Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

WASTE TREATMENT LAGOON

Code 359

(No)

DEFINITION

A waste treatment impoundment made by constructing an embankment and/or excavating a pit or dugout.

PURPOSE

This practice is applied for one or more of the following purposes:

- Reduce nitrogen, phosphorus, and biological oxygen demand of the effluent
- Reduce manure odors

CONDITIONS WHERE PRACTICE APPLIES

Use where storage and treatment is needed for organic wastes generated by agricultural production or processing and where soils, geology, and topography are suitable for construction of the facility. For reception pits, use NRCS Conservation Practice Standard (CPS) Waste Transfer (Code 634).

For liquid waste storage facilities implemented with an embankment, this practice applies only to low hazard structures as defined in NRCS 210-National Engineering Manual (NEM), Part 520, Subpart C, Section 520.23, “Classification.”

This practice does not apply to the storage or treatment of human waste or animal mortality.

CRITERIA

General Criteria Applicable to Purposes.

Laws and regulations. Plan, design, and construct the waste treatment lagoon to meet all Federal, State, and local laws and regulations.

Location. Locate and design the waste treatment lagoon such that it is outside the 100-year floodplain unless site restrictions require locating it within the floodplain. If located in the floodplain, protect the facility from inundation or damage from a 25-year-flood event. Additionally, follow the policy found in NRCS 190-General Manual (GM), Part 410, Subpart B, Section 410.25, “Flood Plain Management,” that may require providing additional protection for storage structures located within the floodplain.

Storage period. The storage period is the maximum length of time anticipated between emptying events. Base the minimum storage period on the timing required for environmentally safe waste utilization considering the nutrient management plan. Base daily waste loading on the maximum daily loading anticipated. Include all waste sources to be treated by the lagoon. Use reliable local information or laboratory test data if available. If local information is not available, NRCS 210-National Engineering

Handbook (NEH), Part 651, Agricultural Waste Management Field Handbook (AWMFH), Chapter 4, "Agricultural Waste Characteristics" may be used for estimating waste loading.

Design volume. Size the facility to contain the following as appropriate:

Operational volume

- Manure, wastewater, bedding, and other wastes accumulated during the storage period.
- Minimum treatment volume (MTV) for anaerobic lagoons only.
- Normal precipitation less evaporation during the storage period.
- Normal runoff from the facility's drainage area during the storage period.
- Planned maximum residual solids. Provide a minimum of 6 inches for tanks unless there is a sump or other device allows complete emptying.
- Additional storage when required to meet management goals or regulatory requirements.

Emergency volume

- 25-year, 24-hour precipitation on the surface area within the top edges of the confining structure
- 25-year, 24-hour runoff from the facility's drainage area

Freeboard volume

Minimum of 12 inches

Exclude nonpolluted runoff from the structure to the fullest extent practical except where including the runoff is advantageous to the operation of the agricultural waste management system.

Inlet. Design inlet to resist corrosion, plugging, freeze damage, and ultraviolet deterioration. Incorporate erosion protection as necessary.

Waste removal. Provide components for removing waste such as gates, pipes, docks, wet wells, pumping platforms, retaining walls, or ramps. Incorporate features to protect against erosion, tampering, and accidental release of stored waste as necessary. Design ramp slopes to accommodate anticipated equipment and traction available. Use NRCS CPS Nutrient Management (Code 590) for land application of stored material or follow other disposal options outlined in a comprehensive nutrient management plan (CNMP).

Accumulated solids removal. To preserve lagoon storage volume, make provision for periodic removal of accumulated solids. The anticipated method for solids removal must be accommodated in design, particularly in determining the configuration of impoundments and the type of liner to be used.

Maximum operating level. The maximum operating level for liquid storage lagoon structure is the level that provides the operational volume.

Staff gauge. Place a staff gauge or other permanent marker in the waste treatment lagoon to clearly indicate the following elevations:

- Maximum operating level (top of the operational volume)
- Emergency level (top of the operational volume plus the emergency volume)
- Minimum operating level (maximum operational drawdown level that provides MTV for anaerobic lagoons plus the volume of accumulated sludge between sludge removal events)

For lagoons where the contents are not visible and a staff gauge would not be visible, identify the method for the operator to measure the depth of accumulated waste in the operation and maintenance (O&M) plan.

Safety. Include appropriate safety features to minimize the hazards of the facility (refer to American Society of Agricultural and Biological Engineers (ASABE) Standard EP470, Manure Storage Safety, for guidance).

Provide warning signs, fences, ladders, ropes, bars, rails, and other devices as appropriate, to ensure the safety of humans and livestock. Provide ventilation and warning signs for covered lagoons, as necessary, to prevent explosion, poisoning, or asphyxiation.

Design covers and grating over openings such that livestock or humans cannot accidentally displace them and fall into the facility.

Design pipelines with a water-sealed trap and vent, or similar device, if there is a potential for gases from the pipe to accumulate in confined spaces.

Place a fence around impoundments. Use NRCS CPS Fence (Code 382) for design of a fence that will prevent accidental entry by people or animals likely to be onsite. Post universal warning signs to prevent children and others from entering the lagoon.

Roofs and covers. Use NRCS CPS Roofs and Covers (Code 367) for design of the lagoon cover or roof, as needed.

Treated wood. Use criteria from NRCS CPS Roof and Covers (Code 367) for treated wood and fasteners.

Design bottom elevation. Locate the impoundment bottom elevation a minimum of 2 feet **(measured from the outside of earthen liners)** above the seasonal high water table unless special design features are incorporated that address buoyant forces, impoundment seepage rate and nonencroachment of the water table by contaminants. The water table may be lowered by use of drains to meet this requirement.

Structural design. Use criteria from NRCS CPS Waste Storage Structure (Code 313) for embankment, excavation, spillway, foundation, outlet, and structural design.

Seepage control. Where seepage will create a potential water quality problem, provide a liner which meets the requirements of NRCS CPSs Pond Sealing or Lining - Compacted Soil (Code 520), Pond Sealing or Lining – Concrete (Code 522), or Pond Sealing or Lining – Geomembrane or Geosynthetic Clay Liner (Code 521). **NOTE:** NRCS CPS Code 521 is included in this Federal Register notice and will replace the current CPS Pond Sealing or Lining - Flexible Membrane (Code 521a).

Additional Criteria for Anaerobic Lagoons

Loading rate. Design anaerobic lagoons to have an MTV based on the volatile solids (VS) loading per unit of volume. Use actual loading rate data if available. Otherwise, follow the maximum loading rates in NRCS AWMFH, Figure 10-27, or State regulatory requirements, whichever is more stringent.

Minimum operating level. Provide a minimum operating level (also referred to as the maximum operational drawdown) that provides volume for the required MTV plus the volume of accumulated sludge between sludge removal events. The proper operating range of the lagoon is above the maximum operational drawdown level and below the maximum operating level. Waste lagoons can be drawn down for sludge removal as described in the O&M plan.

Depth requirements. The minimum depth for the planned maximum residual solids plus the minimum treatment volume is 6 feet. If subsurface conditions prevent practicable construction to accommodate the minimum depth at maximum operational drawdown, a lesser depth may be used if the volume requirements are met.

Additional Criteria for Naturally Aerobic Lagoons

Loading rate. Design naturally aerobic lagoons to have a minimum treatment surface area as determined on the basis of daily BOD5 loading per unit of lagoon surface. The required minimum treatment surface area is the surface area at maximum sludge storage. The maximum loading rate is as indicated by AWMFH Figure 10-30 or according to State regulatory requirements, whichever is more stringent.

Depth requirements. Use a maximum operating level of between 2 and 5 feet **(AWMFH Figure 10-29)**.

Additional Criteria for Mechanically Oxygenated Lagoons

Loading rate. Design mechanically oxygenated waste treatment lagoons on the basis of daily BOD5 loading and oxygenation equipment manufacturer's performance data for oxygen transfer and mixing. Select oxygenation equipment to provide a minimum of 1 pound of oxygen for each pound of daily BOD5 loading.

Operating levels. The maximum operating level is the lagoon level that provides the required lagoon volume and must not exceed the site and oxygenation equipment limitations. The proper operating range of the lagoon is below the maximum operating level and above the minimum treatment elevation established by the manufacturer of the oxygenation equipment. **For this, special design is allowed that foregoes AWMFH Figure 10-29 as per the capacity of the oxygenation equipment and manufacturer's recommendations for design and proper operation.** Waste lagoons can be drawn down for sludge removal as described in the O&M plan.

CONSIDERATIONS

For exposed liners utilizing high-density polyethylene (HDPE) or similar materials that are slippery when wet, consider the use of textured liners or addition of features such as tire ladders that would allow for escape from the waste storage structure.

Consider solid/liquid separation of runoff or wastewater entering impoundments to minimize the frequency of accumulated solids removal and to facilitate pumping and application of the stored waste.

Since the economics and risks associated with waste treatment lagoons are quite high, consider providing the operator with the cost to close the facility. Cost should include removal of the planned sludge accumulation volume and the waste stored at the maximum operating volume. See NRCS CPS Waste Facility Closure (Code 360) for guidance.

Consider the required energy usage of any mechanically oxygenated lagoon since energy usage can be quite high.

Considerations for Siting

Consider the following factors in selecting a site for waste treatment lagoons:

- Proximity of the waste treatment lagoon to the source of waste
- Access to other facilities
- Ease of loading and unloading waste
- Compatibility with the existing landforms and vegetation, including building arrangement, to minimize odor impacts and adverse impacts on visual resources
- Adequate maneuvering space for operating, loading, and unloading equipment
- If the site is within a known karst area

Considerations for Minimizing the Potential for and Impacts of Sudden Breach of Embankment or Accidental Release from the Waste Treatment Lagoon.

Consider features, safeguards, and management measures to minimize the risk of failure or accidental release, or to minimize or mitigate impact of this type of failure when any of the categories listed below might be significantly affected.

Potential impact categories from breach of embankment or accidental release include—

- Surface water bodies—perennial streams, lakes, wetlands, and estuaries.
- Critical habitat for threatened and endangered species.
- Riparian areas.
- Farmstead, or other areas of habitation.
- Off-farm property.
- Historical and archaeological sites or structures that meet the eligibility criteria for listing in the National Register of Historical Places.

Either singly or in combination to minimize the potential of or the consequences of sudden breach of embankments, consider—

- An auxiliary (emergency) spillway.
- Additional freeboard.
- Storage **and planned utilization thresholds for a** wet year rather than normal year precipitation.
- Reinforced embankment— such as, additional top width, flattened, and armored downstream side slopes.
- Secondary containment.
- Double liners.

Options to consider to minimize the potential for accidental release from the waste treatment lagoon through gravity outlets include—

- Outlet gate locks or locked gate housing.
- Secondary containment.
- Alarm system.
- Another nongravity means of emptying the waste treatment lagoon.

Considerations for Minimizing the Potential of Waste Treatment Lagoons Liner Failure.

Avoid sites with categories listed below unless no reasonable alternative exists.

Potential impact categories for liner failure are—

- Any underlying aquifer is at a shallow depth and not confined.
- The vadose zone is rock **(a main concern is when the rock is fissured)**.
- The aquifer is a domestic water supply or ecologically vital water supply.
- The site is located in an area of water soluble bedrock such as limestone or gypsum.

For a site with one or more of these site conditions, consider providing a leak detection system in conjunction with the planned liner to provide an additional measure of safety **(Washington State Department of Ecology requires that leak detection be included in all synthetic liner systems)**.

Considerations for Improving Air Quality

Liquid manure storage may result in emissions of volatile organic compounds, ammonia, hydrogen sulfide, methane, nitrous oxide, and carbon dioxide.

To reduce emissions of greenhouse gases, ammonia, volatile organic compounds, particulate matter, and odor, other NRCS CPSs such as Anaerobic Digester (Code 366), Roofs and Covers (Code 367), Waste Treatment (Code 629), Amendments for Treatment of Agricultural Waste (Code 591), Composting Facility (Code 317), Waste Separation Facility (Code 632), and Air Filtration and Scrubbing (Code 371) can be added to the waste management system.

Adjusting pH below 7 may reduce ammonia emissions from the waste treatment lagoon but may increase odor when waste is surface-applied—see NRCS CPS Nutrient Management (Code 590).

Some fabric and organic covers have been shown to be effective in reducing odors.

PLANS AND SPECIFICATIONS

Prepare plans and specifications that describe the requirements for applying the practice to achieve its intended use. As a minimum, include the following in the engineering plans and specifications:

- Plan view of system layout
- Structural details of all components, including reinforcing steel, type of materials, thickness, anchorage requirements, lift thickness
- Locations, sizes, and type of pipelines and appurtenances
- Requirements for foundation preparation and treatment
- Vegetative requirements
- Quantities
- Approximate location of utilities and notification requirements
- Details of signage, fencing, and other safety features, as needed

OPERATION AND MAINTENANCE

Develop an O&M plan that is consistent with the purposes of the practice, its intended life, safety requirements, and the criteria for its design. At a minimum, the plan will contain where appropriate—

- Operational requirements for emptying the waste treatment lagoon including the expected storage period. Begin removal of the liquid from the waste treatment lagoon as soon as practical after the maximum operating level has been reached. Also include the requirement that waste be removed from the lagoon and utilized at locations, times, rates, and volume in accordance with the overall waste management system plan.
- Include an explanation of the staff gauge or other permanent marker to indicate the maximum operating level and the maximum operational drawdown.
- A provision for emergency removal and disposition of liquid waste in the event of an unusual storm event that may cause the waste treatment lagoon structure to fill to capacity prematurely.
- Instructions as needed for ventilating confined spaces according to ASABE standard S607, Venting Manure Storages to Reduce Entry Risk.
- An emergency action plan for lagoons where there is a potential for significant impact from breach or accidental release. Include site-specific provisions for emergency actions that will minimize these impacts.
- A description of the routine maintenance needed for each component of the facility. Also include provisions for maintenance that may be needed as a result of waste removal or material deterioration.
- Instructions for keeping records on sludge accumulation and removal of sludge when the sludge accumulation reaches the maximum residual solids storage level.

Additional O&M requirements for Anaerobic Lagoons

- Include instructions for anaerobic lagoons for including a precharging volume at lagoon startup or following sludge removal. Precharge the anaerobic lagoon with fresh water equal to the MTV prior to volatile solids loading.
- Provide instruction on timing removal and spreading of wastewater in a manner that will reduce odor

released.

REFERENCES

American Society of Agricultural and Biological Engineers. 2011. Manure Storage Safety. ANSI/ASAE EP470. 1 FEB 2011 (R2011). ASABE, St. Joseph, MI.

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