NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

WASTE STORAGE FACILITY

(No.)
Code 313

DEFINITION

A waste storage impoundment made by constructing an embankment and/or excavating a pit or dugout, or by fabricating a structure.

PURPOSES

To temporarily store wastes such as manure, wastewater, and contaminated runoff as a storage function component of an agricultural waste management system.

CONDITIONS WHERE PRACTICE APPLIES

Where the storage facility is a component of a planned agricultural waste management system or comprehensive nutrient management plan.

Where temporary storage is needed for organic wastes generated by agricultural production or processing.

Where the storage facility can be constructed, operated, and maintained without polluting air or water resources.

Where site conditions are suitable for construction of the facility.

To facilities utilizing embankments with an effective height of 35 feet or less where damage resulting from failure would be limited to damage of farm buildings, agricultural land, or township and country roads.

To fabricated structures including tanks, stacking facilities, and pond appurtenances.

CRITERIA

General Criteria Applicable To All Purposes

Human waste shall not be discharged into the waste storage facility.

Laws and Regulations. Waste storage facilities shall be planned, designed, and installed to meet all federal, state, local, and tribal laws and regulations.

For livestock operations that are a Concentrated Animal Feeding Operation (CAFO) as defined by the Michigan Department of Environmental Quality (MDEQ) or are subject to a National Pollutant Discharge Elimination System (NPDES) permit, use the criteria in this practice standard except for elements where the NPDES requirements are more restrictive.

Location. To minimize the potential for contamination of streams, waste storage facilities should be located outside of floodplains. However, if site restrictions require location within a floodplain, they shall be protected from inundation or damage from a 25-year flood event, or larger if required by laws, rules, and regulations. Waste storage facilities shall be located so the potential impacts from breach of embankment, accidental release, and liner failure are minimized; and separation distances are such that prevailing winds and landscape elements such as building arrangement, landforms, and vegetation minimize odors and protect aesthetic values.

All field tile (subsurface drains) within 50 feet of a waste storage facility shall be removed and capped *or re-routed around the storage facility*. The distance shall be measured from the nearest point in the storage facility at the maximum operating level. This does not apply to drainage systems designed in accordance with the Water Table section of this standard.

The isolation distances between waste storage facilities and drinking water wells shall be as follows:

Well Type	Isolation Distance[1/]
Private [2/]	150 feet
Public - Type IIB and III [3/]	800 feet
Public - Type I and IIA [3/]	2,000 feet

[1/] The isolation distance for existing *public wells may be reduced where the conditions described in the Well Isolation Distance Worksheet apply. Well isolation distance should be maximized to the extent possible*

[2/] As defined by Part 127, 1978 PA 368, Michigan Public Health Code.

[3/] As defined by 1976 PA 399, Michigan Safe Drinking Water Act.

- *Type II wells are classified as any non-community public water supply. This may be further broken down into Type IIA which is a water supply with 25 or more employees and water use of 20,000 gallons per day or more, and Type IIB which is a water supply with 25 or more employees and water use less than 20,000 gallons per day.*
- *Type III public wells include Grade A dairy operations or farms with less than 25 non-family member employees.*

Additional Well Requirements. The NRCS State Conservation Engineer or non-NRCS professional engineer licensed in the State of Michigan may approve variances to the NRCS practice standard for isolation distances for Types IIB and III water wells with concurrence from the Michigan Department of Environmental Quality (MDEQ).

The local health department shall be provided a copy of the decision wherever a variance is used to reduce the well isolation distance less than identified in the table above from an existing well. Deviations from isolation distances authorized through issuance of well construction permits may incorporate additional criteria in accordance with the Michigan Safe Drinking Water Act (1976, PA 399) or Part 127, Water Supply and Sewer Systems of the Michigan Public Health Code (1978, PA 368).

Storage Period. The storage period is the maximum length of time anticipated between emptying events.

For livestock operations that are NOT a CAFO as defined by MDEQ and are NOT subject to a NPDES permit, the minimum storage period shall be:

- 6 months, or
- 6 months less the time period equivalent to the volume of manure spread on land suitable for winter application based on the Manure Application Risk Index (MARI) analysis for each field where winter application of manure is planned.

For livestock operations defined as a CAFO by MDEQ, the minimum storage period shall be 6 months.

For livestock operations applying for or currently covered by an NPDES permit, the minimum storage period shall be as required by the permit.

If livestock are in confinement less than 6 months, the duration of confinement may be used in lieu of 6 months in the minimum storage period criteria above.

Design Storage Volume. The design storage volume equal to the required storage volume shall consist of the total of the following, as appropriate:

(a) Manure, wastewater, bedding, and other wastes accumulated during the storage period.

(b) Normal (mean monthly) precipitation less evaporation on the surface area of the facility during the storage period.

(c) Normal (mean monthly) runoff from the facility's drainage area during the storage period.

(d) 25-year, 24-hour precipitation on the surface of the facility or 100-year, 24-hour precipitation on the surface of the facility for Swine, Poultry, and Veal CAFOs as defined by MDEQ; *populated from January 30, 2004 to January 19, 2009.*

(e) 25-year, 24-hour runoff from the facility's contributing drainage area or 100-year, 24-hour runoff from the facility's contributing drainage area for Swine, Poultry, and Veal CAFOs as defined by MDEQ *populated from January 30, 2004 to January 19, 2009.*

(f) Drifted snow accumulation. (Accumulation in excess of the precipitation that falls directly onto the structure surface.)

(g) Residual solids after liquids have been removed. A minimum of 6 inches shall be provided for tank fabricated structures. (This may be eliminated if a sump or other device that allows for complete emptying is included in the design.)

(h) Additional storage as may be required to meet management goals or regulatory requirements.

For consistency with the MDEQ NPDES permits for CAFOs:

- The sum of items a, b, c, f, g, and h above are referred to as the operational volume.
- The sum of items d and e above are referred to as the emergency volume.

Non-polluted runoff shall be excluded from the structure to the fullest extent possible except where storage, separation or treatment is advantageous to the operation of the agricultural waste management system.

Waste storage facilities designed for use as reception pits shall be sized in accordance with the Waste Transfer, NRCS Conservation Practice Standard (634).

Freeboard - Waste Storage Ponds. In addition to the design volume, a minimum of 1 foot shall be provided for freeboard. For consistency with the MDEQ NPDES permits for CAFOs, this is referred to as the freeboard volume.

Freeboard - Fabricated Structures. In addition to the design volume, a minimum of 6 inches shall be provided for freeboard except for solid stacking fabricated structures.

For consistency with the MDEQ NPDES permits for CAFOs, this is referred to as the freeboard volume and freeboard maybe more where the storage is subject to precipitation.

Solid stacking implies that the manure has a consistency that does not flow, but stays in place even during the wettest time of the storage period. The design volume for solid stacking fabricated structures may exceed the height of the structure walls, *however the maximum height of manure stored along the wall must be a minimum of 6 inches from the top of the wall.* The anticipated stacking angle of the manure must be considered in determining the required wall height and design loads.

Inlet. Inlets shall be of any permanent type designed to resist corrosion, plugging, freeze damage, and ultraviolet ray

deterioration while incorporating erosion protection on the storage facility liner as necessary.

Emptying Component. Some type of component shall be provided for emptying storage facilities *to ensure liner integrity is maintained.* It may be a facility such as a gate, pipe, dock, wet well, pumping platform, retaining wall, or ramp. Features to protect against erosion, tampering, and accidental release shall be incorporated as necessary.

Ramps used to empty slurry, semi-solid, or solid waste shall have a slope of 10 horizontal to 1 vertical or flatter unless special traction surfaces are provided.

Accumulated Solids Removal. Provisions shall be made for periodic removal of accumulated solids to preserve storage capacity. The anticipated method for doing this must be considered in planning, particularly in determining the configuration of ponds and type of seal or liner.

Safety. Design shall include appropriate safety features to minimize the hazards of the facility. Warning signs, fences, ladders, ropes, bars, rails, and other devices shall be provided, as appropriate, to ensure the safety of humans and livestock. *Storage structures* for liquid or slurry waste with *vertical* walls less than 5 feet above ground surface *or any sloped embankment* shall be fenced and warning signs posted to prevent children and others from using them for other than their intended purpose.

Ventilation and warning signs must be provided for covered waste storage facilities, as necessary, to prevent explosion, poisoning, or asphyxiation. Pipelines shall be provided with a water-sealed trap and vent, or similar device, if there is a potential, based on design configuration, for gases to enter buildings or other confined spaces.

Covers and gratings over openings shall be designed such that livestock or humans cannot accidentally displace them and fall into the facility.

Livestock shall be excluded from the storage facility, as appropriate, to prevent damage to liners and to avoid harm to the animals.

Erosion Protection. Embankments and disturbed areas surrounding the facility shall be treated to control erosion.

Service Life and Durability. Storage facilities shall be planned, designed, and installed to provide a minimum service life of *15 years*.

Planning, design, and construction shall ensure that the storage facility is sound and of durable materials commensurate with the anticipated service life, initial and replacement costs, maintenance and operation costs, and safety and environmental considerations.

Water Table. The seasonal high water table shall be determined either by long-term monitoring or by the *analysis of all available indicator factors including percent saturation of the soil* and by the presence of diagnostic soil redoximorphic features as identified during on-site investigations conducted by an individual trained in soil and water relationships. Terms related to water table are as defined below.

- **Water table** - The uppermost surface of the zone of saturation; that surface of a body of unconfined groundwater at which the pressure is equal to atmospheric pressure.
- **Seasonal high water table** - The uppermost surface of the zone of saturation during the wettest season.
- **Perched water table** - Unconfined groundwater separated from the underlying main body of groundwater by an unsaturated zone.
- **Potentiometric surface** - In confined (artesian) conditions, the surface to which water in an aquifer would rise by hydrostatic pressure.

The water table may be lowered *by use of artificial drainage* if all of the following conditions are met:

- *An observation point (typically a catch basin) must be included in the design of the waste storage facility artificial drainage system as close to the storage facility as possible. The Operation and Maintenance Plan outlines visual indicators when liquid observed in the observation point must be pumped back into the waste storage facility.*
- *Must incorporate the ability to disable (such as a gate valve) the outlet at the observation point should contaminants be observed in the waste storage facilities artificial drainage system.*
- The artificial drainage system of the waste storage facility may be part of an existing artificial *or field tile drainage system* only if; the outlet is observable, the outlet is shown on the construction drawings, *and the existing field tile drainage system is analyzed to handle the total capacity needs with the design documentation.*

Subsurface Investigations. A subsurface investigation is required for all waste storage facilities. Subsurface investigations shall be conducted by individuals trained *and knowledgeable* in soil science, engineering, geology, or a related field. The number and depth of test holes, pits, or borings, and lab tests of soil samples will vary depending on:

- The planned storage surface area,
- The excavation depth,
- *The height of the storage structure,*
- *The height of planned embankments*

- The conditions encountered during the investigation such as the complexity of the soils, the depth to groundwater, and the presence or absence of seeps.

Where embankments of significant height are part of a proposed structure the subsurface investigation shall consider the potential for foundation settlement, as well as embankment settlement. The subsurface investigation may require test holes, pits or borings along the centerline of the proposed embankment.

At a minimum, there shall be one test hole, pit, or boring for each 5,000 ft^2 for the first 20,000 ft^2 of planned storage facility surface area plus at least one test hole, pit, or boring for each additional 20,000 ft^2. Each test hole, pit, or boring shall extend at least 2 feet below the planned bottom of the structure. The log for each test hole, pit, or boring shall indicate the following:

- *Location of hole, pit, or boring.*
- Existing ground surface elevation.
- A description of the soil material encountered using the Unified Soil Classification System (ASTM D 2487 or ASTM D 2488).
- Depth to changes in the soil material encountered.
- Depth to any seeps encountered, *including soil classification and thickness of seeping layer*
- Depth to high water (note method of determination: mottling, free water encountered, lab test of soil samples, etc.).
- Depth to bottom of test hole, pit, or boring.

The location and log information for all test holes, pits, and/or borings in or near the structure shall be shown on the construction drawings.

Additional Criteria Where The Animal Feeding Operation Stables Or Confines And Feeds Or Maintains 5,000 Or MORE Animal Units For A Total Of 45 Days Or More In Any 12 Month Period

In addition to the criteria in this practice standard, waste storage facility criteria for animal feeding operations with 5,000 or more animal units (animal units as defined by MDEQ) are described in R 323.2201 through R 323.2240 of the Michigan Administrative Code (Part 22 Groundwater Quality Administrative Rules Promulgated Pursuant to Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended).

Additional Criteria For Waste Storage Ponds

Soil and Foundation. *All waste storage* ponds shall be lined as *described in the Liners section*. Information and guidance on controlling seepage from waste impoundments can be found in the Agricultural Waste Management Field Handbook (AWMFH), Appendix 10D.

The maximum specific discharge for any waste storage pond shall be 0.0153 $ft^3/ft^2/day$ (5.411×10^{-6} $cm^3/cm^2/sec$).

Design Bottom Elevation. The design bottom elevation of the waste storage pond shall be no lower than 2 feet above the seasonal high water table unless it is lowered in accordance with Water Table criteria.

Liners. Self-sealing ponds are not an acceptable means of containing waste. The storage pond shall be sealed by one of the liners as described below. The subgrade shall be a dense base regardless of liner method.

Compacted *Clay Treatment – A compacted earth liner designed and constructed in accordance with the NRCS Conservation Practice Standard 521-D, Pond Sealing or Lining – Compacted Clay Treatment.*

Flexible Membrane - A flexible membrane liner designed and constructed in accordance with NRCS Conservation Practice Standard 521-A, Pond Sealing or Lining - Flexible Membrane; and Construction Specification MI-184, Flexible Membrane Liners.

Soil Dispersant- A soil dispersant liner designed and constructed in accordance with NRCS Conservation Practice Standard 521-B, Pond Sealing or Lining – Soil Dispersant Treatment and Construction Specification MI-185, Soil Dispersant Treatment.

Bentonite *Treatment*- A bentonite liner designed and constructed in accordance with NRCS Conservation Practice Standard 521-C, Pond Sealing or Lining - Bentonite *Treatment*; and Construction Specification MI-183, Bentonite Sealant.

Concrete - A concrete liner designed and constructed in accordance with Construction Specification MI-159, Plain Concrete or *Construction Specification MI-158, Reinforced Concrete and the following criteria:*

1. For side slopes and bottoms that will not have any vehicular traffic, use a minimum 5-inch thick concrete slab. No cold joints, wire mesh, or fiber reinforcement is required.

2. For concrete-lined areas such as approaches, ramps, and bottoms that will have vehicular traffic of any kind, use a minimum 5-inch thick concrete slab placed over a minimum 4-inch thick layer of compacted sand. No joints, wire mesh, or fiber reinforcement is required.

3. Concrete-lined side slopes, including concrete push-off ramps, shall be 1:1 or flatter. Concrete liners with slopes steeper than 2:1 on earthfill greater than 5 feet must be approved by the NRCS State Conservation Engineer or a non-NRCS professional engineer licensed in the State of Michigan.

Natural Clay Base - A natural clay base liner shall meet the criteria for a unified soil classification of CL, CH, MH, SC, or GC for the entire depth required for each of the two options as described below.

10-Foot Option. Subsurface investigations must demonstrate that suitable natural soil material exists continuously from the freeboard elevation to a depth of at least 10 feet below the design bottom elevation of the pond.

2-Foot Option. Subsurface investigations must demonstrate that suitable natural soil material exists continuously from the freeboard elevation to a depth of at least 2 feet below the design bottom elevation of the pond. *Results of* laboratory permeability tests of undisturbed samples or field permeability tests *shall be used and following the design and guidance from the* Agricultural Waste Management Field Handbook (AWMFH), Appendix 10D that *results in a maximum design specific discharge of 0.0153 ft^3/ft^2/day* (5.411×10^{-6} cm^3/cm^2/sec) or less.

At a minimum, there shall be one *undisturbed* permeability test for each 5,000 ft^2 for the first 20,000 ft^2 of the planned storage facility surface area plus at least one permeability test for each additional 20,000 ft^2 *or a whole pond field permeability seepage analysis*. The permeability tests must be representative of the soils throughout the 2-foot depth and must be representative of the soils observed within the storage facility surface area including side slopes.

Natural clay-based liners shall have side slopes of 2:1 or flatter.

Natural clay base soils that have a blocky structure or desiccation cracks shall be disked to a minimum depth of 6 inches and recompacted following the method described in Construction Specification MI-154, Earthfill.

Criteria For Minimizing The Potential Of Waste Storage Pond Liner Failure

Sites with categories listed in Table 1 should be avoided unless no reasonable alternative exists. Under those circumstances, consideration should be given to providing an additional measure of safety from pond seepage when any of the potential impact categories listed in Table 1 are present.

TABLE 1 - Potential Impact Categories for Liner Failure
1. Any underlying aquifer is at a shallow depth and not confined.
2. The vadose zone is rock.
3. The aquifer is a domestic water supply or ecologically vital water supply.
4. The site is located in an area of solutionized bedrock such as limestone or gypsum.

Should any of the potential impact categories listed in Table 1 be present, *an enhanced or dual liner* shall be provided by one *of the* following:

1. A compacted clay liner over a natural clay liner..
2. A flexible membrane liner over a natural clay liner.
3. A flexible membrane liner over a compacted clay liner.
4. A flexible membrane liner over a geosynthetic clay liner (GCL).
5. A *reinforced* concrete liner designed in accordance with slabs on grade criteria for fabricated structures requiring water tightness.

Maximum Operating Level. The maximum operating level for waste storage ponds shall be the pond level that provides for the operational volume. Emptying or drawdown of the storage facility must begin when the contents reach the maximum operating level.

Depth Gauge. A permanent marker shall be installed to visually show all of the following elevations:

- Maximum operating level.
- Top of emergency volume.
- Top of freeboard volume.

The depth gauge shall be referenced and explained in the Operation and Maintenance plan. A depth gauge is not required for solid stacking fabricated structures.

Outlet. No outlet shall automatically release storage from the required design volume. Manually-operated outlets shall be of a permanent type designed to resist corrosion and plugging.

Embankments. The minimum elevation of the top of the settled embankment shall be the waste storage pond's required volume plus the 1-foot freeboard. This settled height shall be increased by the amount needed to ensure that the top elevation will be maintained after settlement. This increase shall be not less than 5 percent.

The minimum top widths are shown in Table 2. The combined side slopes of the settled embankment shall not be less than 5 horizontal to 1 vertical, and neither slope shall be steeper than 2 horizontal to 1 vertical unless provisions are made to provide stability.

TABLE 2 - Minimum Top Widths

Total Embankment Height	Top Width
15 ft. or less	8 ft.
15 - 20 ft.	10 ft.
20 - 25 ft.	12 ft.
25 - 30 ft.	14 ft.
30 - 35 ft.	15 ft.

Excavations. Unless supported by a soil investigation, excavated side slopes shall be no steeper than 2 horizontal to 1 vertical.

Additional Criteria For Fabricated Structures

Foundation. The foundations of fabricated waste storage structures shall be proportioned to safely support all superimposed loads without excessive movement or settlement.

Where a non-uniform foundation cannot be avoided or applied loads may create highly variable foundation loads, settlement should be calculated from site-specific soil test data. Index tests of site soil may allow correlation with similar soils for which test data is available. If no test data is available, presumptive bearing strength values for assessing actual bearing pressures may be obtained from Table 3 or another nationally recognized building code. In using presumptive bearing values, adequate detailing and articulation shall be provided to avoid distressing movements in the structure.

Foundations consisting of bedrock with joints, fractures, or solution channels shall be treated or a separation distance provided consisting of a minimum of 1 foot of impermeable soil between the floor slab and the bedrock, or an alternative that will achieve equal protection.

TABLE 3 - Presumptive Allowable Bearing Stress Values[1/]

Foundation Description	Allowable Stress
Crystalline Bedrock	12,000 psf
Sedimentary Rock	6,000 psf
Sandy Gravel or Gravel	5,000 psf
Sand, Silty Sand, Clayey Sand, Silty Gravel, Clayey Gravel	3,000 psf
Clay, Sandy Clay, Silty Clay, Clayey Silt	2,000 psf

[1/] Basic Building Code, 12th Edition, 1993, Building Officials and Code Administrators, Inc. (BOCA)

Design Bottom Elevation. The design bottom elevation of the fabricated structure waste storage facility shall be no lower than the seasonal high water table unless it is a perched water table lowered in accordance with Water Table criteria.

Liquid Tightness. Applications such as tanks, that require liquid tightness, shall be designed and constructed in accordance with standard engineering and industry practices appropriate for the construction materials used to achieve this objective.

Structural Loadings. Waste storage structures shall be designed to withstand all anticipated loads including internal and external loads, hydrostatic uplift pressure, concentrated surface and impact loads, water pressure due to seasonal high water table, frost or ice pressure, and load combinations in compliance with this standard and applicable local building codes. Hydrostatic uplift pressures from perched seasonal high water tables shall be eliminated by a drain system with a gravity outlet. Refer to the Water Table section of this standard.

The design load under footings for walls and columns shall not exceed 3,000 lb/ft^2 unless the design is based on soil-bearing strength tests made at the site.

The lateral earth pressures should be calculated from soil strength values determined from the results of appropriate soil tests. Lateral earth pressures can be calculated using the procedures in TR-74, Lateral Earth Pressures. If soil strength tests are not available, the presumptive lateral earth pressure values indicated in Table 4 shall be used.

Lateral earth pressures based upon equivalent fluid assumptions shall be assigned according to the following conditions:

Rigid Frame or Restrained Wall. Use the values shown in Table 4 under the column “Frame Tanks,” which gives pressures comparable to the at-rest condition.

Flexible or Yielding Wall. Use the values shown in Table 4 under the column “Free-Standing Walls,” which gives pressures comparable to the active condition. Walls in this category are designed on the basis of gravity for stability or are designed as a cantilever having a base wall thickness to height of backfill ratio not more than 0.085.

Internal lateral pressure used for design shall be 65 lb/ft^2 where the stored waste is not protected from precipitation. A value of 60 lb/ft^2 may be used where the stored waste is protected from precipitation and will not become saturated. Lesser values may be used if supported by measurement of actual pressures of the waste to be stored. If heavy equipment is to be operated within 5 feet of the walls, a surcharge (horizontal pressure) of 100 lb/ft^2 on the wall shall be added.

Tank covers shall be designed to withstand both dead and live loads. The live load values for covers contained in ASAE EP378.3, Floor and Suspended Loads on Agricultural Structures Due to Use, and in ASAE EP393.2, Manure Storages, shall be the minimum used.

The actual axle load for tank wagons having more than a 2,000 gallon capacity shall be used.

TABLE 4 - Lateral Earth Pressure Values [1/]			
Soil		Equivalent Fluid Pressure lb/ft^2/ft of depth	
		Above Seasonal High Water Table [2/]	
Description [3/]	Unified Classification [3/]	Free-Standing Walls	Frame Tanks
Clean gravel, sand, or sand-gravel mixtures (maximum 5% fines) [4/]	GP, GW, SP, SW	30	50
Gravel, sand, silt, and clay mixtures (less than 50% fines) Coarse sands with silt and/or clay (less than 50% fines)	All gravel/sand dual symbol classifications and GM, GC, SC, SM, SC-SM	35	60
Low-plasticity silts and clays with some sand and/or gravel (50% or more fines) Fine sands with silt and/or clay (less than 50% fines)	CL, ML, CL-ML, SC, SM, SC-SM	45	75
Low to medium plasticity silts and clays with little sand and/or gravel (50% or more fines)	CL, ML, CL-ML	65	85
High plasticity silts and clays (liquid limit more than 50) [5/]	CH, MH	NA	NA

[1/] For lightly compacted soils (85-90 percent maximum standard density). Includes compaction by use of typical farm equipment.

[2/] Also below perched seasonal high water table if adequate drainage is provided. Refer to Water Table section of this standard.

[3/] All definitions and procedures in accordance with ASTM D-2488 and D-653.

[4/] Generally, only washed materials are in this category.

[5/] Not recommended. Requires special design if used.

If the facility is to have a roof, snow and wind loads shall be as specified in *the current* Michigan Building Code.

If a fabricated structure is to serve as part of a foundation or support for a building, the total load shall be considered in the structural design and the following conditions shall be met:

1. The building shall not cause any eccentric loads on the storage structure walls. Therefore, the building walls shall:
   (a) Be located so that the load is directly over the storage structure wall;
   (b) Be located outside the storage structure wall by a distance no less than the depth of the storage structure wall below ground; or
   (c) Have footings that extend at least to the bottom elevation of the storage structure and are not connected to the storage structure footings.
2. Sill plates for the building walls should not be placed in direct contact with slatted floors.
3. Storage structure reinforcing steel shall not be extended to connect the building to the storage structure. Bolts or separate reinforcing steel may be used to connect the building to the storage structure. The distance from the face of the storage structure wall to the connecting bolts or reinforcing steel shall be at least 1.5 inches.

Structural Design. The structural design shall consider all items that will influence the performance of the structure, including loading assumptions, material properties, and construction quality. Design assumptions and construction requirements shall be indicated on the plans. For structures that include slatted floors, the walls, which parallel the slats, are usually not supported at the top by the slats and therefore may require a special design.

Tanks may be designed with or without covers. Covers, beams, or braces that are integral to structural performance must be indicated on the construction drawings. The openings in covered tanks shall be designed to accommodate equipment for loading, agitating, and emptying. These openings shall be equipped with grills or secure covers for safety, and for odor and vector control. Adequate reinforcing

shall be designed and detailed for all areas around cover openings. Exposed reinforcing bars across openings shall not be used to provide structural strength.

All structures shall be underlain by free draining material or shall have a footing located below the anticipated frost depth.

Fabricated structures shall be designed according to the criteria in the following references as appropriate:

Steel: "Manual of Steel Construction," American Institute of Steel Construction.

Timber: "National Design Specifications for Wood Construction," American Forest and Paper Association, or Construction Specification MI-174, Timber Fabrication and Installation.

Concrete: "Building Code Requirements for Reinforced Concrete, ACI 318," American Concrete Institute.

Masonry: "Building Code Requirements for Masonry Structures, ACI 530," American Concrete Institute.

Slabs on Grade. Slab design shall consider the required performance and the critical applied loads along with both the subgrade material and material resistance of the concrete slab. Construction Specifications MI-158, Reinforced Concrete, or MI-159, Plain Concrete *or equivalent,* as appropriate, with the following criteria, shall be used:

1. For areas that will not have any vehicular traffic, use a minimum 5-inch thick concrete slab. No joints, wire mesh, or fiber reinforcement is required.

2. For areas that will have vehicular traffic of any kind, use a minimum 5-inch thick concrete slab placed over a minimum 4-inch thick layer of compacted sand. No joints, wire mesh, or fiber reinforcement is required.

3. When heavy equipment loads are to be resisted and/or where a non-uniform foundation cannot be avoided, an appropriate design procedure incorporating a subgrade resistance parameter(s) such as ACI 360, "Design of Slabs on Grade," shall be used.

CONSIDERATIONS

Waste storage facilities should be located as close to the source of waste and polluted runoff as practicable.

Consider the potential effects of installation and operation of waste storage facilities on the cultural, archeological, historic, and economic resources.

Waste separation of runoff or wastewater entering waste storage facilities should be considered to minimize the frequency of accumulated solids removal and to facilitate pumping and application of the stored waste.

Consider the cost effectiveness and durability of connections between flexible membrane liners and concrete (reinforced or unreinforced). It may be more effective to line the entire facility with the flexible membrane liner than to try to establish a leak-proof connection between the flexible membrane and the concrete.

Considerations for Siting

The following factors shall be considered in selecting a site for waste storage facilities:

- Proximity of the waste storage facility to the source of wastes;
- Access to other facilities;
- Ease of loading and emptying wastes;
- Appropriate health regulations;
- Direction of prevailing winds to minimize odors;
- Compatibility with the existing landforms and vegetation, including building arrangement, to minimize odors and adverse impacts on visual resources; and
- Adequate maneuvering space for operating, loading, and unloading equipment.
- *Consider top width for vehicle access and fencing; minimum 10ft width.*

Considerations For Minimizing The Potential For And Impacts Of Sudden Breach Of Embankment Or Accidental Release From The Required Volume

Features, safeguards, and/or management measures to minimize the risk of failure or accidental release; or to minimize or mitigate impact of this type of failure should be considered when any of the categories listed in Table 5 might be significantly affected.

The following should be considered, either singly or in combination, to minimize the potential of or the consequences of sudden breach of embankments when one or more of the potential impact categories listed in Table 5 may be significantly affected:

1. An auxiliary (emergency) spillway *with secondary to containment of waste leaving spillway.*
2. Additional freeboard.

3. Storage for a wet year rather than normal year precipitation.
4. Reinforced embankment - such as additional top width, or flattened and/or armored downstream side slopes.
5. Secondary containment.

TABLE 5 - Potential Impact Categories From Breach of Embankment or Accidental Release
1. Surface water bodies - perennial streams, lakes, wetlands, and estuaries.
2. Critical habitat for threatened and endangered species.
3. Riparian areas.
4. Farmstead or other areas of habitation.
5. Off-farm property.
6. Historical and/or archaeological sites or structures that meet the eligibility criteria for listing in the National Register of Historical Places.

The following options should be considered to minimize the potential for accidental release from the required volume through gravity outlets when one or more of the potential impact categories listed in Table 5 may be significantly affected:

1. Outlet gate locks or locked gate housing.
2. Secondary containment.
3. Alarm system.
4. Another means of emptying the required volume.

Considerations For Improving Air Quality

To reduce emissions of greenhouse gases, ammonia, volatile organic compounds, and odor:

Consider alternatives and additional practices including Anaerobic Digester (366), and Composting Facility (317), *Waste Treatment (629), Waste Separation (632)*.

Adjusting pH below 7 may reduce ammonia emissions from the waste storage facility but may increase odor when waste is surface applied (see Waste Recycling 633).

PLANS AND SPECIFICATIONS

Plans and specifications shall be prepared in accordance with the criteria of this standard and shall describe the requirements for applying the practice to achieve its intended use.

Support data documentation requirements are as follows:

- Inventory and evaluation records
  - Conservation Assistance notes or special report
- Survey notes, where applicable
  - Design survey
  - Construction layout survey
  - Construction check survey
- Design records
  - Physical data, functional requirements, and site constraints, where applicable
  - Soils/subsurface investigation report, where applicable
- Design and quantity calculations
- Construction drawings/specifications with:
  - Location map
  - "Designed by" and "Checked by" names or initials
  - Approval signature
  - Job class designation
  - Initials from preconstruction conference
  - As-built notes
- Construction inspection records
  - Conservation Assistance notes or separate inspection records
  - Construction approval signature
- Record of any variances approved, where applicable
- Record of approvals of in-field changes affecting function and/or job class, where applicable
- For Waste Storage Ponds with a clay liner, include an evaluation report (soils lab or qualified specialist) documenting suitability of liner material
- Well isolation distance documentation

OPERATION AND MAINTENANCE

An Operation and Maintenance (O&M) plan shall be developed for this practice. The O&M plan shall be consistent with the purposes of the practice, its intended life, safety requirements, and the criteria for the design.

REFERENCES

- American Society for Testing and Materials (ASTM), 2000. D 2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).

- American Society for Testing and Materials (ASTM), 2000. D 2488, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).

- American Society for Testing and Materials (ASTM), 2000. D 4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils (Atterberg limits).

- *USDA, NRCS, Agricultural Waste Management Field Handbook, Part 651, 1992. Appendix 10D, August 2009.*