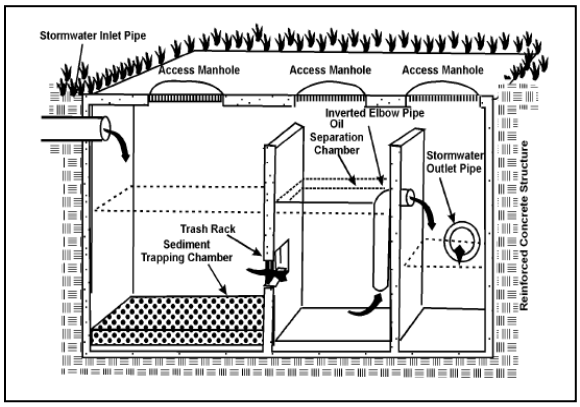
2K-3 Gravity Separator Systems



Source: U.S. EPA, 199

Pollutant Removal **Low = <30% Medium = 30-65% High = 65-100%**			
	Low	Med	High
Suspended Solids	■		
Nitrogen	■		
Phosphorous	■		
Metals		■	
Bacteriological	■		
Hydrocarbons		■	

Description: Gravity oil/particle separators, also called oil/grit separators, water quality inlets**,** and oil/water separators, consist of one or more chambers designed to remove trash and debris and to promote sedimentation of coarse materials and separation of free oil (as opposed to emulsified or dissolved oil) from stormwater runoff. Oil/particle separators are typically designed as off-line systems for pretreatment of runoff from small impervious areas, and therefore provide minimal attenuation of flow. Due to their limited storage capacity and volume, these systems have only limited water quality treatment capabilities. While oil/particle separators can effectively trap floatables, oil, and grease, they are ineffective at removing nutrients and metals and only capture coarse sediment.

Typical Uses: Used in ultra high density and industrial, commercial site for targeted removal of pollutants in stormwater runoff from small catchments (< 10 acres). For limited removal of trash, debris, oil and grease, and sediment from stormwater runoff from relatively small impervious areas with high traffic volumes or high potential for spills such as parking lots and commercial/industrial manufacturing facilities, truck loading areas, gas stations, refueling areas, automotive repair facilities, fleet maintenance yards, and commercial vehicle washing facilities

Advantages:

- Units are typically underground or within existing structures and do not consume much site space
- Filtration devices can be customized to reduce a specific pollutant of concern
- Can often be easily incorporated into fully developed sites
- Can be used for pre-treatment prior to infiltration practices
- Relevant for use on industrial sites because filters can remove pollutants such as metals and oils

Limitations:

- Limited pollutant removal; cannot effectively remove soluble pollutants or fine particles
- Can become a source of pollutants due to re-suspension of sediment unless maintained frequently
- Maintenance often neglected ("out of sight and out of mind")
- Limited to relatively small contributing drainage areas
- Subject to freezing in cold climates; poor cold-weather performance

Maintenance Requirements:

- High degree of maintenance and weekly management required
- Service chemical feed equipment daily and/or weekly

A. General description

Gravity separators (also known as oil-grit separators) are hydrodynamic separation devices that are designed to remove grit and heavy sediments, oil and grease, debris and floatable matter from stormwater runoff through gravitational settling and trapping. Gravity separator units contain a permanent pool of water and typically consist of an inlet chamber, separation/storage chamber, a bypass chamber, and an access port for maintenance purposes. Runoff enters the inlet chamber where heavy sediments and solids drop out. The flow moves into the main gravity separation chamber, where further settling of suspended solids takes place. Oil and grease are skimmed and stored in a waste oil storage compartment for future removal. After moving into the outlet chamber, the clarified runoff is then discharged.

The performance of these systems is based primarily on the relatively low solubility of petroleum products in water and the difference between the specific gravity of water and the specific gravities of petroleum compounds. Gravity separators are not designed to separate other products such as solvents, detergents, or dissolved pollutants. The typical gravity separator unit may be enhanced with a pretreatment swirl concentrator chamber, oil draw-off devices that continuously remove the accumulated light liquids, and flow control valves regulating the flow rate into the unit.

Gravity separators are best used in commercial, industrial and transportation land uses and are intended primarily as a pretreatment measure for high-density or ultra urban sites, or for use in hydrocarbon hotspots, such as gas stations and areas with high vehicular traffic. However, gravity separators cannot be used for the removal of dissolved or emulsified oils and pollutants such as coolants, soluble lubricants, glycols and alcohols. Since re-suspension of accumulated sediments is possible during heavy storm events, gravity separator units are typically installed off-line. Gravity separators are available as prefabricated proprietary systems from a number of different commercial vendors.

B. Pollutant removal capabilities

Testing of gravity separators has shown that they can remove between 40% and 50% of the TSS loading when used in an off-line configuration (Curran, 1996 and Henry, 1999). Gravity separators also provide removal of debris, hydrocarbons, trash and other floatables. They provide only minimal removal of nutrients and organic matter. The following design pollutant removal rates are conservative average pollutant reduction percentages for design purposes derived from sampling data, modeling and independent performance evaluations.

- Total Suspended Solids – 40%
- Total Phosphorus – 5%
- Total Nitrogen – 5%
- Fecal Coliform – insufficient data
- Heavy Metals – insufficient data

Actual field testing data and pollutant removal rates from an independent source should be obtained before using a proprietary gravity separator system.

C. Design criteria and specifications

1. The use of gravity (oil-grit) separators should be limited to the following applications:
   - Pretreatment for other structural stormwater controls
   - High-density, ultra urban or other space-limited development sites
   - Hotspot areas where the control of grit, floatables, and/or oil and grease are required

2. Gravity separators are typically used for areas less than 1 acre. The contributing area to any individual gravity separator can be limited to 1 acre or less of impervious cover.

3. Gravity separator systems can be installed in almost any soil or terrain. Since these devices are underground, appearance is not an issue and public safety risks are low.

4. Gravity separators are rate-based devices. This contrasts with most other stormwater structural controls, which are sized based on capturing and treating a specific volume.

5. Gravity separator units are typically designed to bypass runoff flows in excess of the design flow rate. Some designs have built-in high flow bypass mechanisms. Other designs require a diversion structure or flow splitter ahead of the device in the drainage system. An adequate outfall must be provided.

6. The separation chamber should provide for three separate storage volumes:
   - A volume for separated oil storage at the top of the chamber
   - A volume for settleable solids accumulation at the bottom of the chamber
   - A volume required to give adequate flow-through detention time for separation of oil and sediment from the stormwater flow

7. The total wet storage of the gravity separator unit should be at least 400 cubic feet per contributing impervious acre.

8. The minimum depth of the permanent pools should be 4 feet.

9. Horizontal velocity through the separation chamber should be 1 to 3 feet per minute or less. No velocities in the device should exceed the entrance velocity.

10. A trash rack should be included in the design to capture floating debris, preferably near the inlet chamber to prevent debris from becoming oil impregnated.

11. Ideally, a gravity separator design will provide an oil draw-off mechanism to a separate chamber or storage area.

12. Adequate maintenance access to each chamber must be provided for inspection and cleanout of a gravity separator unit.

13. Gravity separator units should be watertight to prevent possible groundwater contamination.

14. The design criteria and specifications of a proprietary gravity separator unit should be obtained from the manufacturer.

D. Inspection and maintenance requirements

Table 1: Typical maintenance activities for gravity separators

Activity	Schedule
Inspect the gravity separator unit	Regularly (quarterly)
Clean sediment, oil and grease, and floatables, using catch basin cleaning equipment (vacuum pumps). Manual removal of pollutants may be necessary.	As needed

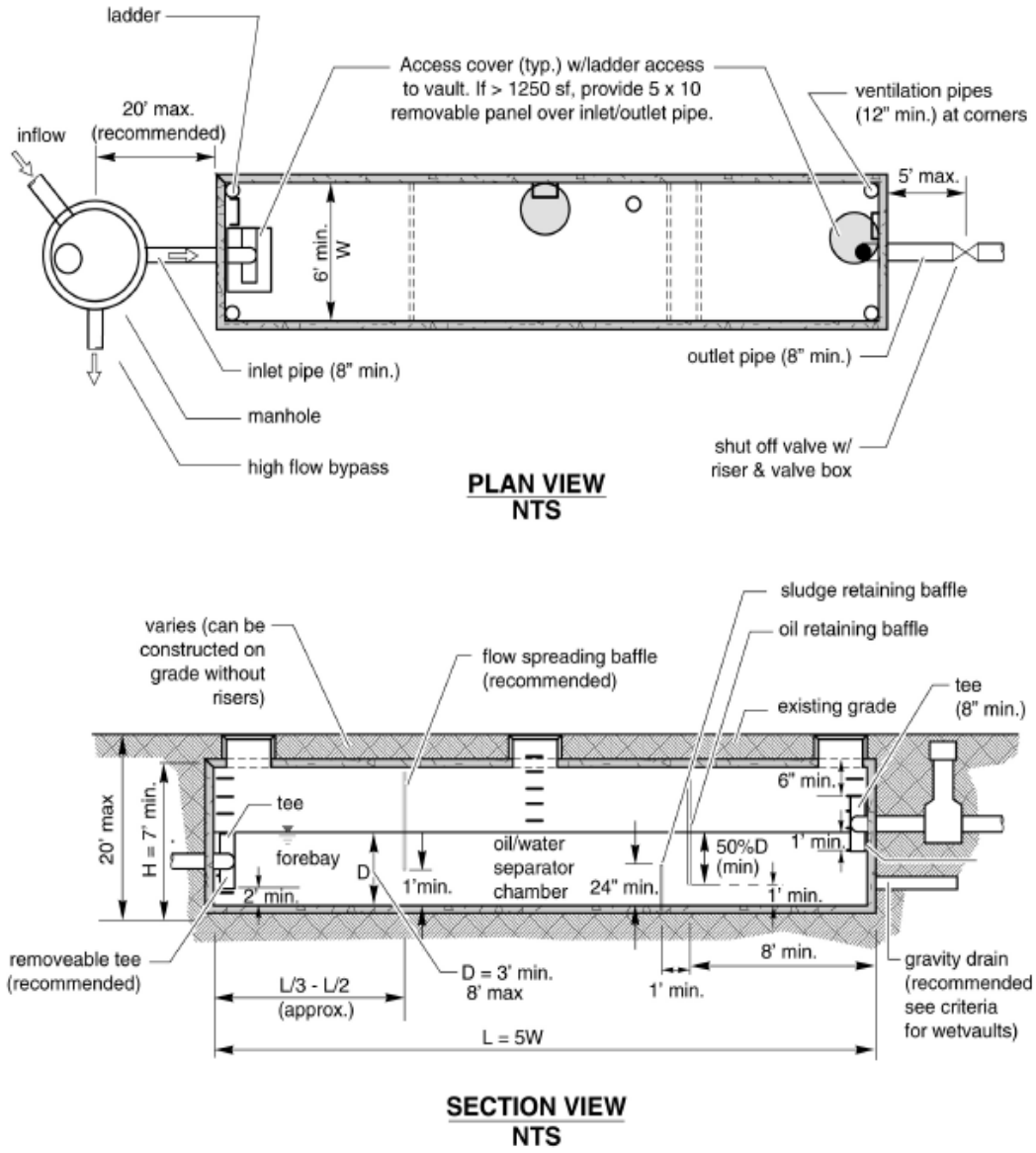
E. Additional maintenance considerations and requirements

1. Additional maintenance requirements for a proprietary system should be obtained from the manufacturer.

2. Failure to provide adequate inspection and maintenance can result in the re-suspension of accumulated solids. Frequency of inspection and maintenance is dependent on land use, climate conditions, and the design of gravity separator.

3. Proper disposal of oil, solids, and floatables removed from the gravity separator must be ensured.

Figure 1: Typical API-type (Baffle) grit chamber



Source: Washington Department of Ecology, 2000

References

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