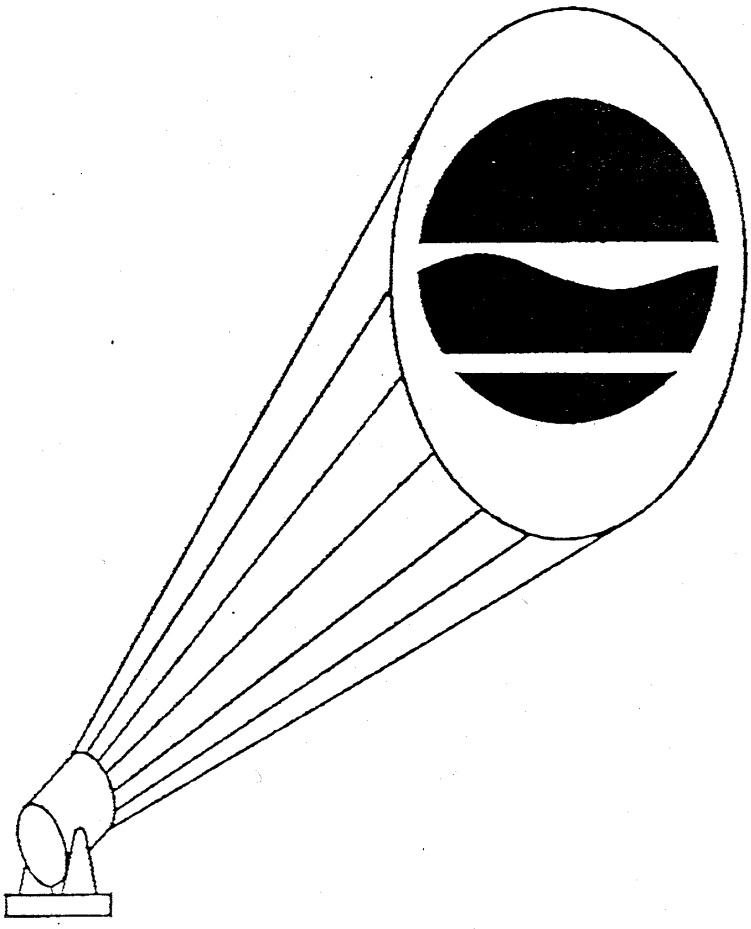

Spill
Prevention
Operations
Technology
Series

SPOTS Memo #10
Secondary Containment Systems for Aboveground Storage Tanks

Prepared by:
New York State Department of Environmental Conservation
Division of Spills Management
Bureau of Source Control

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NewYorkStateDepartmentofEnvironmentalConservation
DivisionofSpillsManagement
50WolfRoad
Albany,NewYork12233-3750
Telephone: (518)457-4351
FAX: (518)457-4332

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MEMORANDUM

To: RegionalWaterEngineers,BureauDirectors,SectionChiefs
Subject: SpillPreventionOperationsTechnologySeries(SPOTS)10
Secondary Containment Systems for Aboveground Storage Tanks
(Originator: Paul Sausville)

I. Purpose

This memo provides guidance on secondary containment systems for above ground petroleum tanks storing all types and grades of petroleum in New York State. It addresses when secondary containment is needed and alternative approaches to complying with the Petroleum Bulk Storage(PBS) regulations, 6 NYCRR Part 613, "Handling and Storage of Petroleum"

II. Background

Section 613.3(c)(6) of the Department's Petroleum Bulk Storage (PBS) regulations, effective December 27, 1985, requires tank owners to install secondary containment systems for:

- all tanks which have a capacity of ten thousand (10,000) gallons or more; and
- smaller tanks (less than 10,000 gallons) which could "reasonably be expected to discharge petroleum to the waters of the State."

Secondary containment systems are engineered dikes, curbs, liners or diversion systems designed to contain spills from tank ruptures, overfills, vandals and equipment failure. They are a safeguard against accidents and protect equipment from vehicular traffic and ground fires. Such systems must be in-place by December 27, 1990.

In addition, section 613.3(c)(6) sets forth the following performance standard for secondary containment systems:

"The secondary containment systems must be constructed so that spills of petroleum and chemical components of petroleum will not permeate, drain, infiltrate or otherwise escape to the groundwaters or surface waters before cleanup occurs. The secondary containment system may consist of a combination of dikes, liners, pads, ponds, impoundments, curbs, ditches, sumps, receiving tanks or other equipment capable of containing the product stored. Construction of diking ant the storage capacity of the diked area must be in accordance with NFPA No. 30, section 2-2.3.3 (see subdivision 613.1 [g])

If soil is used for the secondary containment system, it must be of such character that any spill onto the soil will be readily recoverable and will result in a minimal amount of soil contamination."

These regulations apply to facilities which are both licensed under 6 NYCRR Part 610 and those registered under 6 NYCRR Part 612.

While all of the above are important, three phrases are particularly significant and are underlined for emphasis.

III. Guidance

The following is provided to ensure than DEC's regulations are interpreted consistently and equitably statewide. The guidance should also be used in counties which have received program delegation from the Department.

The Department's PBS Regulations place responsibility on tank owners for complying with section 6134.3(c)(6). This guidance should also be applied on a case-by-case basis by DEC's field engineers and tank owners seeking assistance on how to meet secondary containment requirements.

A. Determining When Secondary Containment Systems Are Needed

1. Tanks With Capacity Less Than 10.000 Gallons - For aboveground tanks smaller than 10,000 gallons in size, the need for secondary containment depends on the threat posed by the tank to ground or surface waters. The responsibility for assessing this threat rests with the tank owner.

   Owners may either equip tanks with adequate secondary containment systems, or determine pursuant to section 613.3(c)(6) that it is unlikely a spill form the tank will "discharge petroleum into the water of the State". Any facility in close proximity to ground or surface waters should should be considered likely to "likely to discharge to the waters of the State". Facilities within 500 feet of the following resources may be considered presumbptive evidence of being in close proximity to ground or surface

waters:

- perennial or intermittent stream;
- public or private well;
- primary or principle aquifer as defined in USGS Water Resource Investigation Report 87-4274, 87-4275, 87-4276, 87-4122, 88-4076, and Appendix C;
- wetlands as defined in 6 NYCRR 664;
- lake/pond, estuary, etc.; or
- storm drain.

If the tanks are closer than 500 feet to any of the above resources, the tank owner should consider installing a secondary containment system.

2. Tanks With Capacity Of 10,000 Gallons Or More - As discussed above, the PBS regulations (6 NYCRR Part 613) require all aboveground tanks with a capacity of 10,000 gallons or more to be equipped with secondary containment meeting the regulatory requirements of section 613.3(c)(6). There are no exceptions.

   PBS regulations require that secondary containment systems be constructed so that spills of petroleum and chemical components do not contaminate ground or surface waters. If a spill should occur within the secondary containment system, it should be contained within the system and be "readily recoverable". If clay or other soils are used to construct the systems, recovery must be possible with "a minimal amount of soil contamination".

   Owners may demonstrate compliance in a variety of ways. An engineering assessment showing that the secondary containment system is in compliance can be conducted, or practices acceptable to the Department may be demonstrated. Each approach is discussed further in Section B and C below.

B. Options For Secondary Containment

1. Owners may evaluate and demonstrate the adequacy of their existing system or determine the need for a new or upgraded system using an engineering approach. Under this method, the owner and engineer should

consider safety, product stored, plant factors, ambient soil conditions, proximity to ground and surface waters and hydrology. Monitoring to determine that the site is free of contamination should also be performed. An engineering report should be prepared by a qualified engineer and kept on file by the owner and made available to the Department as explanation of how the facility complies with the PBS secondary containment regulations. It should discuss the design, permeability and integrity of the system being evaluated, as well as physical effects and environmental consequences of a discharge to and cleanup of the system, including response and removal of product and contaminated material, and restoration of the system. These engineering assessments should be part of the facility's Spill Prevention Control and Countermeasure (SPCC) Plan. The relationship between the engineered secondary containment system and the facility response plan (SPCC Plan) to promptly respond to and remove product released should be discussed. The system and the plan are to be complementary to assure prompt discovery and removal of product, and minimal damage to the environment and the system.

Several good engineering handbooks and manuals have been prepared on the subject. The reader is directed to references in the appendix for further reading. The following is in no way a summary of all factors to be considered, but does cover four major engineering concerns which the Department feels should be addressed.

a. Purposes of Secondary Containment - Designing a secondary containment system requires that the engineer understand the underlying reason DEC requires secondary containment and the environmental objectives to be achieved. Such systems are designed to prevent releases to the environment from tank rupture, equipment failure, vandalism, operation error and overfills. Whenever possible, leakage from pumps, valves, pipes, and other sources should be contained within the secondary containment structure. The system should isolate and protect the tank from vehicular traffic, ground fires and other incidents. Prevention of ground and surface water contamination and fires which could lead to a variety of off-site impacts should be of paramount importance along with the minimization of clean-up costs, lost product and contaminated soil requiring special treatment and disposal.

b. Plant Factors - A variety of design factors should be considered by the engineer including physical and chemical characteristics of the product stored (solubility, viscosity heated and unheated, flammability), likelihood of weather induced effects, e.g., frost heave, reliability of design, quality control of installation, and response time. Depth of ultimate penetration into the liner that will result from a major spill and the amount of contaminated soil

that will have to be removed and treated should be evaluated.

c. Site Assessment - A site assessment should also be performed as part of the engineering study. This should include identifying aquifers and nearby wells, measurements of depth to groundwater, bedrock, soil analysis, permeability measurements and other studies to determine the risk and environmental exposure which exists at the site.

Monitoring under the supervision of a professional engineer or other qualified scientist should also be done. This should consist of checking for contamination of soil and of ground/surface waters in immediate proximity to the facility and if appropriate, downgradient, and if there is evidence of contamination outside of the confines of the facility. Periodic follow-up monitoring may also be needed especially where risks are high.

Contamination exists when there is a visual, olfactory or laboratory evidence of petroleum contamination in the soil, ground or surface water. Laboratory analyses should be for generally accepted measurements of components of petroleum, including benzene, and other volatile aromatic hydrocarbons, benzo (a) pyrene, naphthalene and any other polynuclear aromatic hydrocarbons (PAH).

Criteria for water contamination or any liquid extractions from solid samples should be those numbers established in New York's "Surface Water and Groundwater Classifications and Standards" and Division of Water Technical Operating Guidance #1.1.1, Ambient Water Quality Standards and Guidance Values. For aromatic hydrocarbons or polynuclear aromatic hydrocarbons, the sum total may not exceed 0.1 mg/l and .05 mg/l for any individual compound. Appendix B contains one procedure for monitoring of petroleum contamination. Other approaches are discussed in DEC's Spill Response Guidance Manual. More comprehensive guidance on performing a site assessment can be found in TOG's 4.1.14 "Site Assessments at Bulk Storage Facilities."

2. Department Developed Permeability Criteria

The Division recommends that all secondary containment systems be designed in accordance with engineering approaches outlined above.

As an alternative approach, and to assist owners and engineers with their designs, the Division has developed permeability criteria for dikes and dike floors which will meet the regulatory requirements of section

613.3(c)(6). A demonstration that existing, upgraded, or new secondary containment systems meet or exceed the permeability criteria in Table 1 will be accepted as evidence of compliance with section 613.3(c)(6).

Using generally accepted engineering principles of groundwater movement in soil and the flow relationships of various petroleum products with respect to water (see report entitled "Method of Evaluating the Acceptability of A Diking System", June 21,1988, prepared by Michael S. Milligan, Division of Water), the following permeability criteria were derived:

Table 1

Permeability Criteria For Dikes And Impoundment Floors
Water Permeability Coefficient (centimeters/second)

Product	High Risk Region	Low Risk Region
Gasoline	$1 * 10^{-7}$	$5 * 10^{-7}$
#2 Fuel Oil	$1 * 10^{-6}$	$5 * 10^{-6}$
#4 Fuel Oil	$3 * 10^{-6}$	$1 * 10^{-5}$
#6 Fuel Oil	$1 * 10^{-5}$	$5 * 10^{-5}$

There are several methods of assessing high risk and low risk regions. One method is simply judgment as proposed by Milligan in the paper identified above. Another which is practical and economical to use was developed by Harry E. LeGrand. The LeGrand procedure is described in detail in Appendix E of the Division of Water Report entitled "Siting Manual for Storing Hazardous Substances", 1982.

The coefficients recognize unknowns and the consequences of failure of the secondary containment system as applied to high risk regions such as storage tanks located over a groundwater aquifer, recharge area, near wells or in urban areas. A slightly higher level of permeability would be acceptable for facilities located in a low risk region where the consequences of an escape would have minimal environmental effect.

Permeability measurements of the dike and dike floor should be made to determine the permeability coefficient of the existing system. Guidance on methods and procedures for permeability testing can be found in the paper entitled "Permeability Testing Methods For Secondary Containment Systems", June 21, 1988 prepared by Richard Coriale, Division of Water. A report containing the results of permeability measurements should be signed by a professional engineer or other qualified scientist and kept on file to be made available to DEC upon request.

A. Other Criteria For Secondary Containment Systems

1. Dike Construction and Storage Capacity - Design standards for dikes are incorporated into the PBS Regulations by referencing Section 2-2.3.3 of the NFPA Standard No. 30. Flammable and Combustible Liquids Code. Section 2-2.3.3 covers over a dozen standards for secondary containment systems of which the major ones follow:

   - impoundment floors must be sloped 1% or more away from the tank;
   - capacity of impoundment must be at least 100% of the volume of the largest tank within the dike;
   - dikes must be liquid tight and able to withstand a full hydrostatic head; and
   - storage of combustible materials and drums are prohibited within the dike.

   While NFPA 30 Section 2-2.3.3 requires the impoundment capacity to be a minimum of 100% of the volume of the largest tank, the Division recommends that an additional 10% be added to provide for freeboard and stormwater which may accumulate behind the dike.

   For more details on these and other design standards, see Appendix A.

   The Department's report "Recommended Practices for Aboveground Storage of Petroleum Products" Chapter 5, contains recommendation for six inches or more of impermeable soil for constructing dikes and floors. The report also covers dike construction and stormwater management and should be consulted for further guidance on design and construction practices.

2. Stormwater Drainage - Section 613.3(c)(6) requires that gravity drain pipes extending through the dike be equipped with two manually controlled pipe valves, one on each side of the dike. Valves must be kept locked in a closed position. Pumping the stormwater over the dike or manually controlled siphons are preferred over gravity drains and should be used wherever possible.

   It has been brought to the attention of the Division of Water that a valve on the inside of the dike cannot be safely opened to drain a product engulfed in fire within the impoundment. In fact, NFPA 30 Section 2-2.3.3(h) states "drainage shall be accessible under fire conditions from outside of the dike."

   In recognition of the need for access by fire fighters and the inconsistency between the PBS regulations and NFPA 30, the Division will not require a second valve on the inside of the dike. Revisions to the PBS regulations are currently underway to remove this requirement.

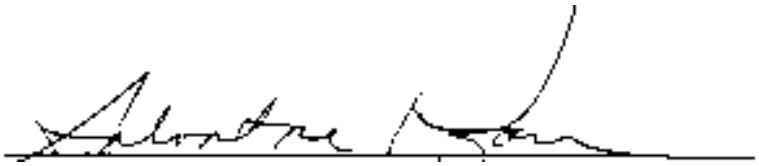
3. Stormwater Disposal - PBS regulations require that stormwater be uncontaminated and free of sheen prior to discharge. Any contaminated stormwater discharge must be permitted under SPDES and must meet permit conditions of the Department. Stormwater which is contaminated must be treated to reduce oil and grease concentration to 15 ppm or less using the freon extraction method, ie., Liquid-Liquid Extraction with trichlorotrifluoroethane method (Federal Register Vol. 38. No. 199, Part II, Title 40, Part 136).

   TOGS 1.3.7, "Analytical Detectability and Quantitation Guidelines For Selected Environmental Parameters" makes reference to the following two additional acceptable methods for measuring oil and grease:

   – "Methods for Chemical Analysis of Water and Wastes" USEPA 600/4-79-020, US. Environmental Protection Agency, March 1979 (Method 413.1)

   – "Standard Methods For The Examination of Water And Wastewater", 16th edition, American Public Health Association, American Water Works Association, Water Pollution Control Federation (Method 503A)

   In addition, any visible sheen must be removed prior to discharge.



Salvatore Pagano, P.E.
Director
Division of Water

2-2.3.3 Impounding Around Tanks by Diking. When protection of adjoining property or waterways is by means of impounding by diking around the tanks, such system shall comply with the following:

(a) A slope of not less than 1 percent away from the tank shall be provided for at least 50 ft (15 m) or to the dike base, whichever is less.

(b) The volumetric capacity of the diked area shall not be less than the greatest amount of liquid that can be released from the largest tank within the diked area, assuming a full tank. To allow for volume occupied by tanks, the capacity of the diked area enclosing more than one tank shall be calculated after deducting the volume of the tanks, other than the largest tank, below the height of the dike.

(c) To permit access, the outside base of the dike at ground level shall be no closer than 10 ft (3 m) to any property line that is or can be built upon.

(d) Walls of the diked area shall be of earth, steel, concrete, or solid masonry designed to be liquidtight and to withstand a full hydrostatic head. Earthen walls 3 ft (0.90 m) or more in height shall have a flat section at the top not less than 2 ft (0.60 m) wide. The slope of an earthen wall shall be consistent with the angle of repose of the material of which the wall is constructed. Diked areas for tanks containing Class I liquids located in extremely porous soils may require special treatment to prevent seepage of hazardous quantities of liquids to low-lying areas or waterways in case of spills.

(e) Except as provided in (f) below, the walls of the diked area shall be restricted to an average interior height of 6 ft (1.8 m) above interior grade.

(f) Dikes may be higher than an average of 6 ft (1.8 m) above interior grade where provisions are made for normal access and necessary emergency access to tanks, valves and other equipment, and safe egress from the diked enclosure.

1. Where the average height of the dike containing Class I a liquids is over 12 ft 3.6 m) high, measured from interior grade, or where the distance between any tank and the top inside edge of the dike wall is less than the height of the dike wall, provisions shall be made for normal operation of valves and for access to tank roof(s) without entering below the top of the dike. These provisions may be met through the use of remote-operated valves, elevated walkways, or similar arrangements.

2. Piping passing through dike walls shall be designed to prevent excessive stresses as a result of settlement or fire exposure.

3. The minimum distance between tanks and toe of the interior dike walls shall be 5 ft (1.5 m).

(g) Each diked area containing two or more tanks shall be subdivided, preferably by drainage channels or at least by intermediate dikes in order to prevent spills from endangering adjacent tanks within the diked area as follows:

1. When storing normally stable liquids in vertical cone roof tanks constructed with weak roof-to-shell seam or floating roof tanks, or when storing crude petroleum in producing areas in any type of tank, one subdivision for each tank in excess of 10,000 bbls. and one subdivision for each group of tanks (no tank exceeding 10,000 bbls. capacity) having an aggregate capacity not exceeding 15,000 bbls.

2. When storing normally stable liquids in tanks not covered in subsection (1), one subdivision for each tank in excess of 2,380 bbls.(378,500 L) and one subdivision for each group of tanks [no tank exceeding 2,380 bbls. (378,500 L) capacity] having an aggregate capacity not exceeding 3,570 bbls.(567,750 L).

3. When storing unstable liquids in any type of tank, one subdivision for each tank except that tanks installed in accordance with the drainage requirements of NFPA 15, *Standard for Water Spray Fixed Systems for Fire Prevention*, shall require no additional subdivision. Since unstable liquids will react more rapidly when heated than when at ambient temperatures, subdivision by drainage channels is the preferred method.

4. Wherever two or more tanks storing Class I liquids, any one of which is over 150 ft (45 m) in diameter, are located in a common diked area, intermediate dikes shall be provided between adjacent tanks to hold at least 10 percent of the capacity of the tank so enclosed, not including the volume displaced by the tank.

5. The drainage channels or intermediate dikes shall be located between tanks so as to take full advantage of the available space with due regard for the individual tank capacities. Intermediate dikes, where used, shall be not less than 18 in. (45 cm) in height.

(h) Where provision is made for draining water from diked areas, such drains shall be controlled in a manner so as to prevent flammable or combustible liquids from entering natural water courses, public sewers, or public drains, if their presence would constitute a hazard. Control of drainage shall be accessible under fire conditions from outside the dike.

(i) Storage of combustible materials, empty or full drums, or barrels, shall not be permitted within the diked area.

Appendix B

Testing for
Petroleum Contamination

Method #1

Once a soil or water sample has been collected, it can be inspected in the field for a sheen, odor or monitored by field instruments. Intentional inhalation is not recommended. If there is evidence of contamination, no further analysis is necessary. If it passes, then samples should be sent to a certified laboratory for analysis.

In the lab, soil samples are evaluated for leaching of any petroleum products that might be in it. The first step is the preparation of liquid extracts, using the EP-Toxicity Extraction Procedure. This procedure can be found both in 40 CFR Part 261, Appendix II, or 6 NYCRR Part 371, Appendix 20. Once the extracts are prepared, a portion of each is tested for oil and grease using the Liquid - Liquid Extraction Method (Federal Register Volume 38, #199, Part II, Title 40, Part 136).

If the oil and grease level of the soil extracts or water sample exceeds 15.0 mg/1, the soil or water fails. If the sample contains 15 mg/1 or less, proceed to the final test.

For each sample that passes the oil and grease test, the extract or water sample receives a final test as follows with the pass/fail criteria indicated:

A. For soil or water that may be contaminated with gasoline or aviation fuel, test for volatile aromatic hydrocarbons by EPA method 602.

   i. Benzene: Not detectable.

   ii. Other aromatic hydrocarbons: The sum of all may not exceed 0.1 mg/1, and no individual compound may exceed 0.05 mg/1.

B. For soil or water that may be contaminated with kerosene, diesel fuel, fuel oil, or lubricating oil, test for polynuclear aromatic hydrocarbons (PHA) by EPA Method 610.

   i. Benzo (a) Pyrene: Not detectable.

   ii. Naphthalene: 0.01 mg/1.

   iii. Other PAHs: The sum total of all may not exceed 9.1 mg/1, and no individual compound may exceed 0.05 mg/1.1

Appendix C

Primary Aquifers in Upstate New York

Name of the Aquifer	USGS No.
Schenectady	OF Rpt. 82-84
Endicott/Johnson City	OF Rpt. 82-268
Ramapo/Mahwah River Valley	OF Rpt. 82-114
Irondogenesee Buried Valley	OF Rpt. 82-552
Jamestown	OF Rpt. 82-113
Big Flats/Horseheads/Elmira	OF Rpt. 82-110
Cortland	OF Rpt. 81-1022
Corning	OF Rpt. 82-85
Olean/Salamanca	WRI Rpt. 85-4157/85-4149
Fishkill/Sprout Creek	OF Rpt. 82-81
Clifton Park/Halfmoon	WRI Rpt. 84-4031
Owego/Waverly	Not Published
Fulton	OF Rpt. 82-83
Seneca River (Baldwinsville)	WRI Rpt. 85-4094
S. Fallsburgh/Woodbourne	OF Rpt. 82-112
Tonawanda Creek	WRI Rpt. 85-4096
Cohocton River	WRI Rpt. (Upper) 85-4040 (Lower) 83-4095
Croton-on-Hudson	Not published

STRIP MAPS

Finger Lakes	WRI Rpt. 87-4122
Adirondack	WRI Rpt. 87-4276
Hudson-Mohawk	WRI Rpt. 87-4275
Lower Hudson	WRI Rpt. 87-4274
Niagara	WRI Rpt. 88-4076

WRI Rpt. = Water Resources Investigations Report
OF Rpt. = Open File Report