4-4. Pretreatment Practices

The following Treatment Practices are presented in this Section:

1. Sediment Forebay
2. Vegetated Filter Strip
3. Pre-treatment Swale
4. Flow-Through Structures
    - 4.a. Water Quality Inlet
    - 4.b. Proprietary Devices
5. Deep Sump Catch Basin

1. SEDIMENT FOREBAYS

General Description

A sediment forebay is an impoundment, basin, or other storage structure designed to dissipate the energy of incoming runoff and allow for initial settling of coarse sediments. Forebays are used for pretreatment of runoff prior to discharge into the primary water quality treatment BMP. In some cases, forebays may be constructed as separate structures but often, they are integrated into the design of larger stormwater management structures.

General Requirements Applicable to All Sediment Forebays

- Provide a fixed vertical sediment marker to measure depth of accumulated sediment.
- Re-stabilize all disturbed areas upon completion of maintenance in accordance with approved plans.

Design Considerations

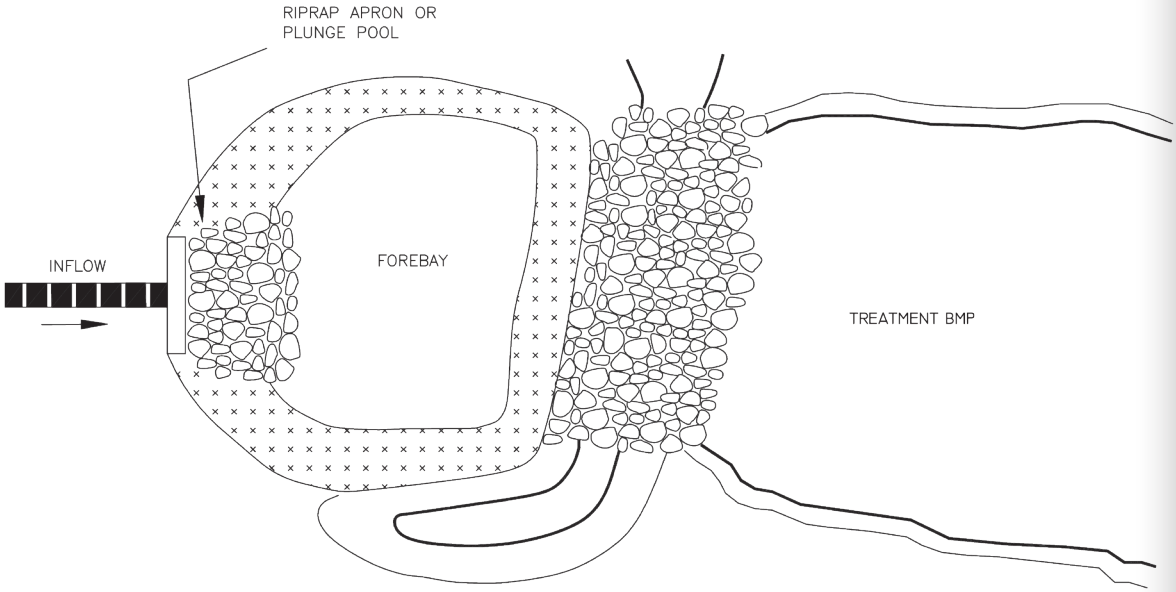
- Maintenance access must be provided;
- Embankment design must be engineered to meet applicable safety standards (see description of Detention Basins);
- Exposed earth slopes and bottom of basin should be stabilized using seed mixes appropriate for soils, mowing practices, and exposure to inundation;
- Exit velocities from the forebay should be non-erosive;
- As an alternative to an earthen basin, an underground structure may serve as a forebay. However, use of fully enclosed structures must consider accessibility for inspection and cleaning.

Maintenance Requirements

- Forebays help reduce the sediment load to downstream BMPs, and will therefore require more frequent cleaning.
- Inspect at least annually;
- Conduct periodic mowing of embankments (generally two times per year) to control growth of woody vegetation on embankments;
- Remove debris from outlet structures at least once annually;
- Remove and dispose of accumulated sediment based on inspection;
- Install and maintain a staff gage or other measuring device, to indicate depth of sediment accumulation and level at which clean-out is required.

Example Design

Plan View



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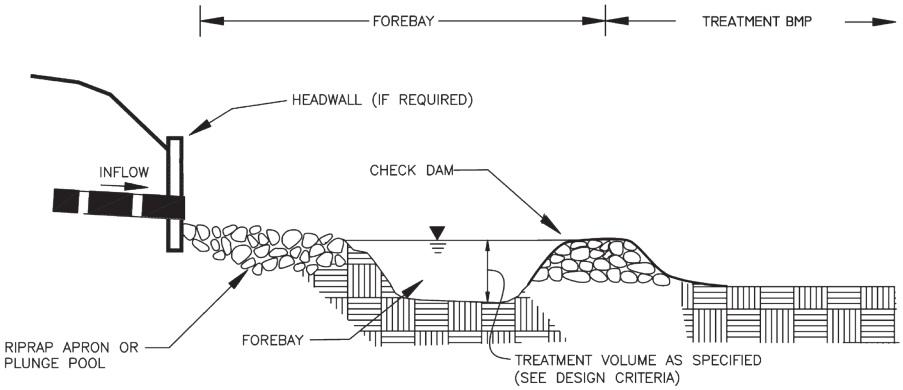


Adapted from MassHighway (2004)

Design References

- Schueler (1987)
- Schueler, et al. (1992)

Design Criteria

Design Parameter	Criteria
Forebay Volume	10% of the WQV, at a minimum. See specific Treatment Practice for appropriate size.
Minimum Depth	2 feet
Maximum Depth	6 feet
Maximum Side Slopes	3:1

2. VEGETATED FILTER STRIPS

General Description

Vegetated Filter Strips are gradually sloped areas of land with natural or established vegetation allowed to grow with minimal to no maintenance. They are designed to receive runoff as sheet flow. The vegetation slows runoff and allows water to infiltrate as sediments settle. A level spreader may be necessary to convert runoff to sheet flow as it enters the filter strip. Vegetation may consist of meadow, forest, or a combination.

Vegetated Filter Strips may have substantially shorter lengths of flow path than "Vegetated Buffers" (see BMP description), and would not be anticipated to provide the level of treatment afforded by buffers sized in accordance with this Manual. Therefore, Filter Strips are not considered "Treatment Practices" under the AoT requirements, but may be used as pretreatment practices.

General Requirements Applicable to Vegetated Filter Strips

- Vegetative cover type should be forest, meadow, or combination forest/meadow

Design Considerations

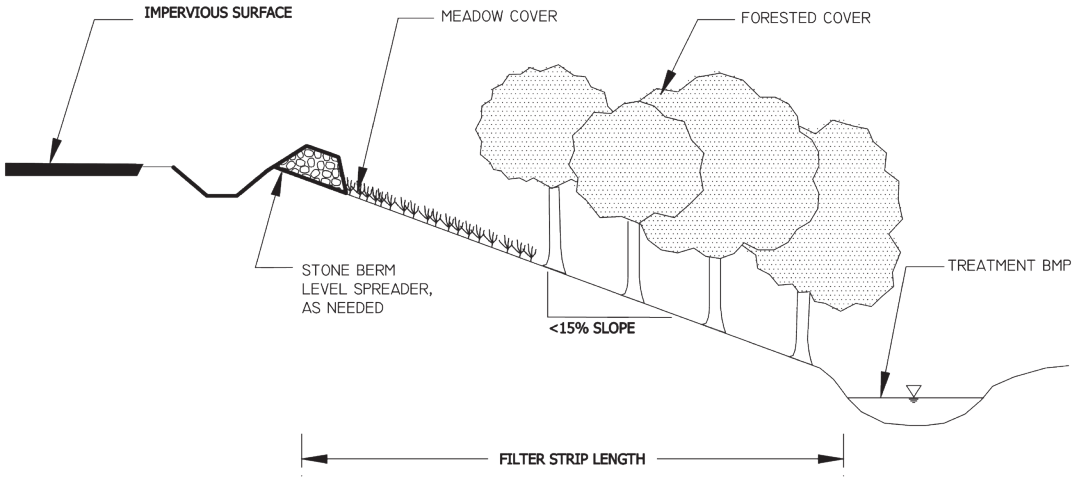
- Effectiveness of filter strip is dependent on shallow diffuse flow. Care is required to select or prepare the site, so that flow enters the filter strip as sheet flow and does not re-concentrate after entering the filter strip.
- The filter strip should be continuous for its entire length (flow path), not interrupted by other site features.

Maintenance Requirements

- Inspect filter strip at least annually for signs of erosion, sediment buildup, or vegetation loss.
- Along the upper edge of the filter strip, the deposition of sediment may form a "berm" that obstructs flow into the filter area or concentrates flow. The filter strip and level spreader (if applicable) should be inspected at least annually to detect this condition, and accumulated sediment removed to restore sheet flow into the filter area.
- If a meadow, provide periodic mowing as needed to maintain a healthy stand of herbaceous vegetation.
- If a forested filter strip, maintain in an undisturbed condition, unless erosion occurs.
- If erosion of either forested area or meadow occurs, eroded areas should be repaired and replanted with vegetation similar to the remaining buffer. Corrective action should include eliminating the source of the erosion problem, and may require retrofit with a level spreader.
- Remove debris and accumulated sediment, based on inspection.

Example Design

Profile



Adapted from MassHighway (2004)

Design References

- Maine DEP (2006)

Design Criteria

Design Parameter	Criteria
Maximum Length of Overland Flow to the Filter Strip	75 feet
Maximum Longitudinal Slope	15% measured along flow path
Minimum Filter Strip Length	25 feet measured along flow path
Filter Strip Width	Equal to width of the area draining to the strip

3. PRE-TREATMENT SWALES

General Description

Pre-treatment swales are shallow, vegetated, earthen channels designed to convey flows, while capturing a limited amount of sediment and associated pollutants. A pre-treatment swale differs from a Treatment Swale in that the grass swale is not designed for a specified hydraulic residence time, but only for a minimum length. Therefore, pre-treatment swales do not necessarily provide sufficient time for the removal of pollutants other than those associated with larger sediment particles, and may only be used for pretreatment.

The Treatment Swale is described in this manual under Treatment Practices, and provides enhanced pollutant removal through filtration through vegetation, infiltration into underlying soils and physical settling.

General Requirements Applicable to Pre-treatment Swales

- Swales are prohibited in areas of RSA 482-A jurisdiction unless a wetlands permit has been issued
- Swales are prohibited in groundwater protection areas receiving stormwater from a high-load area unless an impermeable liner is provided
- Swale shape should be trapezoidal or parabolic
- Bottom of swale should not be within the seasonal high water table.
- Swale should be vegetated.

Design Considerations

- Pre-treatment swales must be designed so that the flow travels the full length to receive adequate pretreatment. For this reason, flow must be directed to the inlet end of the swale, rather than the swale collecting water continuously along its length.
- Vegetation should be selected based on site soil conditions, anticipated mowing requirements (height, frequency), and design flow velocities.
- All channels should be designed for *capacity* and *stability*. A channel is designed for capacity when it can carry the maximum specified design flow within the design depth of the channel (allowing for recommended freeboard). A channel is designed for *stability* when the channel lining (e.g., vegetation) will not be eroded under maximum design flow velocities. Analyses of these conditions must account for both the type of lining and its condition (for example, capacity analysis for a grassed channel must consider the resistance of the maximum height of grass, while the stability analysis must consider the grass under its shortest, mowed condition).

Maintenance Requirements

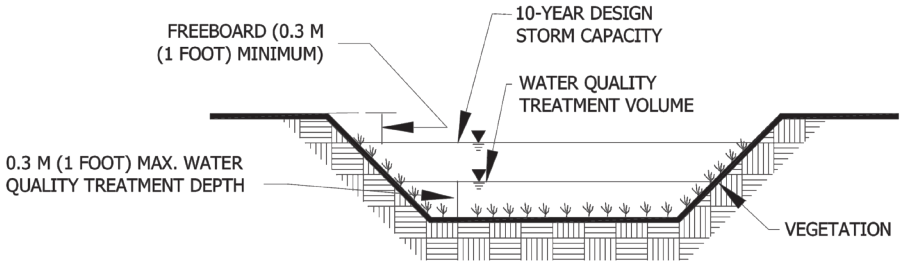
- Inspect annually for erosion, sediment accumulation, vegetation loss, and presence of invasive species.
- Perform periodic mowing; frequency depends on location and type of grass. Do not cut shorter than Water Quality Flow depth (minimum 4-inches)
- Remove debris and accumulated sediment, based on inspection.
- Repair eroded areas, remove invasive species and dead vegetation, and reseed with applicable grass mix as warranted by inspection.

Design References

- EPA (1999e)

Example Design

Section



Adapted from MassHighway (2004)

Design Criteria

Design Parameter	Criteria
Minimum Length	≥ 50 feet (not including portions in a roadside ditch)
Bottom Width	4 to 8 feet
Longitudinal Slope	0.5% to 2% without check dams 2% to 5% with check dams
Maximum Side Slopes	3:1
Flow Depth	4 inches maximum at the WQF
Design Discharge Capacity	10-year, 24-hour storm without overtopping

4. FLOW-THROUGH DEVICES

General Description

The AoT Regulations recognize the following flow-through devices as BMPs for pre-treatment of stormwater runoff before entering a treatment practice:

- Water Quality Inlets
- Proprietary Flow-through Devices (Such as Oil/Particle Separators and Hydrodynamic Separators)

General Requirements Applicable to Flow-Through Devices

- Design devices according to manufacturer's recommendations based on the Water Quality Flow (WQF) to achieve required removal rate
- Document that devices remove a minimum of 80% of U.S. Silica grade OK-110 at the WQF.

4a. Water Quality Inlet

A water quality inlet is an underground storage structure with multiple chambers, designed to capture coarse sediments, floating debris, and some hydrocarbons from stormwater runoff. Such inlet devices are typically used for pretreatment of runoff prior to discharge to another treatment practice.

The devices use baffles with weirs or orifices to control flow and help capture sediment, and inverted baffles or hooded outlets to help capture floating materials. Depending on the design of the unit and the magnitude of peak flow events, the captured sediments may be subject to re-suspension and flushing from the device. Floating hydrocarbons captured in the unit can be removed for disposal during maintenance operations by skimming or by use of sorbent materials. Note, however, that hydrocarbons carried by stormwater frequently are dispersed in suspension or adsorbed to fine-grained sediment particles or organic materials, and may not necessarily be captured in the unit.

To limit potential for re-suspension of captured materials, the device is usually designed as an "off-line" unit sized for the Water Quality Flow. Larger storm events would then bypass the unit.

Design Considerations

- Recommended installation as an off-line device;
- Inspection and maintenance may require "confined space" safety procedures;
- Limited capacity for fine sediment removal, together with potential for re-suspension, result in limited overall pollutant removal capability. The device should only be used for pre-treatment.

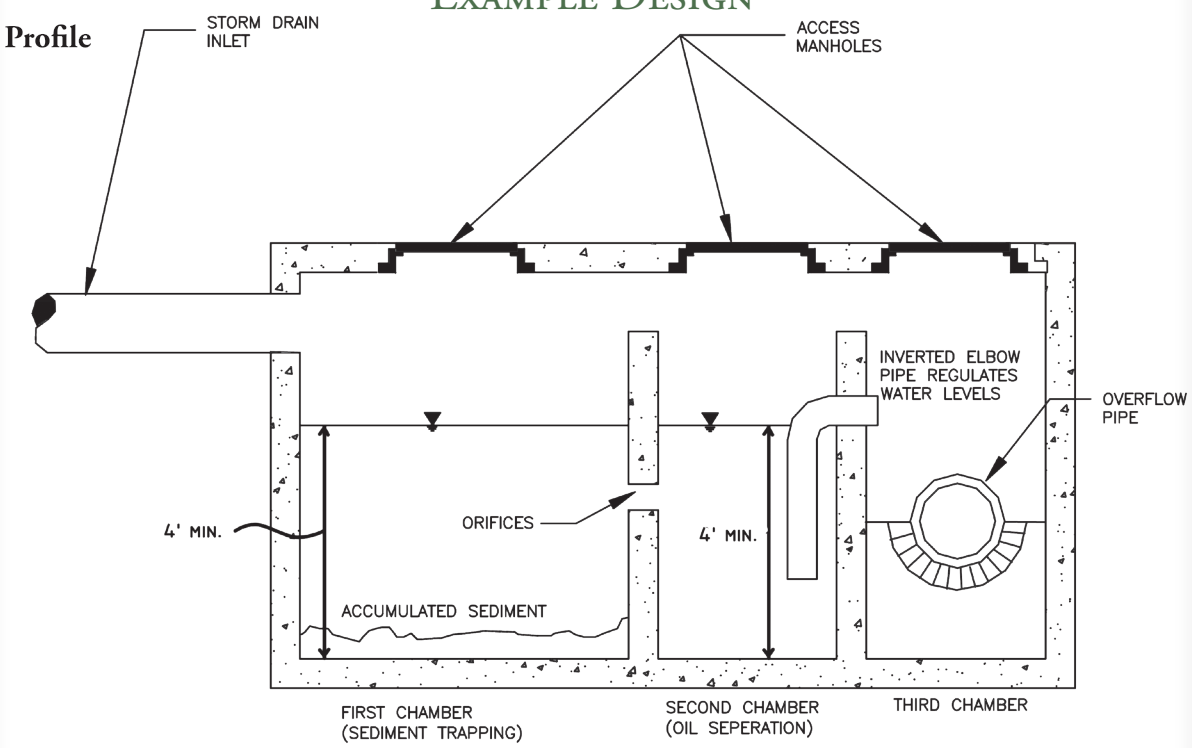
Maintenance Requirements

- Inspect Water Quality Inlet quarterly. Remove and legally dispose of floating debris at each inspection.
- Remove sediment when inspection indicates depth is approaching half the depth to the lowest orifice or other outlet in the first chamber baffle. However, it is recommended that the unit be cleaned at least once per year;
- Remove floating hydrocarbons immediately whenever detected by inspection;
- Dispose of sediments and other wastes in conformance with applicable local, state, and federal regulations.

Design References

- Schueler (1987)
- Schueler, et al. (1992)

Example Design



Adapted from MassHighway (2004)

Design Criteria

Design Parameter	Criteria
Required chamber arrangement	3 chambers, each with separate manhole
Minimum Sump Depth	4 feet
Combined Volume of 1st & 2nd Chamber	≥ 400 cubic feet per acre of contributing impervious area
Maximum recommended contributing area	< 1 acre of impervious area

4b. Proprietary Flow Through Devices Including Hydrodynamic Separators & Oil/Particle Separators

Several manufacturers offer a number of proprietary flow-through stormwater treatment devices. These devices are variously referred to as "oil/particle separators," "oil/grit separator," or "hydrodynamic separators." Some of these devices use multiple chambers arranged horizontally or vertically to help trap and retain sediments and floating substances. Some use internal components to promote a swirling flow path to help enhance removal and retention of sediment.

These flow-through devices are normally sited close to the source of runoff, often receiving stormwater from relatively small areas that are mostly, if not entirely, impervious surface. They may only be used as pretreatment of stormwater prior to discharge to other treatment BMPs.

Because runoff is detained briefly in conventional separators, only moderate removal of coarse sediments, oil and grease can be expected. Soluble pollutants, fine-grained sediment, and pollutants attached to the sediment such as trace metals or nutrients will likely pass through the separator.

With their comparatively small size and underground installation, they can be conveniently located to facilitate access for inspection and maintenance. However, given their limited capacity they require frequent maintenance. Also, because they are enclosed underground structures, selection, design, and installation should consider whether maintenance activities will be subject to confined-space safety procedures.

Design Considerations

- Flow-through units must be installed as an off-line device;
- Inspection and maintenance may require "confined space" safety procedures;
- Limited capacity for removal of fine sediment and dissolved contaminants, may result in limited overall pollutant removal capability. The devices may only be used for pre-treatment.

Maintenance Requirements

- Inspect quarterly, or more frequently as recommended by manufacturer. Remove and legally dispose of floating debris at each inspection.
- Based on inspection, remove sediment when it reaches level specified by manufacturer. However, it is recommended that the unit be cleaned at least once per year, or more frequently as recommended by manufacturer;
- Remove floating hydrocarbons immediately whenever detected by inspection;
- Dispose of sediments and other wastes in conformance with applicable local, state, and federal regulations.

Design References

- New Hampshire Department of Environmental Services (2002)

Design Criteria

Design Parameter	Criteria
Minimum Sump Depth	4 feet
Maximum Drainage Area	1 acre of impervious area
Minimum Permanent Pool Storage Volume	400 cubic feet per acre of contributing impervious area
Maximum contributing impervious drainage area	≤ 1 acre
Off-line configuration	Required
Manhole access	Each chamber must be accessible by separate manhole

5. DEEP SUMP CATCH BASIN

General Description

A deep sump catch basin consists of a manhole-type structure with an inlet grate, an outlet pipe connected to the piped drainage system, and a sump with a depth several times the diameter of the outlet pipe. The inlet grate is located at the surface, and is sometimes combined with a vertical inlet integrated with a street or parking area curb. The sump's purpose is to capture coarse sediments and debris from the runoff intercepted by the structure. The outlet pipe can be fitted with a "hood" consisting of a cast metal or formed plastic fitting, designed to prevent floating materials from exiting the structure.

Deep sump catch basins used as pretreatment are most effective if sited "off-line" since flow-through basins are more susceptible to sediment re-suspension. The outlet hood provides benefits for trapping floating trash, as well as for short-term spill containment.

Design Considerations

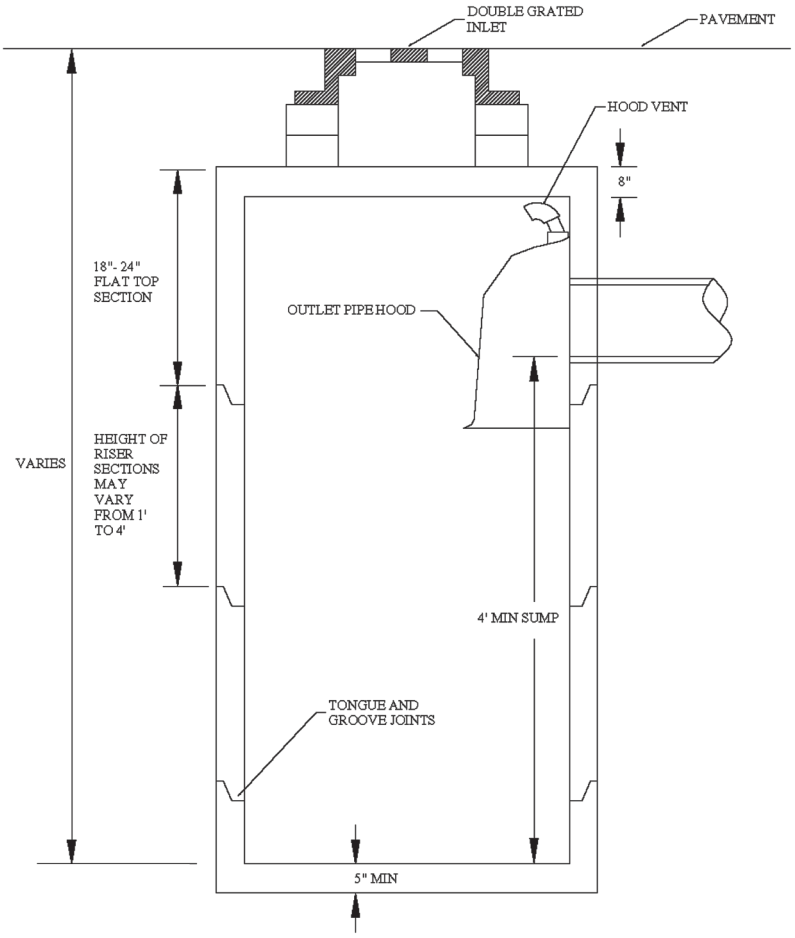
- Deep sump catch basins used as pretreatment devices must be located "off-line."
- Hoods may be susceptible to displacement or damage from cleaning activities. This should be considered in the configuration of the tops of structures (e.g., use of eccentric cones or flat tops with the inlet offset from alignment with the hood) to minimize risk of damage from cleaning equipment. However, the configuration should also permit access for repositioning or replacing the hood.

Maintenance Requirements

- Catch basins may require frequent maintenance. Depending on location, this may require several cleanings of the sumps each year. At a minimum, it is recommended that catch basins be inspected at least twice annually, once following snow-melt and once following leaf-drop, and cleaned as indicated by inspection.
- Sediment should be removed when it approaches half the sump depth.
- If floating hydrocarbons are observed during an inspection, the material should be removed immediately by skimming, absorbent materials, or other method and disposed in conformance with applicable state and federal regulations.
- Cleaning may require Vacuum-truck instead of "clam-shell" to avoid damage to hood.
- Damaged hoods should be replaced when noted by inspection

Example Design

Profile



Design Criteria

Design Parameter	Criteria
Maximum Drainage Area	≤ 0.25 acre of impervious area
Off-line configuration (no storm drain inlet pipes to the device)	Required
Minimum Catch Basin Diameter	4 feet
Depth from Outlet Invert to Sump Bottom	≥ 4 times the diameter of the outlet pipe
Hooded Outlet	Required. Horizontal hood opening ≥ 1 foot below outlet invert