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RCRA/UST, Superfund, & EPCRA Hotline Training Module

Introduction to: Land Disposal Units (40 CFR Parts 264/265, Subparts K, L, M, N)

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LAND DISPOSAL UNITS

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1. INTRODUCTION

Subtitle C of RCRA creates a cradle-to-grave management system for hazardous waste to ensure proper treatment, storage, and disposal in a manner protective of human health and the environment. Under RCRA §3004(a), Congress authorized EPA to promulgate regulations establishing design and operating requirements for land disposal units (LDUs). The requirements are intended to minimize pollution resulting from the disposal of hazardous waste in or on the land. The statute lists nine types of LDUs. Section 3004(k) of RCRA defines land disposal as placement of hazardous waste in any of the following:

- Landfill
- Surface impoundment
- Waste pile
- Injection well
- Land treatment facility
- Salt dome formation
- Salt bed formation
- Underground mine
- Underground cave

EPA has promulgated unit-specific technical standards for four of these LDUs within the treatment, storage, and disposal facility (TSDF) requirements of Parts 264/265. This module provides an overview of the requirements for these four LDUs: landfills, surface impoundments, waste piles, and land treatment units. LDUs that do not qualify as one of these units are considered miscellaneous units (see the "Miscellaneous Units" module for more details)

When you have completed this module, you will be able to summarize the land disposal standards and list the relevant statutory and regulatory citations. Specifically, you will be able to:

- Summarize the differences between interim status (Part 265) and permitted (Part 264) standards for land disposal units
- Find the definition of "surface impoundment" and distinguish surface impoundments from tanks
- Explain the connection between land disposal standards, post-closure, and groundwater monitoring
- Cite the statutory and regulatory minimum technological requirements
- Describe surface impoundment retrofitting and retrofitting variance procedures.

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Use this list of objectives to check your knowledge of this topic after you complete the training session.

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2. REGULATORY SUMMARY

Regulations governing surface impoundments, waste piles, land treatment units, and landfills appear under Subparts K through N of Parts 264/265. The standards for permitted and interim status units address, among other things, design and operating requirements, including a liner and a leachate collection and removal system (LCRS); closure and post-closure requirements; and special standards for ignitable, reactive, and dioxin-containing wastes. In addition to these unit-specific requirements, LDUs managing hazardous waste are subject to the general facility standards found in Subparts A through E of Parts 264/265, as well as the appropriate groundwater monitoring, closure and post-closure, and financial assurance requirements.

For each unit, this module will address five different topic areas: design and operation, inspections, response actions, closure and post-closure, and special issues. Using these topic areas will enable the reader to compare and contrast the regulations for each unit.

2.1 SURFACE IMPOUNDMENTS

Subpart K of Parts 264/265 contains the design and operating standards for surface impoundments used to treat, store, or dispose of hazardous waste. Surface impoundments are very similar to landfills in that both units are either a natural topographic depression, man-made excavation, or diked area formed primarily of earthen materials, such as soil (although the unit may be lined with man-made materials). The units are, however, very different in their use. Surface impoundments are generally used for temporary storage or treatment, whereas a landfill is a designated area for final disposal. Therefore, while the design and operating standards are very similar, the closure and post-closure standards differ. More detail will follow in the applicable sections.

Most of the design, operating, and inspection requirements are in fact very similar for surface impoundments, waste piles, and landfills. The requirements are thus discussed in detail in this section, with successive sections referring to this section for specifics.

DESIGN AND OPERATION

In developing design and operation requirements for surface impoundments (as well as landfills and waste piles), EPA adopted a regulatory goal of minimizing the formation and migration of

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leachate to the adjacent subsurface soil, groundwater, or surface water.

The most comprehensive technical requirements for surface impoundments are the minimum technological requirements (MTRs) mandated by RCRA (§§3004(o)(1)(A) and 3004(o)(4)). These sections require a double liner, a leachate collection and removal system (LCRS) and a leak detection system (§§264.221(c) and 265.221(a)). The MTRs apply to all new units, lateral expansions, and replacement units for which construction (or reuse) commences after July 29, 1992. The double liner system consists of a top liner to prevent migration of hazardous constituents into the liner and a composite bottom liner consisting of a synthetic geomembrane and three feet of compacted soil material. The unit must also be equipped with an LCRS, which also serves as the leak detection system. The LCRS, along with the leak detection system drainage layers, must be designed with a bottom slope of at least one percent, be made of materials chemically resistant to the wastes placed in the unit, and be able to remove the liquids at a specified minimum rate. The LCRS itself must be designed to collect liquids in a sump and subsequently pump out those liquids. In addition to the performance and design requirements, the LCRS must be located between the liners immediately above the bottom composite liner. This location standard should enable the LCRS to collect the largest amount of leachate, while also representing the most efficient place to identify leaks.

Existing units are subject only to the single liner requirements (§264.221(a)). In addition, a surface impoundment must be designed to prevent the flow of liquids over the top of an impoundment (or overtopping) and ensure the structural integrity of any dikes.

Section 264.222 requires that the owner or operator establish a leachate flow rate, called the action leakage rate (ALR), for each regulated unit. Based on site-specific considerations, the owner or operator must identify an ALR that will indicate that the system is not functioning properly.

No design criteria will be effective if the impoundment is installed improperly or uses inferior materials. To ensure that a surface impoundment meets all technical criteria, EPA requires a construction quality assurance (CQA) program (see the "TSDFs" module). The CQA program requires a CQA plan which identifies how construction materials and their installation will be monitored and tested and how the results will be documented (§264.19). The CQA program is developed and implemented under the direction of a registered professional engineer, who must also certify that the CQA plan has been successfully carried out

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and that the unit meets all specifications before any waste may be received in the unit.

INSPECTION

Inspection requirements are found under two sections of regulations. First, the owner/operator of the surface impoundment must inspect the leak detection sump to measure the amount of liquid in the sump and determine whether the ALR has been exceeded. If a leak which causes the system flow rate to exceed the ALR occurs, the owner or operator must notify the Agency and respond in accordance with the response action plan (§§264/265.223).

Whereas the first requirement is meant to ensure that the unit is meeting performance requirements, the second inspection requirement addresses the design and structural integrity of the unit (§§264/265.226). Basically, the owner/operator must inspect liners and covers for any problems after construction or installation and continue inspections weekly and after storms to monitor for evidence of deterioration, malfunctions, improper operation of overtopping systems, sudden drops in the level of the impoundment contents, and severe erosion of dikes and other containment devices. Owners/operators must also monitor leak detection sumps at least once a week. This final inspection requirement, which is also used to check the ALR requirement, is designed to verify that the pump used to drain liquids from the sump is working properly.

RESPONSE ACTIONS

There are also two different types of response actions for the design and performance of the unit. The response action for the performance of the unit is determined by the terms of the response action plan, triggered when the ALR has been exceeded (§§264/265.223). If the action leakage rate has been exceeded, the owner/operator must: notify the Regional Administrator; determine what short term actions must be taken (e.g., shut down of the facility for repairs); determine the location, size, and cause of any leak; and send the assessments to the Region.

There are also emergency repair provisions for unit design failure at permitted facilities only (§264.227). Essentially, if there is positive indication of a failure of the containment system (e.g., a sudden drop in the level of the contents when the drop is not attributable to changes in the flow in or out of the impoundment), the surface impoundment must be removed from service. When this occurs, the owner/operator must follow the procedures in the contingency plan, including any necessary emergency repairs.

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CLOSURE

Closure of a hazardous waste surface impoundment can take one of two forms. The first option, called clean closure, requires for the owner/operator to remove or decontaminate all wastes and unit components at closure (§§264/265.228(a)(1)). If the unit cannot be clean-closed, then the owner/operator must employ the second alternative. Under this approach, wastes are left in place and stabilized, free liquids are removed, and a cap or cover is placed on top of the waste. Since surface impoundments are generally used for storage, the second option is equivalent to closing as a landfill (which is always a final resting place of hazardous wastes) and also requires the operator to take certain precautions for a certain time period after closure (known as post-closure care (§§264/265.228(a)(2) and (b)).

REGULATIONS FOR SPECIAL WASTES

The regulations place special requirements on surface impoundments that handle ignitable or reactive wastes because these wastes require continuing protection from conditions that could cause them to ignite or react (§§264/2 65.229).

Additionally, §§264/265.230 prohibit the placement of incompatible waste or materials, as described in Appendix V of Parts 264/265, in the same surface impoundment unless certain precautions are taken.

Further, if an owner/operator of a surface impoundment plans to manage dioxin-containing waste (F020, F021, F022, F023, F026, and F027), they must employ a special management plan approved by the Regional Administrator (§264.231). These wastes can only be disposed of in a permitted surface impoundment.

SURFACE IMPOUNDMENT RETROFITTING

Owner/operators of newly-regulated surface impoundments have four years to upgrade the units to meet MTR while continuing to manage wastes that contain (or generate) newly identified or listed wastes. The statute contains conflicting language regarding the timing of surface impoundment retrofitting. RCRA §3005(j)(6) provides a retrofitting period lasting for four years from the promulgation of a new listing or waste identification. This conflicts with §3004(j)(11), which states that wastes subject to land disposal restrictions treatment standards may only be placed in an impoundment if the unit meets MTR. This would effectively limit the retrofitting period to roughly one year (including the maximum of six months for EPA to promulgate Part 268 treatment standards for newly identified or listed wastes, as required under §3004(g)(4), plus the standard six months before treatment

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standards become effective). RCRA §3005(h)(4) also conflicts with §3004(j)(6), by stating that wastes subject to a national capacity variance may only be placed in units which meet MTR. Thus, §§3005(j)(11) and 3004(h)(4) apparently curtail the four-year retrofitting period by precluding non-MTR impoundments from managing prohibited wastes, including wastes subject to national capacity variances.

To resolve these conflicts, EPA clarified on August 18, 1992 (57 FR 37194), that owner/operators of surface impoundments have four years from the promulgation of a new listing or waste identification to retrofit the unit, regardless of whether or not EPA promulgates treatment standards for the wastes in question or issues a national capacity variance within the four-year retrofitting period. For example, owner/operators of surface impoundments brought under regulation by the promulgation of the F037 and F038 listings need not retrofit or close the affected units until November 2, 1994, although land disposal restriction (LDR) treatment standards for F037 and F038 sludges will have become effective prior to that date.

SURFACE IMPOUNDMENT VS. TANK

The definitions of surface impoundment and tank are very similar and tend to create confusion. The major difference in the two definitions is what provides the structural support to the unit. Surface impoundments are supported by earthen materials while tanks are supported by non-earthen materials (e.g., wood, concrete, steel, plastic). In determining whether a unit is supported by earthen or non-earthen material, it should be evaluated as if it were free-standing and filled to its design capacity. If the unit can maintain its structural integrity it is considered a tank. If the unit cannot retain its structural integrity, it is considered a surface impoundment.

2.2 WASTE PILES

Regulations governing the management of hazardous waste in waste piles are found in Parts 264/265, Subpart L. Waste piles, which are essentially non-containerized piles of solid, nonflowing hazardous waste, are temporary units, for storage or treatment only (§260.10). Because waste piles are temporary units, not intended for final disposal of wastes, Subpart L does not contain post-closure care regulations for waste piles that are closed with waste in place; such units are considered permanent or disposal units, and are subject to post-closure regulation as landfills (see Section 2.4).

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Owners/operators of permitted waste piles that meet special requirements are subject to reduced regulations. Specifically, the waste pile must be located inside or under a structure and not receive free liquid, be protected from surface water run-on, be designed and operated to control dispersal of waste, and be managed to prevent the generation of leachate. If these standards are met, the owner/operator of the permitted waste pile is exempt from groundwater monitoring requirements as well as the design and operation requirements for waste piles.

DESIGN AND OPERATION

Waste piles are subject to nearly the same MTRs as surface impoundments. Specifically, new units, lateral expansions, and replacement units require a double liner and LCRS (§§264.251(c) and 265.254). In addition, waste piles, with certain exceptions, require a second leachate collection and removal system above the top liner. If the permitted waste pile is not subject to MTR (i.e., a unit, lateral expansion, or replacement for which construction commenced before July 29, 1992), then the unit is subject to a single liner and basic LCRS requirements. Interim status waste piles that are not subject to MTR are subject only to liner, run-on, and run-off controls if leachate or run-off is found to be a hazardous waste.

Permitted waste piles are subject to stormwater run-on and run-off controls to minimize leachate generation during storms (§§264.251(g),(h) and (i)). These requirements are designed to keep stormwater from contacting the hazardous wastes and to keep any contaminated stormwater from being released into the environment. Owners/operators of waste piles must also cover or manage their wastes to prevent any wind dispersal. Interim status waste piles are not subject to the stormwater controls, but are subject to wind dispersal provisions (§265.251).

INSPECTION AND RELEASE RESPONSE

Waste piles are subject to the same inspection and release response requirements as surface impoundments. Specifically, waste piles are required to establish an ALR (§§264.252 and 265.255), a response action plan (§§264.253 and §265.259), monitoring and inspection schedule (§264.254), and a CQA plan (§§264/265.19). The interim status monitoring and inspection provision only requires the owner/operator of a waste pile meeting MTR to record the amount of liquids removed from the leak detection system sump at least once a week (§265.260). Note that waste piles are not subject to the emergency repair provisions for surface impoundments.

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CLOSURE

Since waste piles are storage, as opposed to disposal, facilities, all waste residues and contaminated subsoils and equipment must be removed or decontaminated at closure (§§264/265.258(a)). This requirement is identical to clean closure of a surface impoundment. If the owner or operator removes or decontaminates all waste residues and makes all reasonable efforts to remove or decontaminate all structures and soils and finds that some contamination remains, the waste pile will then be subject to the closure requirements for landfills, including post-closure care (§§264/265.258(b)).

Special Requirements For Certain Wastes

Waste piles are subject to the same specialized standards for ignitable, reactive, incompatible, and dioxin-containing waste as surface impoundments. These requirements are discussed in Section 2.1.

SPECIAL ISSUES

Containment Buildings

Containment buildings, sometimes characterized as "indoor waste piles," are units used to hold uncontainerized piles of hazardous waste. The difference between waste piles and containment buildings, from a regulatory standpoint, is that containment buildings are not land disposal units. For this reason, containment buildings are designed with a containment system rather than a liner and leak detection system (Parts 264/265, Subpart DD). The "Containment Buildings" module provides more information about the standards that apply to containment buildings.

2.3 LANDFILLS

Since landfills serve as final disposal for a large portion of the nation's hazardous waste, it is critical that they are monitored during the entire active life (which includes closure) and the post-closure period. The regulations concerning hazardous waste landfills are promulgated as Subpart N of Parts 264/265.

DESIGN AND OPERATION

Landfills are subject to virtually the same MTRs as surface impoundments and waste piles. They must have a double-liner, LCRSs, leak detection (§§264/265.301), and an ALR

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(§§264/265.302). Like waste piles, landfills require the second LCRS above the top liner. In addition, landfills must have stormwater run-on and run-off controls to prevent migration of hazardous constituents for at least a 25-year storm, and a cover to prevent wind dispersal.

INSPECTION AND RESPONSE ACTIONS

Once again, the inspection and response action plans are almost identical to the requirement for surface impoundments, including a response action plan (§§264.304 and 265.303), if the ALR is exceeded, and a CQA program (§§264/265.19). In addition, the owner/operator of a hazardous waste landfill must perform monitoring and inspections (§§264.303 and 265.304). As with surface impoundments and waste piles, these requirements ensure that the unit is maintained in good working condition and that any problems are promptly detected.

Since landfills typically serve as permanent disposal sites, the closure and post-closure requirements for landfills are somewhat different from those for other land-based units. The requirements for a final cover that can provide long-term minimization of migration of liquids through the closed landfill, promote drainage, accommodate settling, and function with a minimum amount of maintenance (§§264/265.310(a)). After closure, the owner or operator must comply with the post-closure requirements of §§264/265.117 through 264/265.120 covering such actions as monitoring and maintenance (see the "Closure/Post-Closure" module). In addition, the owner/operator must maintain the final cover, leak detection system, and groundwater monitoring system, as well as prevent run-on and run-off from damaging the final cover, and protect the surveyed benchmarks (i.e., location and characteristics) of the landfill.

Special Requirements For Certain Wastes

Like surface impoundments and waste piles, landfills are subject to certain restrictions on the management of ignitable, reactive, incompatible, and dioxin-containing wastes. Unlike other units, though, the placement of bulk or noncontainerized liquid hazardous waste or hazardous waste containing free liquids in any landfill is prohibited (§§264/265.314(b)). The placement of nonhazardous liquids in a landfill is also essentially prohibited (§§264.314(e) and 265.314(f)). There are only certain situations when containers holding free liquids can be placed in a landfill (e.g., small containers such as ampules, containers that are products such as batteries, or lab packs) (§§264.314(d) and 265.314(c)). If sorbents are used to treat hazardous wastes so that the waste no longer contains free liquids, the owner/operator must use nonbiodegradable sorbents.

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Special Requirements For Certain Containers

To prevent significant voids that could cause collapse of final covers when containers erode and to maintain and extend available capacity in hazardous waste landfills, containers placed in a landfill must be either at least 90 percent full or crushed, shredded, or in some other way reduced in volume, unless they are very small, such as ampules (§264.315).

Finally, there are special standards for labpacks or overpacked drums being placed in a landfill (§§264./265.316). Labpacks generally contain small containers of a wide variety of hazardous wastes in relatively small volumes that are packed in sorbent material to prevent leaking. This sorbent material must be nonbiodegradable.

2.4 LAND TREATMENT UNITS

While surface impoundments, waste piles, and landfills share many regulatory standards, land treatment units (LTUs) are significantly different both in purpose and in management. Land treatment involves the application of waste on the soil surface or the incorporation of waste into the upper layers of the soil in order to degrade, transform, or immobilize hazardous constituents present in hazardous waste. Essentially, the waste is treated within the matrix of the surface soil, whereas the major goal of the other units is to prevent migration to the surface soil. Specifically, the waste must be placed only in the unsaturated zone, which is the portion of the surface soil above the water table (or the highest point of the groundwater flow) Based upon the proximity to the groundwater, the success of land treatment is highly dependent on the operational management of the unit.

Because the goal of land treatment is to let the soil microbes and sunlight degrade the hazardous waste, the design and operating standards are significantly different from those imposed on the three types of units already covered. Land treatment units generally do not use impermeable liners to contain wastes. Instead, units rely on the physical, chemical, and biological processes occurring in the top soil layers. In a sense, these units can be viewed as an open system.

Maintenance of proper soil pH, careful management of waste application rate, and control of surface water run-off are all key to the operation of a land treatment unit. The regulations concerning hazardous waste land treatment units are promulgated in Subpart M of Parts 264/265.

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Because placement of hazardous waste in a land treatment unit is considered land disposal, LDR standards must be considered. If the hazardous waste does not meet the applicable treatment standard prior to placement in the land treatment unit, the unit owner or operator must obtain a no-migration variance before applying any hazardous waste to the unit. See the "Land Disposal Restrictions" module for more details concerning the LDR standards and no-migration variances.

DESIGN AND OPERATION

Land treatment units must devise a program and demonstrate its effectiveness given the design of the unit and characteristics of the area. In addition, the regulations set out specific operating requirements that must be met in the treatment program. The following discussion details these requirements.

Treatment Program and Demonstration

The requirements outlined in the treatment program, including design and operating criteria and unsaturated zone monitoring, stem from a treatment demonstration. The purpose of the treatment demonstration is to show that hazardous constituents in the waste can be completely degraded or immobilized in the treatment unit. A treatment demonstration may involve field testing on a sample soil plot or laboratory testing. The Regional Administrator uses information provided by the treatment demonstration to set permit standards. Interim status units are not required to establish a treatment program because the interim status regulations are self-implementing. However, owners/operators can only place hazardous waste in the LTU if the waste will be rendered non-hazardous or less hazardous (§265.272(a)).

During the treatment demonstration, the owner/operator must establish the following parameters:

1) Specify the wastes that may be handled at the unit. In general, land treatment is confined to wastes that are primarily organic and that can be greatly reduced in volume by physical, chemical, and biological decomposition in surface soils. The owner/operator must be able to account for smaller fractions of heavy metals and persistent organic compounds by immobilizing those constituents.

2) Formulate a set of operating measures. The LTU must be operated in a manner that will maximize degradation, transformation, and immobilization of hazardous waste

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constituents. The specifics of the operation are discussed in the following section of this module.

3) Establish unsaturated zone monitoring. The purpose of this program is to make sure that treatment is occurring within the treatment zone, and that all hazardous constituents are being adequately treated. The information provided from the monitoring can help the owner/operator "fine tune" the treatment process to maximize the success of the treatment. Unsaturated zone monitoring involves soil monitoring (e.g., obtaining soil samples) immediately below the treatment zone.

4) Define the treatment zone. This zone is comprised of the horizontal and vertical dimensions of the unsaturated zone in which the owner/operator intends to perform the actual treatment. The zone can be no deeper than 1.5 meters (5 feet) and the bottom of the zone must be at least one meter (3 feet) from the seasonal high water table.

Operation

Basic design and operating requirements are outlined in §§264.273 and 265.272. These sections require the Regional Administrator to specify certain parameters in the facility permit:

- Rate and method of application
- Measures to control soil pH
- Measures to enhance microbial and chemical reactions
- Measures to control the moisture content of the treatment zone.

In addition, land treatment units are subject to requirements for stormwater run-on and run-off controls. Management to control wind dispersal and weekly inspections are also required.

Food Chain Crops

In some cases, an owner/operator may grow food-chain crops on a land treatment unit (§§264/265.276). The Agency believes that this can be done safely if certain conditions are met that require the owner or operator to demonstrate that hazardous constituents are not present in the crop in abnormally high concentrations. Additionally, if cadmium is present in the unit, the owner/operator must comply with additional management standards specified under §§264/265.276(b).

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INSPECTIONS AND RESPONSE ACTIONS

Although there are no requirements to inspect the unit, the owner/operator must maintain unsaturated zone monitoring to assure that the unit is meeting its performance standards (§§264/265.278).

As discussed earlier, the purpose of unsaturated zone monitoring is to provide feedback on the success of treatment in the treatment zone and to determine if hazardous constituents are migrating out of the treatment zone (i.e., the monitoring program must be designed to determine the presence of hazardous constituents below the treatment zone). Generally this means that the owner/operator would monitor for the most stable hazardous constituents found in the wastes placed in or on the treatment zone. Keep in mind that unsaturated zone monitoring is not a substitute for groundwater monitoring. Both are required for land treatment units.

To perform unsaturated zone monitoring, the owner/operator must first establish which constituents must be monitored and the background levels of those constituents in the soil. The frequency of the monitoring is based upon the elements of the operation of the LTU, such as the frequency, timing, and rate of application of the waste. Once the samples have been taken, the owner/operator must determine whether there is a statistically significant change over the background values (i.e., the natural constituent levels in the soil) for any hazardous constituent. If there is a statistically significant increase in the hazardous constituents of concern, the owner/operator must notify the Regional Administrator within seven days, and submit a permit modification within 90 days to change the operating practices at the facility to sufficiently treat hazardous constituents within the treatment zone.

CLOSURE

When a land treatment unit is being closed, the owner/operator maintains all operating parameters to continue the treatment processes, and continues run-on and run-off controls and unsaturated zone monitoring. The major element of the closure procedure is placing a vegetative cover over the closing unit that is capable of maintaining growth without extensive maintenance. At completion of closure the owner or operator may submit the closure certification by an independent qualified soil scientist in lieu of an independent registered professional engineer. Closure and post-closure are waived if the hazardous constituents in the treatment zone no longer exceed background levels.

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Special Requirements for Certain Wastes

Like other LDUs, land treatment units are subject to limitations regarding ignitable, reactive, incompatible, and dioxin-containing wastes (§§264/265.281-.283).

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