8.0 Pretreatment Devices

Definition: A structure designed to be incorporated into stormwater conveyance systems for pretreatment of stormwater flows.

Purpose: Pretreatment devices are primarily used to filter sediment and, in some cases, oil and grease from runoff before flows are discharged to receiving waters or final treatment structures. Some pretreatment devices have the capacity to remove other floatable contaminants.

Applicability: Vendor supplied (often prefabricated) and other pretreatment devices help reduce the pollutant load flowing to other treatment structures (such as detention basins or wetlands) and offer removal of bulk pollutants. In many places, pretreatment devices serve as the only treatment for storm water before it is discharged to receiving waters. In general, these devices are the first line of defense in treating pollutant laden runoff. Since most pretreatment devices offer limited residence time, they are most effective at removing heavy sediment and have limited ability to eliminate fine particles.

Advantages: Prevent downstream BMPs from being overwhelmed by heavy sediment loads and provide treatment in intervening areas where land availability limits other treatment options. Pretreatment also prevents the contamination of secondary BMPs with oil and grease. Maintenance of pretreatment structures is often easier than secondary treatment facilities. For example, cleaning sediment from a vault system with a Vactor truck is less labor intensive than removing sediment from a treatment basin.

Disadvantages: Pretreatment devices require regular maintenance to function properly. If not maintained, some pretreatment devices can serve as a source rather than a sink for sediments. Many pretreatment devices have limited flow capacities and removal efficiencies vary considerably.

Maintenance: Pretreatment structures must be inspected frequently during storms and after snowmelt runoff. Accumulated sediment and other trapped pollutants must be removed, usually by Vactor truck. Pretreatment systems need to be inspected/maintained *at least* bi-annually to ensure the system is working properly. Water quality monitoring may be warranted if the system is discharging directly to surface or ground water.

Planning Considerations:
The complexity of pretreatment devices varies considerably, from basic drop-inlet sumps and sand cans to more intricate vendor supplied structures such as products by Vortechnics, Stormceptor, and BaySaver. In general, vendor supplied systems can offer enhanced removal of oil and grease when compared to basic sediment sumps. As such, these systems are well suited for treating runoff from industrial and commercial parking lots and other impervious areas susceptible to spills.

Basic pretreatment structures include:

- **8.1 - Sand Cans and Drop Inlets**

Vendor supplied pretreatment vaults currently used in the Tahoe Basin are:

- **8.2 – BaySaver**
- **8.3 – CDS Technologies**
- **8.4 - Jensen Boxes**
- **8.5 - Stormceptor**
- **8.6 - Vortechnics**

New drop inlet protection technologies include being tested include:

- **8.7 – CLR**
- **8.8 - DrainPac**
- **8.9 - Hydro-Kleen**

References

More detailed construction specifications and installation guidelines are available from various product manufacturers:

Note: Reference to specific product manufacturers does not constitute an endorsement. Any criticism or support is neither implied nor intended.

Baysaver ® - Nevada Inc.
3425 Shawnee Circle
Reno NV 89502
(888) 393-5112
www.baysaver.com

CDS ™ Technologies
16360 South Monterey Road, Suite 250
Morgan Hill, CA 95037
(888) 535 7559
www.cdstech.com

DrainPac ™
United Storm Water, Inc.
14000 East Valley Blvd., Suite B
City of Industry, CA 91746
1-800-272-2832
www.drainpac.com

Hydro-Kleen ™ Filter Systems
318 N. Carson Street
Carson City, NV 89701
(800) 611-5995
www.hydro-kleen.com

Jensen ® Precast
625 Bergin Way
Sparks, NV 89431-5801
(800) 648-1134
www.jensenprecast.com

Stormceptor® Hyro Conduit
P.O Box 939
Corona, CA 91718-0939
www.stormceptor.com

Vortechnics, ™ Inc.
41 Evergreen Drive
Portland, ME 04103
207-878-3662
www.vortechnics.com

Basic Pretreatment Devices

Definition: Basic inlet sediment traps are used to collect coarse and medium sized sediments. The general design consists of a sump for the collection of settled material with a drainage pipe positioned towards the top of the sump. Variations include sand cans, double sand cans, and pre-cast concrete boxes.

8.1 Sand Cans and Drop Inlets

Please read section 8.0 for important information applicable to all pretreatment devices.

Definition: Sand cans are inverted culvert pipes, usually 36 inches in diameter and between six and eight feet tall. Storm water enters through a grated inlet at the top; the outlet is positioned roughly 1 foot below the surface allowing for four to five feet of storage capacity. Large gravel is placed in the bottom to allow for infiltration.

Drop inlets are generally circular or rectangular structures, often of pre-cast concrete, designed to collect and convey runoff into a storm drain system.

Advantages:

- Low cost.
- Easy to install.

Disadvantages:

- Settled sediment may become re-suspended during heavy flows.
- Regular maintenance required to remove accumulated sediment.

Sizing: A professional engineer must design the device to accommodate estimated sediment and peak flow rates.

Field Experience:

- El Dorado County has performed two different uncontrolled studies to evaluate particle sizes being captured by sand cans. The first study focused on roadside cans collecting mostly road sand. The second tested cans where road sand was not applied. The county is not convinced that more sophisticated designs provide better sediment removal (Apache Monitoring Study - Contact Bruce Lee with El Dorado County for additional information).
- Sand cans have been installed in series (i.e. Double Sand Cans) to help capture additional sediment.
- Using larger diameter pipes may improve sediment trapping efficiency.
- Modifications to existing designs, such as offsetting the inlet pipe to create a vortex, may further improve trapping efficiency.
- Drop inlets are used extensively in the Tahoe Basin.
- Placer County as found sediment cans to be the most cost-effective way to collect road sand. Hauling sediment out of the Tahoe basin remains the most prohibitive aspect of all sediment collection devices.

Vendor Supplied Pretreatment Devices

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Definition: These products generally include a sump for sediment collection and a baffle (or series of baffles) designed to trap floatable materials such as trash, oil, and grease. Vendor supplied vaults often include a high flow bypass to prevent scouring and resuspension of collected material during large events. Products currently used in the Basin include those manufactured by Jensen, Stormceptor (CSR Hydro Conduit), BaySaver, and Vortechnics.

8.2 BaySaver

Please read section 8.0 for important information applicable to all pretreatment devices.

Definition: Similar design to the Stormceptor with two round, manhole-like structures. Heavy solids settle in the first vault while floatables (such as oil and grease) and finer sediments are retained in the second. The second vault prevents the loss of previously accumulated floatables and sediment.

Advantages:

- Wire mesh screen prevents pine cones and other debris from plugging internal piping.
- Water tight inlet pipe.
- Unrestricted access to the bottom of both vaults.
- Limited flows to secondary vault to improve oil and fine particle retention.

Disadvantages:

- Components are typically made of PVC. If material compaction around pipes is not perfect pipes may be broken.
- Limited field experience in the Tahoe area.
- Recent studies indicate variable pollutant removal efficiencies (Walker et al., 1999).

Sizing: Sized for peak of the design event with consideration for the total volume of the manholes. Several models are available to accommodate a range of flow capacities.

Field Experience:

- The first BaySaver unit in the Lake Tahoe Basin was installed at Sierra Pacific Power Company's maintenance yard at South Lake Tahoe on August 26, 1999.

8.3 CDS Technologies

Please read section 8.0 for important information applicable to all pretreatment devices.

Definition: A pre-cast round vault with a circular removal chamber. The separation and containment chamber consists of a containment sump in the lower section and an upper separation section. Flow moves in a circular motion through a screen located around the outer parimeter of the removal chamber. The relatively high velocity of the water in the entry chamber is reduced by water in the outer chamber (outside of the screen) moving counter current to the outlet.

Settleable materials drop to the containment sump at the screen interface while floatables pass upward.

Advantages:
- Effective for coarse sediment removal.
- Design prevents screen blockage.
- Can be fitted with sorbents to capture oil and grease.

Disadvantages:
- Smallest screen size (1200 microns) is too large to effectively remove fine sediments.
- No field experience in the Tahoe Basin.
- Recent studies indicate variable pollutant removal efficiencies (Walker et al., 1999).

Sizing: Using the manufacturer's sizing guidelines, this device is generally designed to achieve only coarse pollutant removal.

Field Experience:

8.4 Jensen Boxes

Please read section 8.0 for important information applicable to all pretreatment devices.

Definition: Pre-cast, multi-chambered, rectangular concrete vaults with interior chambers separated by baffle walls. The elevation of the outlet is such to cause standing water in the vault, allowing sediment to settle, while high baffles trap floatable oil and grease.

Advantages:
- Can be less expensive than more complex vault systems.
- Optional adsorption pillows can be used to enhance oil and grease capture.
- Large capture volume.

Disadvantages:
- Requires separate bypass to divert flows more than the unit flow.
- Compared to other vendor supplied vaults, Jensen boxes have a large pump-out volume, which can add to maintenance costs.

Sizing: Using the manufacturer's sizing guidelines, this device is generally designed to achieve only coarse pollutant removal.

Field Experience:

8.5 Stormceptor

Please read section 8.0 for important information applicable to all pretreatment devices.

Definition: A pre-cast, round, manhole-like structure with a flow diverter and a high-flow bypass.

Advantages:
- Limits inflow to prevent potential scour and resuspension of sediment.
- Incorporated high-flow bypass.
- Can accommodate several inlet pipes.

Disadvantages:
- Design allows for access at one point only.

- Recent studies indicate variable pollutant removal efficiencies (Walker et al., 1999).

Sizing: Stormceptors are sized for peak of the design event with consideration for the total volume of the manhole. Several models are available to accommodate a range of flow capacities.

Field Experience:

8.6 Vortechnics

Please read section 8.0 for important information applicable to all pretreatment devices.

Definition: A pre-cast, rectangular structure with a circular removal chamber. Flow entry is designed to cause a swirling motion around the removal chamber. Like the BaySaver, there are two chambers. The first is the vortex separator, the second stores floatable material (oil and grease) within an inner chamber. A high flow bypass directs flow through the first chamber and past the second.

Advantages:

- Low pump-out volume can reduce maintenance costs.
- Center baffle traps floatables in the oil chamber, even during clean out.
- Flow control chamber gradually drains the system as flow subsides.
- One-piece unit – easy to install.

Disadvantages:

- Removal efficiency is effected by flow rate.
- Installation and maintenance costs may be high.
- Recent studies indicate variable pollutant removal efficiencies (Walker et al., 1999).

Sizing: The manufacturer typically recommends sizing to achieve an average of 80 percent removal of TSS. The resulting treatment flow capacity is approximately one quarter the maximum hydraulic flow capacity of the unit.

Field Experience:

- The City of South Lake Tahoe has established a monitoring program on a Vortechnics unit installed as part of the Beecher/Lodi Erosion Control Project. Preliminary results indicate collected sediments are frequently re-suspended and discharged.
- Two 16,000 gallon units were installed to treat runoff from the Stateline casino corridor in 1999. A comprehensive monitoring program is in place to evaluate effectiveness. Results will be included in an appendix when available.
- Placer County installed two units as part of the Tahoe City Urban Improvement Project. They have not been monitored to evaluate performance.

Drop Inlet Protection

Reference to specific product manufacturers does not constitute an endorsement. Any criticism or support is neither implied nor intended.

Definition: Drop inlet inserts are installed into storm drain inlets to directly intercept sediment and petroleum products before runoff enters a primary conveyance.

8.7 CLR Filter

Please read section 8.0 for important information applicable to all pretreatment devices.

Definition: A rigid frame, stainless steel insert with a sedimentation chamber and a filtration vessel filled with an oil absorbent media.

Advantages:
- Design allows sediment to drop out before runoff passes through the filter media to help preventing clogging.
- Stainless steel resists breaking.
- Low cost.

Disadvantages:
- Applicable to smaller parking lots.
- Frequent maintenance is required.
- No monitoring/effectiveness studies available.

Field Experience:
- Two CLR Filters were installed at the Ski Run Marina Village
- One CLR was installed at the Cantina.
- No monitoring has been performed.

8.8 DrainPak

Please read section 8.0 for important information applicable to all pretreatment devices.

Definition: A flexible, multi-layer, insert comprised of non-woven filter cloth designed to collect and retain petroleum products, heavy metals, and fine sediments.

Advantages:
- Initial and replacement costs are low.
- Simple retrofit of existing inlets – design conforms to all storm drain configurations.
- Bypass system prevents flooding.
- Retained solids are dewatered and ready for disposal.
- Eliminates sediment in lateral discharge lines.
- Initial and replacement costs are low.
- May provide “polishing” for multi-phase systems.

Disadvantages:
- May have the potential to scour and resuspend collected material during high flows.
- Freezing temperatures may limit flow capacity and complicate routine maintenance.
- Maintenance intensive.
- Easily clogged, which can drastically reduce flow capacities. Post-event maintenance required to preserve conveyance and treatment capacities.

Field Experience:
- Caltrans installed 50 DrainPaks along Highway 50 between Trout Creek and Stateline. The units were monitored

during winter 1999/2000. Caltrans reports that the units plug after one or two rain events, reducing flow and treatment capacity (Dan Peterson, personal communication).
- The Tahoe Keys Property Owners Association is committed to installing 200 DrainPaks. The City of South Lake Tahoe will be responsible for maintenance.

8.9 HydroKleen

Please read section 8.0 for important information applicable to all pretreatment devices.

- **Definition:** A rigid frame insert that directs runoff through a sediment collection chamber followed by a separate chamber filled with special media. The media (treated paper pulp and activated carbon) remove hydrocarbons, heavy metals, and other industrial waste products. May be best suited for industrial, gas station, and auto repair lots where spills threaten storm water flows.

Advantages:
- Multiple design options allow for easy retrofit.
- Can be customized to remove site-specific substances.
- Manufacturer claims the product is effective in subfreezing temperatures and at high flows.

Disadvantages:
- May be easily clogged.
- Frequent maintenance required.

Field Experience:
- Six HydroKleen inserts have been installed in the South Shore area: two near Trout Creek, two near the Alta Mira building, and two along the Upper Truckee River.
- Caltrans reports the units plug quickly and break when exposed to freezing temperatures (Dan Peterson, personal communication).