing fine, soluble pollutants such as nutrients, metals and bacteria.
- They need maintenance at set intervals. Most of them are small and designed for concentrated flow from small, highly impervious sites. Sediment, debris and trash can therefore accumulate rapidly in them, causing them to become a source of pollutants if not properly maintained.

Siting and Design Considerations

Designers should always refer to manufacturer specifications for stormwater inlet control siting, design and installation details. Several design options are available for catch basin inserts:

- One option consists of a series of trays, where the top tray is an initial sediment trap and the underlying trays are media filters.
- A second option uses filter fabric to remove pollutants from stormwater.

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- Another option uses a plastic box that fits directly into the catch basin as a filter; the box removes petroleum products as stormwater passes through it and captures trash and sediment.

In most cases, designers can incorporate hooded outlets to prevent floatable materials and trash from bypassing inserts.

Designers should size inserts according to the catch basin size and the expected load of settleable solids and debris. (Even within an individual site, these factors can be highly variable.) In any case, inserts are very small compared to the volume of the catch basin sump.

In sizing hydrodynamic separators, designers should consider the peak flow of a specific storm event. (In contrast, designers size most other stormwater controls based on the capture, storage or treatment of a specific volume.) Sizing based on peak flow rate uses less space to treat stormwater than other controls such as bioretention practices and ponds.

Maintenance Considerations

Stormwater inlet controls need regular monitoring and maintenance to prevent clogging; designers should consult manufacturer instructions for specifics. Maintenance logs are a helpful way to keep track of the rate of sediment accumulation. Some cities have even used GIS to track sediment collection and optimize maintenance schedules.

Catch basin insert maintenance includes removing sediment, trash and other debris and may include replacing filter media, if applicable. Maintenance staff can remove sediment and debris from the catch basin insert by removing and manually emptying the insert or by using a vacuum truck.

For hydrodynamic separators, maintenance staff also use vacuum trucks to remove sediment and debris.

In some regions, it may be difficult to find environmentally acceptable ways to dispose of sediment from stormwater inlet controls. Hazardous waste, pretreatment or groundwater regulations may bar this sediment from landfills, land application and sanitary sewer systems. If so, responsible parties should dispose of it at a landfill approved to accept it.

Effectiveness

Overall effectiveness varies considerably and depends on control type as well as site-specific conditions, such as the amount of sediment that reaches the inlet, the presence of organic debris (e.g., leaf litter), street sweeping programs, and the frequency of maintenance.

Although stormwater inlet controls do not remove smaller or more soluble constituents as effectively as other stormwater controls (e.g., stormwater wetlands or bioretention practices), they may partially filter suspended solids, nutrients and metals along with the coarse sediment and debris they remove. The International Stormwater BMP Database reviewed performance data from studies that looked at a number of manufactured devices, including catch basin inserts (11 studies) and manufactured devices that promote gravitational settling or hydrodynamic separation (22 studies). The review found moderate removal rates for total suspended solids and phosphorus, but not significant removal of nitrogen. Removal of metals varied. Table 1 presents summary results.

Table 1. Pollutant removal performance of stormwater inlet controls.

Control Type	Pollutant	Influent Concentration (mg/L)[a]	Effluent Concentration (mg/L)[a]
Catch basin inserts	Total suspended solids	51.7	32.9
	Total phosphorus	0.20	0.12
	Total Kjeldahl nitrogen	1.80	1.64
	Copper	21.43	14.20
	Lead	5.00	4.76
	Zinc	124.6	122.3

Control Type	Pollutant	Influent Concentration (mg/L)[a]	Effluent Concentration (mg/L)[a]
Hydrodynamic separators	Total suspended solids	33.6	29.7
	Total phosphorus	0.35	0.22
	Total Kjeldahl nitrogen	1.74	1.63
	Copper	12.41	11.35
	Lead	7.56	5.84
	Zinc	75.2	57.6

Source: Median concentrations from Leisenring et al., 2012

[a] Copper, lead and zinc concentrations are in µg/L.

Cost Considerations[1]

Important costs for stormwater inlet controls include structure costs, installation costs, maintenance costs, and costs associated with sediment and debris disposal.

- *Structure.* Catch basin inserts cost from $300 to $10,000 per unit. Hydrodynamic separators range in cost from $6,000 to $450,000 per unit, depending on how much flow they can treat (SCVURPPP, 2007).
- *Installation.* A single catch basin insert costs roughly $1,800 to install. A hydrodynamic separator takes significant work to construct—and, correspondingly, has a construction cost roughly double that of the separator itself (SCVURPPP, 2007).
- *Maintenance.* The cost associated with stormwater inlet control maintenance depends on the maintenance method and labor costs. To remove sediment and debris, maintenance staff typically use vacuum trucks for hydrodynamic separators and either vacuum trucks or manual removal for catch basin inserts. Using a vacuum truck requires less labor, but a small community might find it too expensive to buy one—though it might be able to share one with another community or hire a contractor with access to one. Cleanout of a hydrodynamic separator costs roughly $4,000 per structure (Kim, 2014).
- *Sediment and debris disposal.* Depending on local regulations, costs for disposing of the sediment captured in hydrodynamic separators may be significant—$65 per ton (Kim, 2014).

[1] Prices updated to January 2019 dollars. Inflation rates obtained from the Bureau of Labor Statistics CPI Inflation Calculator (https://data.bls.gov/cgi-bin/cpicalc.pl); reference dates used were January 2007 (for dollars from SCVURPPP, 2007) and January 2014 (for dollars from Kim, 2014).

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

Kim, J. (2014). *Maintenance guidance for stormwater hydrodynamic separators* (Doctoral dissertation). Rutgers University, New Brunswick, NJ.

Leisenring, M., Clary, J., & Hobson, P. (2012). International stormwater best management practices (BMP) database—Manufactured devices performance summary. Alexandria, VA: Water Environment & Reuse Foundation.

Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP). (2007). *Trash BMP tool box*. Sunnyvale, CA: Santa Clara Valley Urban Runoff Pollution Prevention Program.