**Technical Report**

**CRWR 05-06**

# Hazardous Materials Traps

## Transport Spill Containment for Stormwater Pollution Prevention along Texas Highways

**by**

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## I. Introduction and Background

The transport of hazardous materials along the public roads of Texas is a necessary function of the state and national economy. With the large number of petrochemical and manufacturing industries located in Texas, there is a great need to move raw materials and finished products across the state by air, highway, rail and waterway. Every year, thousands of trips are made to deliver these materials to their destinations. Unfortunately, many of these transported materials are classified as hazardous substances.

Much of the hauling of these hazardous materials is accomplished along the public highway system in tractor-trailer tanker trucks or other container vehicles. Although the majority of these deliveries are uneventful, accidents do occur which can cause the release of hazardous materials to the environment. The causes of these accidental releases can be attributed to human error, packaging failure or vehicular accident. Regardless of the cause, the goal is to prevent these hazardous materials from injuring people or contaminating the environment and particularly from reaching waterways through natural or manmade drainage structures.

Table 1.1 summarizes data on reported hazardous material spills for materials that were transported along Texas and national highways from 1993 to 2001. This data represents incidents that were reported to the United States Department of Transportation (USDOT) using the Hazardous Materials Incident Report (form DOT F 5800.1). The majority of the reported incidents involve small releases during loading and unloading operations. Approximately 15% of the incidents occurred en route between origin and destination, according to USDOT, the rest occurred at origin, destination or temporary storage locations. The transporter contains most of these incidents “on-site” through the use of sorbents, booms and portable containers.

**Table 1.1**

**U.S. Department of Transportation Hazardous Materials Incident Data**

| Year | Reported Highway Incidents in Texas | Monetary Damages | Reported Highway Incidents Nationwide | Monetary Damages |
|---|---|---|---|---|
| 1993 | 718 | 964,518 | 11,080 | 19,849,049 |
| 1994 | 789 | 1,745,978 | 13,995 | 25,242,713 |
| 1995 | 914 | 1,319,973 | 12,764 | 22,144,029 |
| 1996 | 807 | 1,767,037 | 11,916 | 29,256,831 |
| 1997 | 859 | 1,128,109 | 11,864 | 24,719,802 |
| 1998 | 1,011 | 2,488,005 | 13,017 | 28,613,957 |
| 1999 | 1,163 | 2,950,915 | 14,984 | 32,114,394 |
| 2000 | 1,203 | 4,018,443 | 15,087 | 49,284,081 |
| 2001 | 1,017 | 3,160,179 | 15,398 | 60,999,336 |
| Totals | 8,481 | 19,543,157 | 120,105 | 292,224,192 |

A very small percentage of the total number of incidents involves an actual release of hazardous materials into a waterway or storm drain. For the year 2001, for instance, USDOT reports that 71 of a total number of 17,870 reported incidents nationwide resulted in such a release. This total number of incidents represents all reported releases for air, highway, rail and water transport. Exactly four incidents were reported for water transporters that year, therefore it may be surmised that less than 0.5% of all reported highway incidents involved a release of hazardous materials into a waterway or sewer. Data gathered for other years reported similar values.

At the rate of 0.5%, approximately 5 highway incidents a year in Texas would result in a release of hazardous materials into a waterway or storm drain. This gives an estimate of the number of this type of incidents that may be expected to

occur in Texas in a given year. The results of such an incident would depend on the substance and amount released. However, if a large amount of a hazardous material that was toxic and/or easily dissolved in water was to enter a waterbody that was environmentally sensitive or a drinking water source, the results could be disastrous. At the very least, a spill of any material considered hazardous into a waterway or sewer will require an extensive cleanup and monitoring operation.

In the absence of federal or state regulations requiring structural controls to prevent such an incident, some municipalities and other entities have instituted local requirements to install hazardous material traps in stormwater collection systems in order to capture any potential spills. The goal of these systems is to minimize the impact of a hazardous materials release to the public health and the environment and to contain the material so that it may be collected and disposed of in an appropriate manner. The difficulty, of course, is to balance the desire to control accidental releases and the cost of installing such containment devices.

## II. Summary of Applicable Regulations

The transport of hazardous materials along the public roads of Texas is regulated by federal, state and local agencies. This chapter summarizes the pertinent aspects of transportation and environmental legislation regarding hazardous materials transport and accidental releases.

There are essentially no federal or state laws requiring hazardous material containment devices to be installed on storm drain systems along public roadways. There are regulatory requirements to protect the public and the environment from exposure to hazardous materials; however, the regulations apply mainly to transporters and manufacturers of these materials.

Some specific areas within the state (i.e. the Edward's Aquifer recharge zone) have more stringent development and stormwater control regulations, but there are still no local requirements for hazardous materials traps even in these more sensitive areas. The presence of existing facilities in these areas appears to be due to the actions of some environmental groups and state or local agencies that have requested the inclusion of these controls on a case-by-case basis.

### Federal Regulations

The Federal Hazardous Materials Transportation Law contained in U.S. Code Title 49, Subtitle III, Ch. 51 – *Transportation of Hazardous Materials* is the federal statute regarding the transport of hazardous materials in the United States. The code essentially gives the Secretary of Transportation the authority to classify hazardous materials (see Chapter 3) and to regulate their transport. The hazardous materials regulations promulgated under this law are outlined in 49 CFR Parts 171-180.

The USDOT Research and Special Programs Administration (RSPA) is responsible for issuing rules and regulations, receiving and maintaining important records (e.g. cylinder test reports, incident reports, etc.), and has primary enforcement jurisdiction over container manufacturers. The RSPA shares enforcement authority over shippers of hazardous materials with other administrations depending on the mode of transport.

The Federal Highway Administration (FHWA) enforces all regulations applicable to motor carriers shipping hazardous materials by highway. The FHWA enforces the Federal Motor Carrier Safety Regulations (49 CFR Parts 390-397) as well as the hazardous materials regulations. The FHWA also regulates the highway routing of hazardous materials and issues safety permits for shippers. The federal regulations regarding routing of non-radioactive hazardous materials are contained in 49 CFR Part 397.

The Federal Railroad Administration (FRA) enforces all regulations regarding the shipping of hazardous materials by rail, including the manufacturers of tank cars. The Federal Aviation Administration (FAA) enforces all regulations regarding the shipping of hazardous materials by air. The United States Coast Guard (USCG) enforces all regulations regarding the shipping of hazardous materials by water.

In the event of an accidental release of a hazardous material that exceeds a specified amount (see Chapter 3) or that causes death or substantial damage, the incident must be reported to the USCG National Response Center (NRC) by phone at 800-424-8802. Written notification is also required to the RSPA using the *Hazardous Materials Incident Report* (form DOT F 5800.1). The NRC will contact USDOT personnel as well as the National Transportation Safety Board (NTSB) if the situation warrants. The NRC is linked to CHEMTREC, a service operated by the Chemical Manufacturers Association (CMA), which can provide information on the properties of most chemicals transported in the US.

In the event of an emergency the USDOT acts in a support role to state and local agencies. To enhance emergency response the RSPA has published the *North American Emergency Response Guidebook* which cross-references hazardous materials, provides information to first responders about the threats of fire, explosion and health hazards and recommends initial emergency actions regarding evacuation, spill containment and first aid. This document along with available training programs and materials constitute the federal spill response and preparedness program.

The federal regulations provide for the proper packaging, handling and transporting of hazardous materials. These regulations apply to shippers and carriers of regulated materials and do not apply directly to agencies that maintain the roads on which these materials are transported. The regulatory focus is on proper packaging, manifesting, placarding and emergency response training for shipper and carriers.

In addition to the federal statutes regarding transport of hazardous materials, there are provisions contained in U.S. Code Title 33, Ch. 26 – Water pollution Prevention and Control (otherwise referred to as the Clean Water Act) that prohibit the release of hazardous materials to the environment. This legislation provides for penalties for dischargers of oil and hazardous materials and outlines clean up procedures and responsibilities. The Clean Water Act also provides for testing of the nation's waters to determine if pollution is present.

**Texas Regulations**

The laws of the State of Texas are listed in the Texas Codes. The codes are divided into different areas of specialization. The state statutes regarding the transportation and spillage of hazardous materials are primarily contained in the Texas Transportation Code and the Texas Water Code. Other sections of the

codes, such as the Texas Health & Safety Code, Texas Civil Practice & Remedies Code and the Texas Natural Resources Code may contain hazardous materials statutes but do not specifically pertain to transportation releases.

Sections of the Texas Transportation Code which apply to the transport of hazardous materials include the following:

- Ch. 472 – Miscellaneous Provisions (provides TXDOT the authority to remove hazardous materials from roadways)
- Ch. 522 – Commercials Driver's Licenses (defines who is eligible to transport hazardous materials in Texas)
- Ch. 644 – Commercial Motor Vehicle Safety Standards (provides for the routing of hazardous materials)

Chapter 26, entitled Water Quality Control, of the Texas Water Code under section 26.039, entitled Accidental Discharges and Spills, requires notification of the TNRCC of any release of hazardous materials that may cause pollution of the environment. Subchapter G (sections 26.261-267) of Chapter 26, entitled Oil and Hazardous Substance Spill Prevention and Control, defines the state's spill response plan and gives ultimate authority for spill response and remediation to the TNRCC. This subchapter outlines how TXDOT equipment and personnel may be utilized to accomplish the spill containment and cleanup operation.

The rules and regulations for all the state agencies in Texas are compiled in the Texas Administrative Code (TAC). The rules regarding the operation of the TNRCC are contained in Title 30 – Environmental Quality. The rules regarding the operation of the TXDOT are contained in Title 43 – Transportation, Part 1.

Ch. 327, entitled Spill Prevention and Control, of Title 30 of the TAC applies directly to the accidental release of hazardous materials to the environment and defines the reportable quantities for such releases. The TNRCC reportable

quantities are generally the same as those listed in Table 302.4 in 40 CFR §302.4, but are not to exceed 210 gallons for liquids or 100 pounds for solids.

**Municipalities and Special Protection Areas**

In the State of Texas, some geographic areas and municipalities have more stringent watershed protection and development standards than other less sensitive areas. The geographic areas that contribute to the Edwards Aquifer have been deemed particularly sensitive to pollution from contaminated runoff as well as being the primary drinking water source for a large population. These areas, including the major metropolitan areas of San Antonio and Austin, are protected by special legislation designed to prevent groundwater contamination from occurring from accidental releases. The special requirements of this area do not include the mandatory installation of hazardous material traps on stormwater collection systems.

Ch. 213, entitled Edwards Aquifer, of Title 30 of the TAC applies to the Edwards aquifer recharge zone and defines special considerations that must be made to protect the aquifer from contaminated stormwater runoff. Construction activities or other possible sources of contaminated runoff are thoroughly reviewed for compliance with this section of the regulations. A spill response plan, including a description of the measures to be taken to contain any spill of hydrocarbons or hazardous substances, must be included with any construction plan submitted for review under this chapter. The TNRCC office in Austin is responsible for the review of these plans.

Ch. 216, entitled Water Quality Performance Standards for Urban Development, of Title 30 of the TAC applies to municipalities with populations over 10,000. This chapter of the state environmental regulations requires municipalities that have identified water quality problems to develop Water Pollution Control and Abatement Programs to control non-point sources of pollution. These plans may

include structural runoff controls to reduce the pollutant loads from roadways and transport facilities, if they are suspected of contributing to the water quality problem.

Although municipalities in Texas may pass development codes that require stringent stormwater controls for developers and capital improvement projects, those codes would not be applicable to TxDOT projects. The enforcement of the Edward's Aquifer and other environmental regulations is the responsibility of the TNRCC when state projects are reviewed. Therefore, no municipal regulation will supersede the state law.

Outside of the state, there are cities that have locally enforced environmental regulations that are stricter than the federal or state requirements. Portland, OR is an example of a city that has enacted stormwater protection requirements for certain groundwater resource protection areas. These special protection areas have stricter stormwater runoff control requirements, but are focused on facilities where hazardous materials are handled. Transportation routes servicing these facilities are also classified as hazardous material containment zones (HMC's) when located within the groundwater resource protection areas.

The requirements for HMC routes are to provide a minimum of 150 gallons of containment at each stormwater inlet, provide impervious paving, curb and gutter and to seal all joints and cracks in paving with an epoxy material. Stormwater treatment/detention facilities or an oil/water separator type device may be used to provide the containment volume. The primary focus of these requirements is the capture of relatively small amounts of spilled petroleum products.

## III. Transported Hazardous Materials Characteristics

### Hazardous Materials Classification

A hazardous material, as defined by the USDOT, means a substance or material that has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and which has been so designated. The term includes hazardous substances, hazardous wastes, marine pollutants, and elevated temperature materials as defined in section 49CFR§172. Materials designated as hazardous by USDOT are listed in subchapter 49CFR§172.101 (a very extensive list) and materials that meet the defining criteria for hazard classes and divisions in subchapter 49CFR§173.

Hazardous materials are classified by the type of danger they present and the subsequent storage and handling requirements. The hazard class of a hazardous material is indicated either by its class number, division number, its class name, or by the letters “ORM-D” which stands for other regulated materials. Table 3.1 lists class numbers, division numbers, class or division names and those sections of the CFR that contain definitions for classifying hazardous materials, including forbidden materials.

Hazardous materials in the 49CFR§172.101 Hazardous Materials Table are listed alphabetically and include information on the hazard class, identification numbers, label codes, special handling provisions, packaging requirements and quantity limitations for air transport for each listed substance. Reportable quantities (the amount which, if spilled, triggers the federal response and reporting requirements) of these materials can be found in the separate listing of hazardous materials found in 40CFR§302.4 Appendix A.

**Table 3.1**

**USDOT Classifications of Hazardous Materials**

| Class No. | Division No. | Name of class or division | 49 CFR reference for definitions |
|---|---|---|---|
| None | | Forbidden materials | 173.21 |
| None | | Forbidden explosives | 173.54 |
| 1 | 1.1 | Explosives (with a mass explosion hazard) | 173.50 |
| 1 | 1.2 | Explosives (with a projection hazard) | 173.50 |
| 1 | 1.3 | Explosives (with predominately a fire hazard) | 173.50 |
| 1 | 1.4 | Explosives (with no significant blast hazard) | 173.50 |
| 1 | 1.5 | Very insensitive explosives; blasting agents | 173.50 |
| 1 | 1.6 | Extremely insensitive detonating substances | 173.50 |
| 2 | 2.1 | Flammable gas | 173.115 |
| 2 | 2.2 | Non-flammable compressed gas | 173.115 |
| 2 | 2.3 | Poisonous gas | 173.115 |
| 3 | | Flammable and combustible liquid | 173.120 |
| 4 | 4.1 | Flammable solid | 173.124 |
| 4 | 4.2 | Spontaneously combustible material | 173.124 |
| 4 | 4.3 | Dangerous when wet material | 173.124 |
| 5 | 5.1 | Oxidizer | 173.127 |
| 5 | 5.2 | Organic peroxide | 173.128 |
| 6 | 6.1 | Poisonous materials | 173.132 |
| 6 | 6.2 | Infectious substance (Etiologic agent) | 173.134 |
| 7 | | Radioactive material | 173.403 |
| 8 | | Corrosive material | 173.136 |
| 9 | | Miscellaneous hazardous material | 173.140 |
| None | | Other regulated material: ORM-D | 173.144 |

TNRCC reportable quantities for spilled hazardous materials are:

- for spills or discharges onto land—the quantity designated as the *final reportable quantity* (RQ) in Table 302.4 in 40CFR§302.4; or

- for spills or discharges into waters in the state—the quantity designated as the final RQ in Table 302.4 in 40CFR§302.4, except where the final RQ is greater than 100 pounds for solids or 210 gallons for liquids, in which case the RQ shall be 100 pounds or 210 gallons.

In 1998, the USDOT Office of Hazardous Materials Safety estimated that over 800,000 daily shipments of hazardous materials occurred in the US. It was estimated that approximately 48% of the total tonnage of hazardous materials was transported by truck, however truck transport accounted for approximately 94% of the individual shipments. The reported USDOT estimate for the annual amount of hazardous materials shipped in the US was 3.1 billion tons per year. Based on these estimates, there are over 750,000 truck shipments a day nationally hauling approximately 1.5 billion tons of hazardous materials annually.

The primary focus for the containment of a release of hazardous materials is on materials that may easily migrate from the site of an accidental release into a nearby stormsewer or natural waterway. The focus is, therefore, on liquids and solids with a measurable solubility in water. These materials may be classified as mobile with regards to off-site migration and containment. A material that does not meet either of these two descriptions would be considered immobile and would not present a significant risk of off-site migration.

The USDOT Hazardous Materials Information System incident data for 2001 shows that, nationally, over 40% of spills involved corrosive materials (class 8), approximately 39% involved flammable–combustible liquids (class 3) and the remaining 21% of spills involved other classes of materials. Figure 3.1

summarizes the distribution, by hazard class, of reported incidents for calendar year 2001. The data shows that corrosive materials, strong acids or bases that are corrosive to human skin, are the most commonly spilled substances. The data also indicates that approximately 80% of reported hazardous materials incidents involved mobile materials, specifically liquids. Examination of annual data from 1993 to 2001 shows that spills of corrosive materials have out numbered spills of flammable–combustible liquids since 1999, having been a slightly lower percentage in previous years.

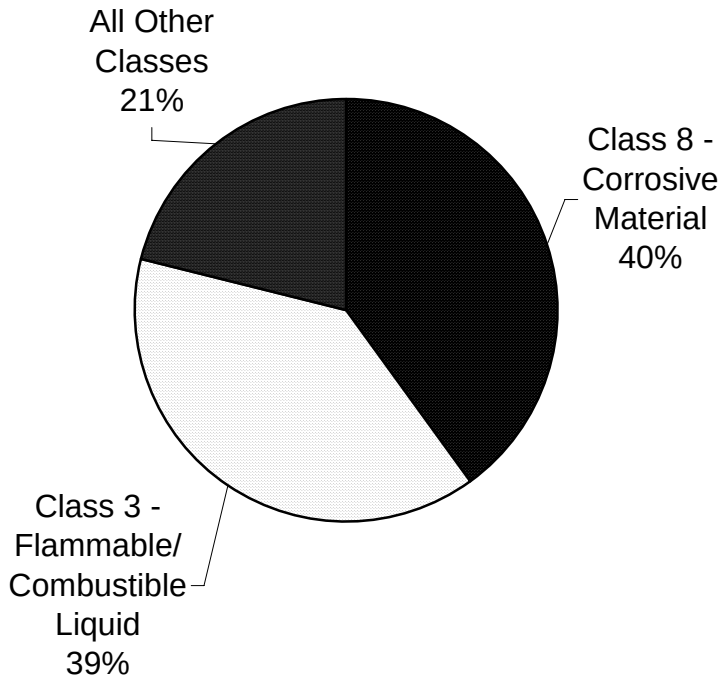


**Figure 3.1 - Summary by Class of Reported Incidents in 2001**

Many stormwater interceptor systems are designed as oil/water type separation units that assume a free phase hydrocarbon with a density significantly different than water. This type of separator will obviously not work to contain a spill of water-soluble corrosive material. The other classes representing 21% of reported spills in Figure 3.1 are predominantly solids or gases. Therefore, less than 40% of all reported hazardous material spills in 2001 would be amenable to an

oil/water separation type containment device. Less than 40% of all spills are liquids with specific gravities significantly different than water.

The amount of each class of hazardous material that may be legally shipped on public highways is regulated by 23CFR§658. This part of the federal highway regulations limits the weight of a motorized cargo vehicle to 80,000 pounds gross weight. This means that a tanker truck is limited to approximately 10,000 gallons of liquid or less depending on the specific gravity of the material.

**Routing of Hazardous Materials**

Under 49CFR§397, any state may designate restricted or prescribed routes for hazardous materials transporters. The restricted and prescribed routes are listed in the National Hazardous Materials Route Registry, which is maintained by the USDOT Federal Motor Carrier Safety Administration. There are currently 19 restricted routes located in Texas listed in the registry. All but three of these restricted routes are located in the Dallas, Houston or San Antonio areas and restrict the transport of hazardous materials into the congested downtown areas.

The prescribed hazardous materials routes constitute a much larger list, with most major cities in the state having several routes listed. These prescribed routes will obviously carry the bulk of the hazardous material shipments in these areas. The prescribed routes are an important factor to consider in the location and installation of hazardous materials traps on stormwater collection systems.

## IV. Hazardous Materials Spill Response and Containment Systems

### Summary of Available Technology

Devices for the capture of hazardous material spills include a variety of types. Most are designed to separate and capture immiscible fluids with a density less than that of water. Others simply capture a fixed volume and then allow the remaining flow, in the case of a rain event, to bypass the structure. The capture volume of these installations varies greatly from less than 10 gallons up to 10,000 gallons. Basic designs include the following:

- Trapping catchbasins
- Catchbasin inserts
- Oil/water separators
- Proprietary end-of-pipe controls (i.e., Stormceptor®, Vortechs©, etc.)
- Lined detention basins
- TxDOT Hazardous Materials Traps with siphons

The various designs are summarized by type in the following section.

### Trapping Catchbasins

Trapping catchbasins consist of curb or drop inlet structures that include a sump containing a permanent pool for collection for coarse sediment, trash, and oil. A common example is shown Figure 4.1, which uses a baffle to retain trash and oil in the basin. Other designs use a downward facing outlet. These are required in many areas of the northeast, such as New York; however, their use can be controversial at times. The permanent pool provides a habitat where mosquitoes and other biota can reproduce. Consequently, areas with concern about the mosquito population may not allow their installation. The total volume of floating liquid that can be retained is normally on the order of about 200 gallons. During

rainfall events the floating liquid can be transported out of the catch basin by the turbulence created by entering runoff.

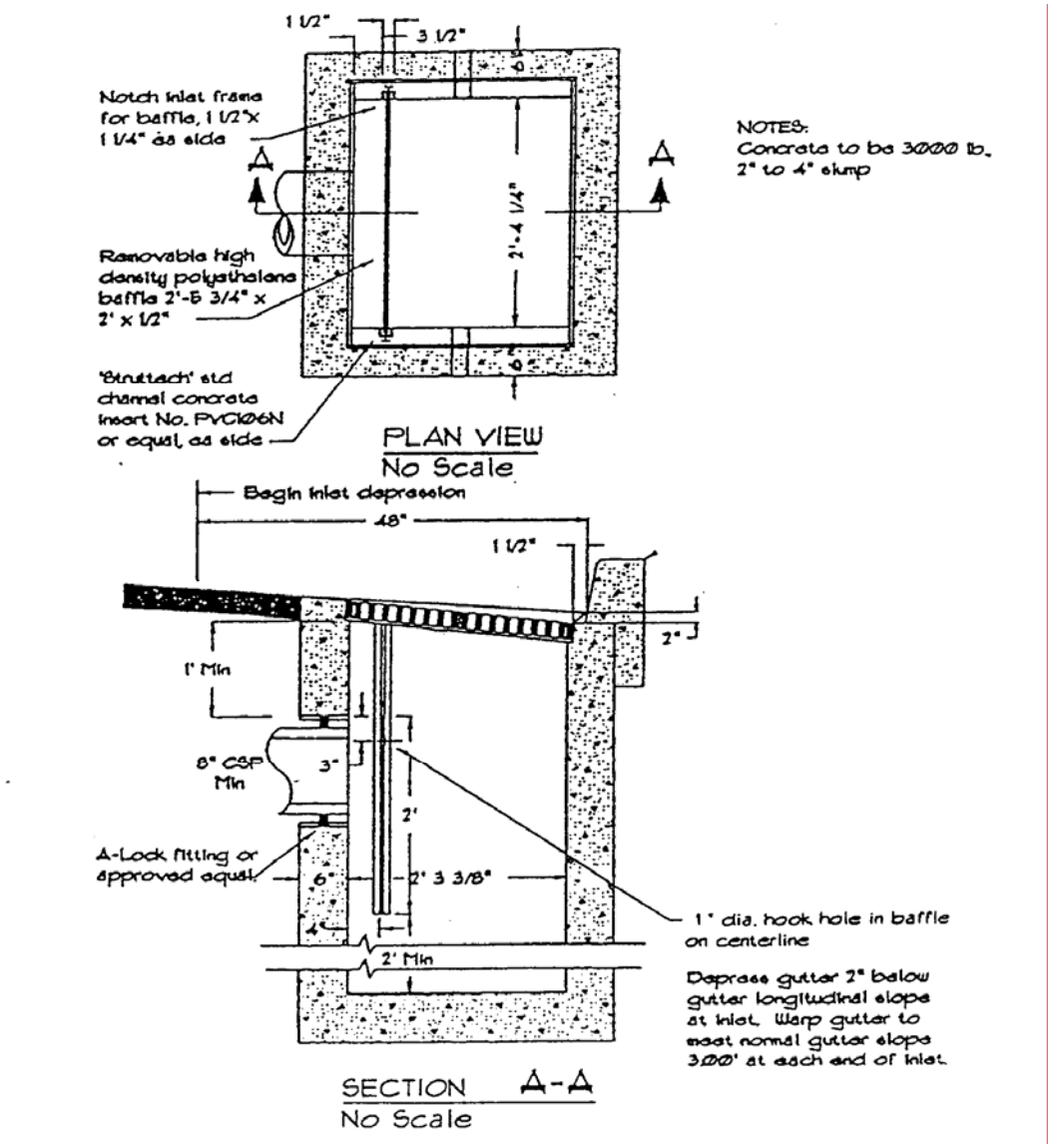


**Figure 4.1 - Schematic of Trapping Catchbasin (City of Portland, 1995)**

**Catchbasin Inserts**

Catchbasin inserts consist of curb or drop inlets that include a device installed within the inlet structure for collection for coarse sediment, trash, and oil. The inserts commonly consist of a geotextile filter fabric and use various sorbent materials to collect pollutants. A schematic of a catchbasin insert is shown in Figure 4.2.

Catchbasin inserts have a limited capacity for collection of oil. The design of the insert varies for each manufacturer, but the current maximum oil retaining capacity is less than one gallon. Because of the small capacity, inserts are not practical for large-scale spill containment.

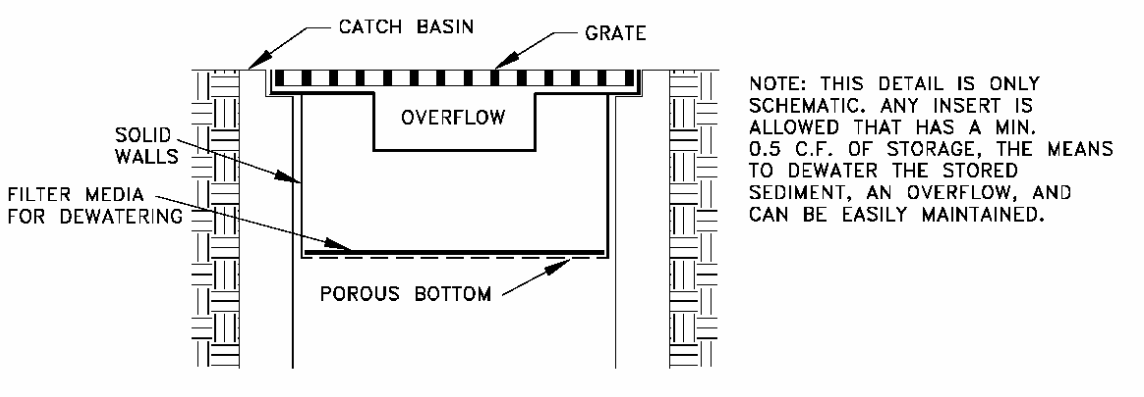


**Figure 4.2 - Schematic of Catchbasin Insert (King County, WA, 1998)**

Catchbasin vaults (with or without filter inserts) are a newly emerging technology that works on the same principles as catchbasin inserts on a larger scale. The design consists of a cartridge or plates of sorbent material placed in a larger underground vault. The vault has the added benefit of providing greater detention and allows settling to occur before contact with the sorbent material. This technology is still in development.

**Oil/Water Separators**

Oil/water separators rely on passive mechanisms that take advantage of oil being lighter than water. Oil rises to the surface and can be periodically removed. The three types of oil/water separators used for stormwater treatment are the baffle type or API (American Petroleum Institute) oil/water separator, the coalescing plate oil/water separator, and the spill control separator.

Baffle oil/water separators use vaults that have multiple cells separated by baffles extending down from the top of the vault. The baffles block oil flow out of the vault. Baffles are also commonly installed at the bottom of the vault to trap solids and sludge that accumulate over time. In many situations, simple floating or more sophisticated mechanical oil skimmers are installed to remove the oil once it has separated from the water. A schematic diagram for the baffle type oil/water separator is shown in Figure 4.3.

Coalescing plate separators are manufactured units consisting of a baffled vault containing several inclined corrugated plates stacked and bundled together. The plates are equally spaced and are made of a variety of materials, most commonly fiberglass and polypropylene. Efficient separation results because the plates reduce the vertical distance oil droplets must rise in order to separate from the stormwater. Once they reach the plate, oil droplets form a film on the plate surface. The film builds up over time until it becomes thick enough to migrate upward under the influence of gravity along the inclined plate. When the film reaches the edge of the plate, oil is released as large droplets that rise rapidly to the surface, where the oil accumulates until the unit is maintained.

Because the plate pack significantly increases treatment effectiveness, coalescing plate separators can achieve a specified treatment level with a smaller vault size than a simple baffle separator. A schematic diagram for the coalescing plate type oil/water separator is shown in Figure 4.4.

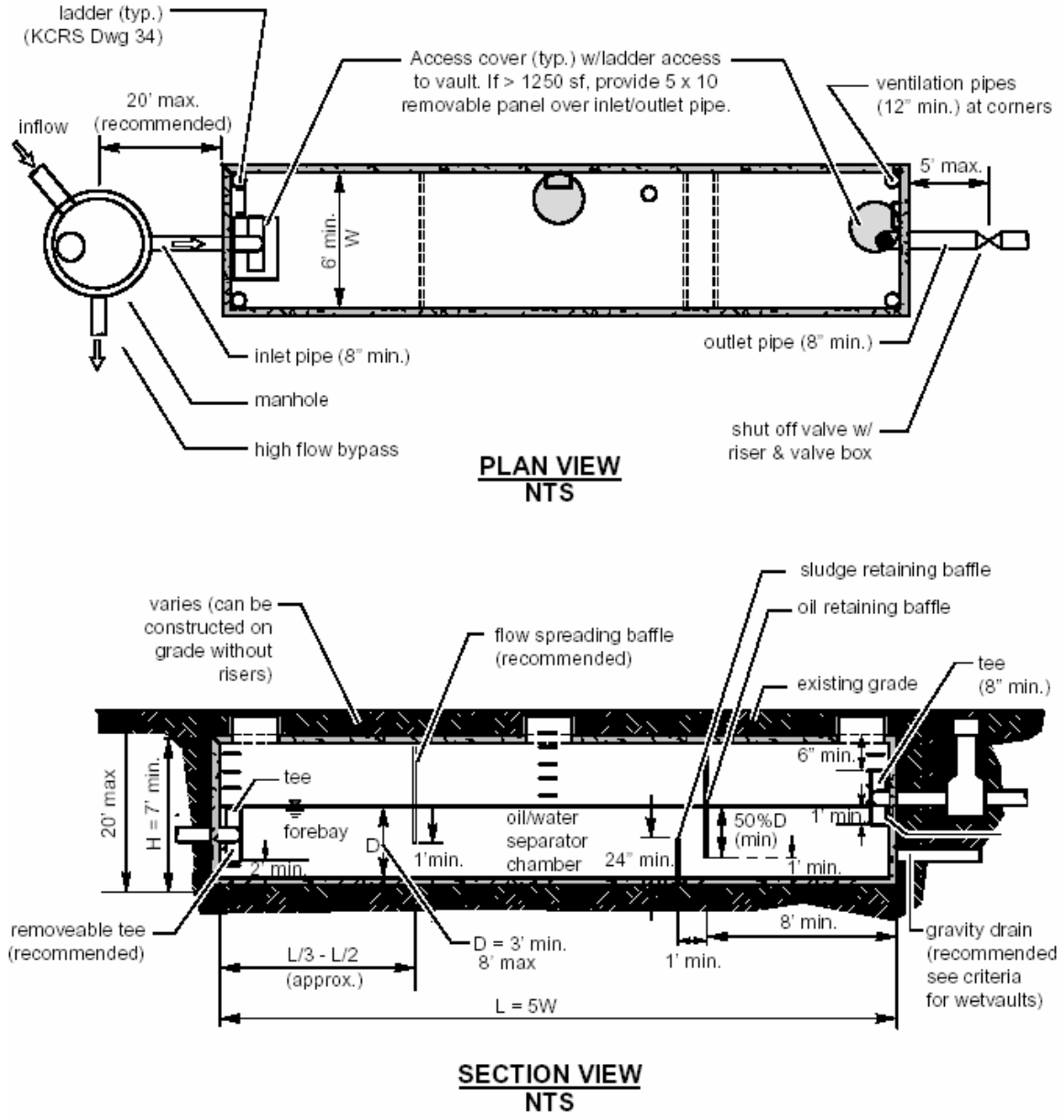


**Figure 4.3 - Baffle Oil/Water Separator (King County, WA, 1998)**

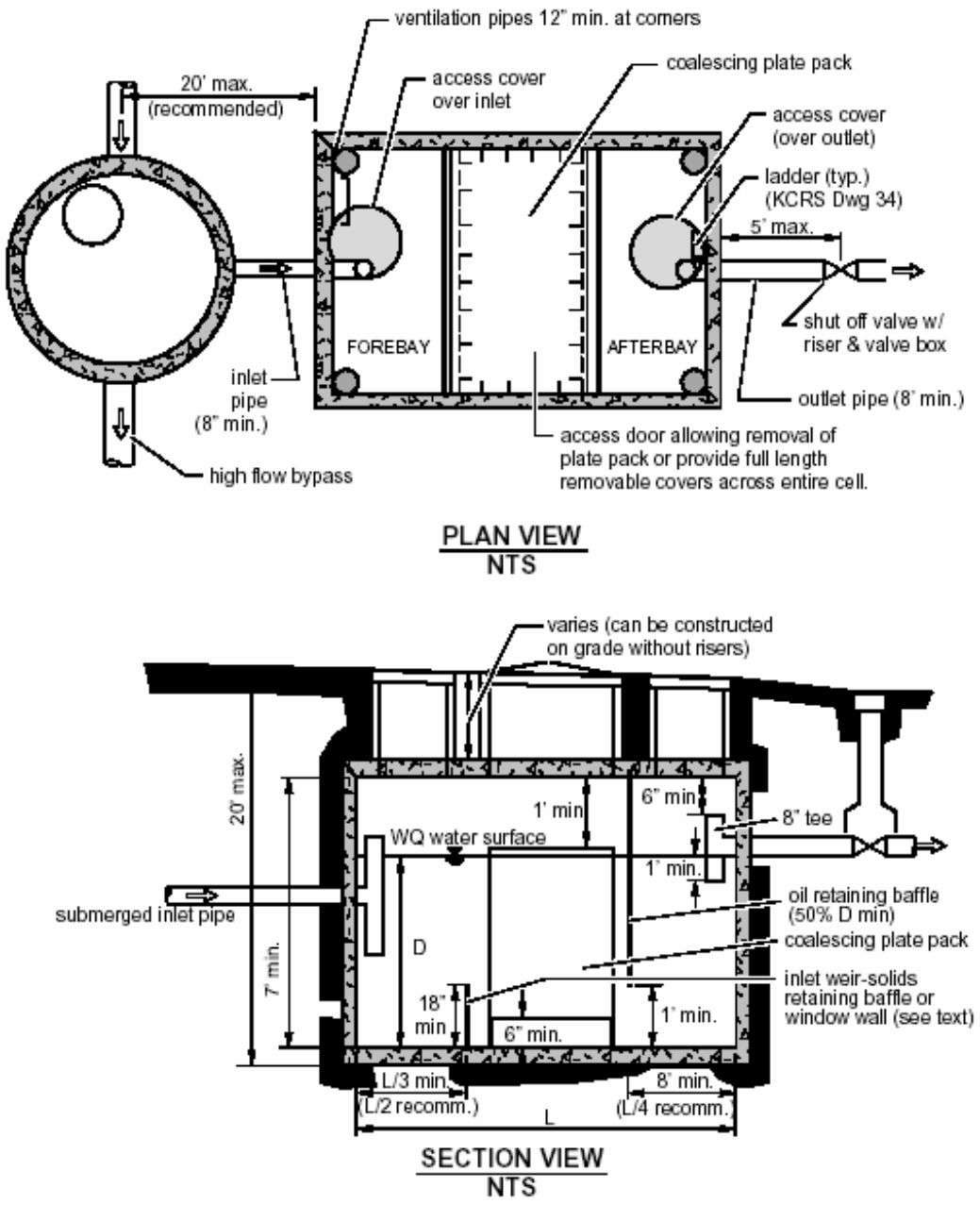


**Figure 4.4 - Coalescing Plate Oil/Water Separator (King County, WA, 1998)**

Spill control separators are the least complex of the three types of oil/water separators. They consist of a simple underground vault or manhole with a “T” outlet designed to trap small spills. They are less effective at removing oil than baffle or coalescing plate separators.

Each of these designs is capable of capturing spills of liquid materials that are lighter than water. Their use for removal of oil and grease in stormwater has generally been found to be inappropriate. The removal of these materials depends on a free phase of hydrocarbons that can float to the surface of the device where they are retained; however, most hydrocarbons in stormwater runoff are associated with the particulate material and are attenuated only to the extent that solids are removed in these facilities. Because of the relatively short detention times and high degree of turbulence, retention of solids (and therefore of hydrocarbons) is normally not very good.

**Proprietary Treatment Devices**

In 1999, Minton reviewed a number of proprietary devices in a guidance document prepared for the California Department of Transportation. The document summarized the treatment capabilities and capacities of the following proprietary devices.

- Actiflow©
- BaySaver™
- CDS™ (Continuous Deflective Separation)
- Downstream Defender™
- Stormceptor®
- StormFilter®
- StromTreat™
- Vortechs©
- V2B1™

Each of these devices, with the exception of the Actiflow© unit, is essentially an oil/water separation unit with some solids removal capability to remove suspended particles. The Actiflow© unit is a stormwater treatment system that utilizes a coagulant to enhance settling and is comparable in complexity to a wastewater treatment facility. The rest of these devices utilize gravity and/or

centrifugal forces, induced through vortex flow patterns, to remove particulate pollutants combined with baffling to retain floatables. A brief discussion of two of these devices is provided below.

One well-known proprietary stormwater treatment device is the Stormceptor®. The basic design is a manhole with an inlet insert that diverts flow into a permanent pool before it can rise out of the outlet structure. The manufacturers claim 97% oil/water separation and over 80% TSS removal. A schematic of a Stormceptory is shown in Figure 4.5.

Another proprietary device is the Vortechs© Stormwater Treatment System. The Vortechs© unit is essentially an oil/water separator with an enhanced inlet area where solids are removed. This system uses a vortex flow pattern at the inlet in order to capture particles centrifugally. The manufacturers claim that the system will remove approximately 80% of incoming suspended solids and will remove oils similarly to standard baffle type oil/water separators with even less washout at high flow rates. A schematic of a Vortechs© is shown in Figure 4.6.

Either of these devices will remove most settable solids and some oils entering the system. These devices may be more easily installed and have a smaller footprint than more traditional oil/water separation devices. However, the relative effectiveness of either versus more economical non-proprietary treatment devices, such as those listed above, is not well documented.

In the event of a hazardous materials spill, only settable solid materials or lighter than water non-aqueous phase liquids would be captured by these proprietary devices. None of these devices contains the volume required to contain the entire contents of a tanker truck carrying 10,000 gallons of petroleum products. These devices are instead designed to treat typical pavement stormwater runoff from roads and parking lots.

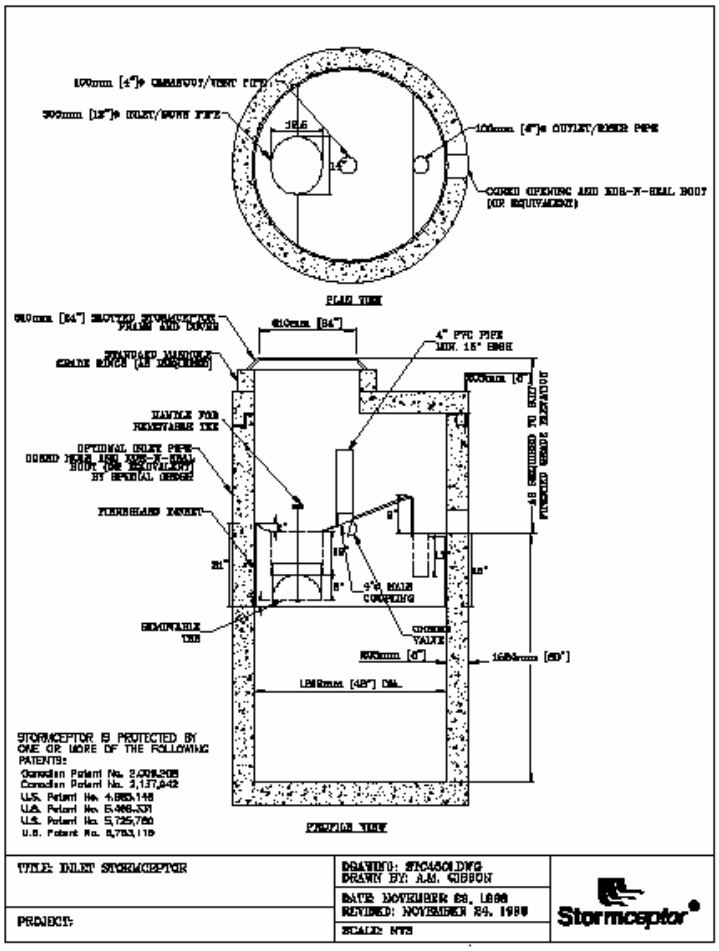


**Figure 4.5 – Stormceptor® Treatment Device**

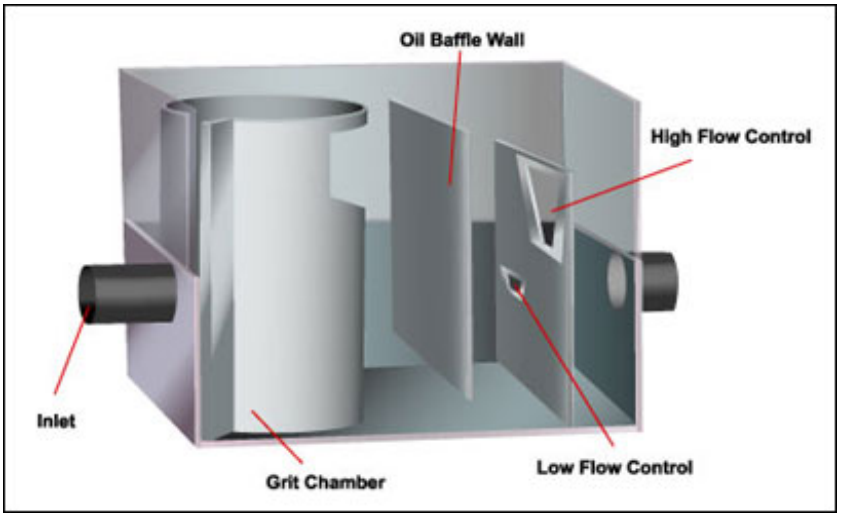


**Figure 4.6 – Vortechs© Stormwater Treatment System**

**Lined Detention Basin**

Lined detention basins generally consist of a concrete lined basin that can capture spilled hazardous materials collected by a stormwater collection system. The basin is sized to contain the largest anticipated spill, usually 10,000 gallons. The hazardous materials are stored until personnel can pump out the basin or drain the basin by opening a valve. This type of in-line capture basin will not contain a spill if it occurs during a rain event or if the basin is full from a prior rain event.

Lined detention basins are often used in conjunction with other stormwater quality treatment structures, such as sedimentation ponds or sand filters. The relatively small detention basin is installed at the inlet of the larger treatment structure in order to catch spilled materials and prevent it from contaminating the larger structures. A photo of such an installation in Austin, TX can be seen in Figure 4.7. This one includes a siphon in the small chamber in the lower right.

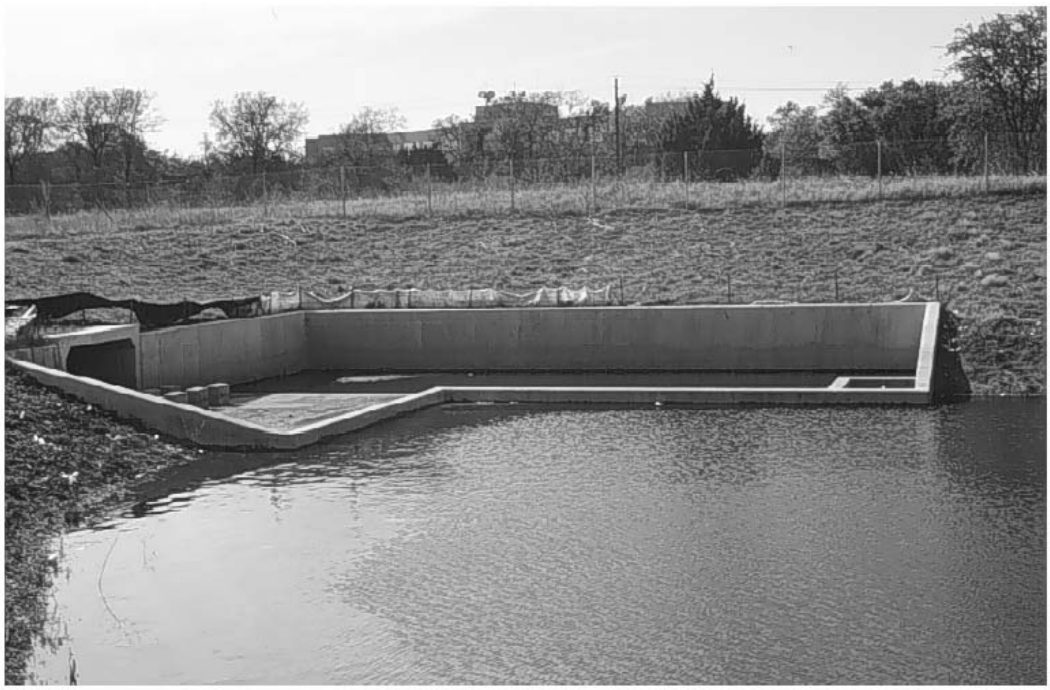

**Figure 4.7 – Concrete Lined Detention Basin, City of Austin (Barrett, 1999)**

Lined detention basins may be constructed with a clay or flexible membrane liner as an alternative to concrete. A typical clay liner may consist of 12-inches of compacted clay with permeability not greater than $1x10^{-6}$ cm/s. Plastic membrane liner materials must be suitable for use with the expected collection of petroleum products and the probable exposure to UV sunlight. Either clay or plastic liners would generally be covered with soil to protect the liner system.

Any lined detention basin that will capture stormwater runoff will serve to contain a hazardous material spill, as long as the basin has sufficient available capacity before the spill event and until the hazardous contents can be properly removed. In order for the basin to be drained, a valved outlet pipe must be provided. For the operation of this type of detention basin to be successful in capturing hazardous materials spills, the basins must be monitored and drained often.

**TXDOT Hazardous Materials Traps with Siphons**

To eliminate the need for manual draining of a lined detention basin, TxDOT has developed an automatic siphon system to drain the basin when it becomes full. Figure 4.8 shows a typical siphon detail from a set of TxDOT construction plans.

The siphon device is designed to drain the basin after it becomes full from a rain event, but is installed at an elevation above the full capacity of the trap, usually 10,000 gallons. Therefore, as long as a hazardous material spill does not occur during a rain event the system should contain the spill. The siphon is provided with bypass and shutoff valves so that alert on-scene responders can shutoff the automatic siphon and thereby maintain some containment even in the event of a concurrent rain/spill.

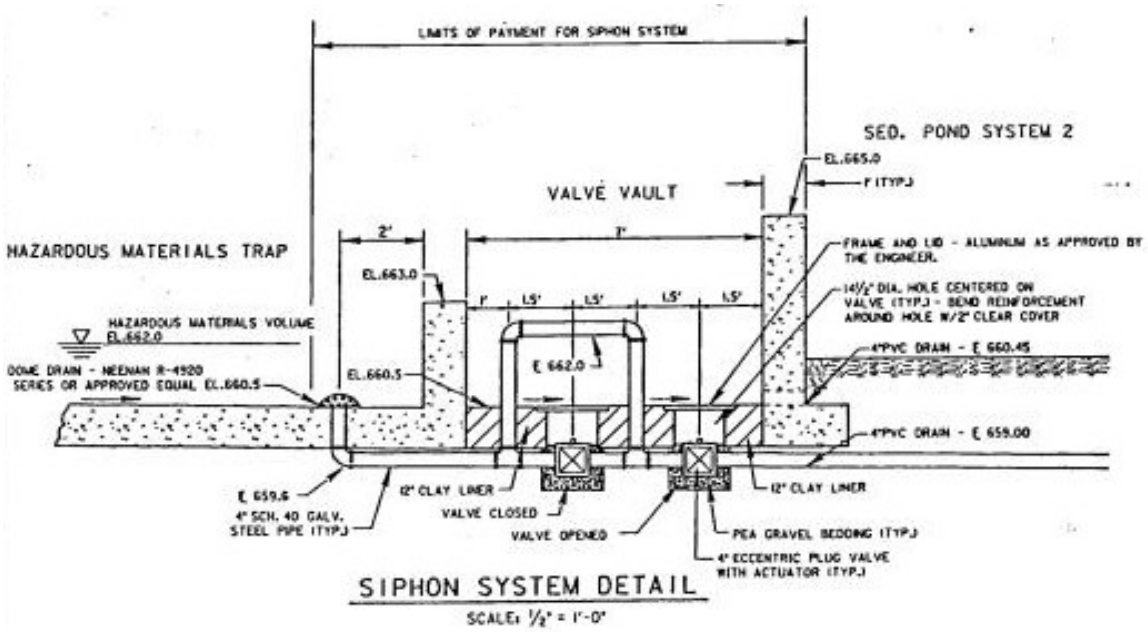


**Figure 4.8 – Typical TxDOT Automatic Siphon Detail**

**Spill Response Agencies**

The following listings for state and federal response agencies and their respective contact phone numbers were taken from the State of Texas Oil and Hazardous Substances Spill Contingency Plan.

| **State of Texas** | **24-Hour Phone** |
|---|---|
| State of Texas Environmental Emergency Hot Line<br>for reporting spills to the TNRCC and<br>coastal oil spills to the GLO and RRC | 1-800-832-8224 |
| Texas Commission on Environmental Quality (TCEQ): | |
| TCEQ Emergency Response Team | 512-239-2507 |
| Oil and Hazardous Substance Spills | 1-800-832-8224 |
| General Land Office (GLO)<br>Coastal Oil Spills | 1-800-832-8224 |
| Railroad Commission of Texas (RRC)<br>Natural Gas and Hazardous Liquid Pipeline Emergencies<br>LPG (Liquified Petroleum Gas) Emergencies<br>Crude Oil Spills | 512-463-6788 |
| Texas Parks and Wildlife Department (TPWD) | 512-389-4848 |
| Texas Department of Health (TDH)<br>Radiation Emergency Reporting | 512-458-7460 |
| Texas Poison Center | 1-800-POISON-1 |
| Governor's Division of Emergency Management (DEM) | 512-424-2000 |

| **National** | **24-Hour Phone** |
|---|---|
| National Response Center (NRC) | |
| for federal spill reporting | 1-800-424-8802 |
| for reporting FREON releases to federal government | 1-800-296-1996 |
| U.S. Environmental Protection Agency (EPA) | 214-665-2222 |
| Region VI—Dallas, Texas | |
| 24-hour spill reporting hotline | |
| National Weather Service | 817-334-3401 |
| CHEMTREC (Chemical Transportation Emergency Center) | 1-800-424-9300 |
| CHLOREP (Chlorine incidents) | 1-800-424-9300 |
| NACA Pesticides Safety Team Network | 1-800-424-9300 |
| Chemical Referral Center | 1-800-CMA-8200 |

In the event of a spill of hazardous material over the reportable quantity limits (see chapter 3), both the NRC and the State of Texas Environmental Emergency Hot Line must be notified within 24 hours. Notification of one does not constitute notification of the other.

## V. Conclusions and Recommendations

Every day thousands of shipments of hazardous materials are made across the State of Texas. When an accidental release of hazardous materials occurs, it is the goal of all agencies involved to quickly respond and contain the release in order to protect the health, safety and welfare of the public and to protect the environment. Hazardous material traps are one tool that may be utilized to control these releases. Although there is no regulatory requirement for the installation of these devices along roadways, there use makes sense in certain areas where an accidental release would be deemed catastrophic.

The location of hazardous materials traps along Texas highways will be determined by the sensitivity of the surrounding watershed and the probability of an accidental release of hazardous materials. Certain areas in the state, like the Edwards Aquifer contributing zone, that include delicate ecosystems that provide drinking water for large populations are logical locations for the added protection of hazardous material traps on stormwater collection systems. The prescribed routes listed in the National Hazardous Material Route Registry provide another guide to locating hazardous material traps.

Statistical data on reported accidental releases from around the country show that the types of materials that are most commonly spilled fall into two main categories: corrosives and flammable liquids. Traditional oil/water separators that have been used for years in collection systems to separate spilled materials from stormwater are not effective in containing the corrosives. The effectiveness of such devices for removing petroleum products form stormwater collection systems is also limited. Oil/water separators and other proprietary stormwater treatment devices often lack the capacity to contain a spill of the size that might occur along highway hazardous material transportation routes.

In order to capture the contents of a tanker truck hauling hazardous materials, a capture volume of at least the maximum expected volume of 10,000 gallons is necessary. Any type of clay, flexible membrane or concrete lined capture basin can be used for this purpose. A lined capture basin will be able to contain most types of spilled hazardous materials, not just those that have a specific gravity which is significantly different from water. It is important to be able to drain the basin after rain events to provide adequate capture volume. It is also important to be able to access the basin for maintenance and to remove the contents in the event of a spill.

The proper placement and design of hazardous material traps will be constrained by the location and site restrictions. Further study is required to develop a standard design, which may be implemented at any location, providing a hazardous material trap for spilled materials entering a highway stormwater collection system. The economics and technical feasibility of the various technologies listed in this report should be compared in order to develop an optimal design for TxDOT installations.

## Appendix A - References:


- City of Austin, “2025 Austin Metropolitan Area Transportation Plan”, adopted by Austin City Council, June 7, 2001

- Barrett, Michael E. 1999. “Complying with the Edwards Aquifer Rules: Technical Guidance on Best Management Practices”. Austin: Texas Natural Resource Conservation Commission.

- Bennett, G.F., Feates, F.S., Wilder, I., Hazardous Materials Spills Handbook, McGraw-Hill, 1982

- California Department of Transportation, “Storm Water Quality Handbook Project Planning and Design Guide”, May 2000

- The Code of Federal Regulations, online publication
  URL: http://www.access.gpo.gov/nara/cfr

- The Edwards Aquifer Authority website
  URL: http://www.edwardsaquifer.org/index.html

- Federal Motor Carrier Safety Administration - Accident/Hazardous Materials Countermeasures website
  URL: http://www.fmcsa.dot.gov/factsfigs/accidenthm.htm

- Hazardous Materials Control Research Institute, Hazardous Materials Control Directory 1987-1988, Silver Spring, MD

- Idaho Department of Environmental Quality, “Catalog of Stormwater Best Management Practices”, 2nd Edition, August 2001
  URL: http://www2.state.id.us/deq/water/stormwater_catalog/index.asp

- King County Department of Public Works, “King County Stormwater Pollution Control Manual”, Seattle, WA, July 1995

- Minton, Gary R., “End-of-Pipe Products Review Memorandum, Guidance Document on BMP Evaluation and Selection”, California Department of Transportation Document No. 43A005, February 1999

- New York State Department of Environmental Conservation, “New York State Stormwater Management Design Manual”, October 2001

- City of Portland, OR, Stormwater Management Manual, adopted July 1, 1999; revised September 1, 2000

- Texas Department of Transportation, “Hydraulic Design Manual”, April 2002, URL: http://manuals.dot.state.tx.us/docs/colbridg/forms/hyd.pdf

- Texas Administrative Code, online publication
  URL: http://www.info.sos.state.tx.us/pub/plsql/readtac$ext.viewtac

- Texas Natural Resources Conservation Commission, Field Operations Division, “State of Texas Oil and Hazardous Substances Spill Contingency Plan”, RG-290, November 1997
  URL: http://www.tnrcc.state.tx.us/admin/topdoc/rg/290.pdf

- Texas Transportation Institute, “Design Methods, Selection, and Cost-Effectiveness of Stormwater Quality Structures”, FHWA/TX-01/1837-1, November 2000

- U.S. Department of Transportation (USDOT), Research and Special Programs Administration, Office of Hazardous Materials Safety, “An Overview of the Federal Hazardous Materials Transportation Law (Federal Hazmat Law)”, online publication
  URL: http://hazmat.dot.gov/pubtrain/overhml.pdf

- USDOT, Office of Hazardous Materials Safety, Hazardous Materials Incident Summary Statistics and Data website, URL: http://hazmat.dot.gov/files/hazmat/hmisframe.htm

- USDOT, Federal Highway Administration, “Urban Drainage Design Manual”, Hydraulic Engineering Circular No. 22, 1996. Publication No. FHWA-SA-96-078

- USDOT, Federal Highway Administration, “Retention, Detention and Overland Flow for Pollutant Removal from Highway Stormwater Runoff. Volume 2. Design Guidelines”, 1996, Publication No. FHWA-SA-96-096.

- US Environmental Protection Agency, “Preliminary Data Summary of Urban Storm Water Best Management Practices”, EPA-821-R-99-012, August 1999

- Washington State Department of Transportation, “Highway Runoff Manual”, M31-16, February 1995


Note: The Texas Natural Resources Conservation Commission was renamed the Texas Commission on Environmental Quality effective September 1, 2002