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.

PURPOSE

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
- 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 Waste Storage Facilities.

Laws and Regulations. Waste storage facilities must be planned, designed, and constructed to meet all federal, state, and local laws and regulations.

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.

Storage Period. The storage period is the maximum length of time anticipated between emptying events. The minimum storage period shall be based on the timing required for environmentally safe waste utilization considering the climate, crops, soil, equipment, and local, state, and federal regulations. The minimum storage period shall be based on the length of time the ground is frozen as shown in Table 1 for some locations. An additional 45 days shall be added to the values in Table 1 if the net application of liquid manure is more than 2 inches or the application efficiency is less than 60%. Adjustments to the minimum storage period can be considered when: manure will be applied on frozen and/or snow

covered ground based on the Utah Manure Application Risk Index and Nutrient Management (590), Manure Staging Areas are designed, and Composting Facilities (317) are designed. Individual components can be sized for less than the minimum required storage provided the combined storage volume of the system components equals or exceeds the minimum storage volume required for the operation.

Table 1 – Minimum Storage Period

Location	Storage Period, Days
Beaver	**105**
Cedar City	**90**
Delta	**90**
Farmington	**90**
Hanna	**150**
Heber	**120**
Kanab	**45**
Logan	**120**
Manti	**120**
Ogden	**90**
Panguitch	**120**
Randolph	**150**
Richfield	**105**

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, and other wastes accumulated during the storage period

(b) Normal precipitation less evaporation on the surface area (at the design storage volume level) of the facility during the storage period

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

(d) 25-year, 24-hour precipitation on the surface (at the required design storage volume level) of the facility

(e) 25-year, 24-hour runoff from the facility's drainage area

(f) Residual solids after liquids have been removed. A minimum of 6 inches shall be provided for tanks

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

Inlet. Inlets shall be of any permanent type designed to resist corrosion, plugging, freeze damage and ultraviolet ray deterioration while incorporating erosion protection as necessary.

Emptying Component. Some type of component shall be provided for emptying storage facilities. 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.

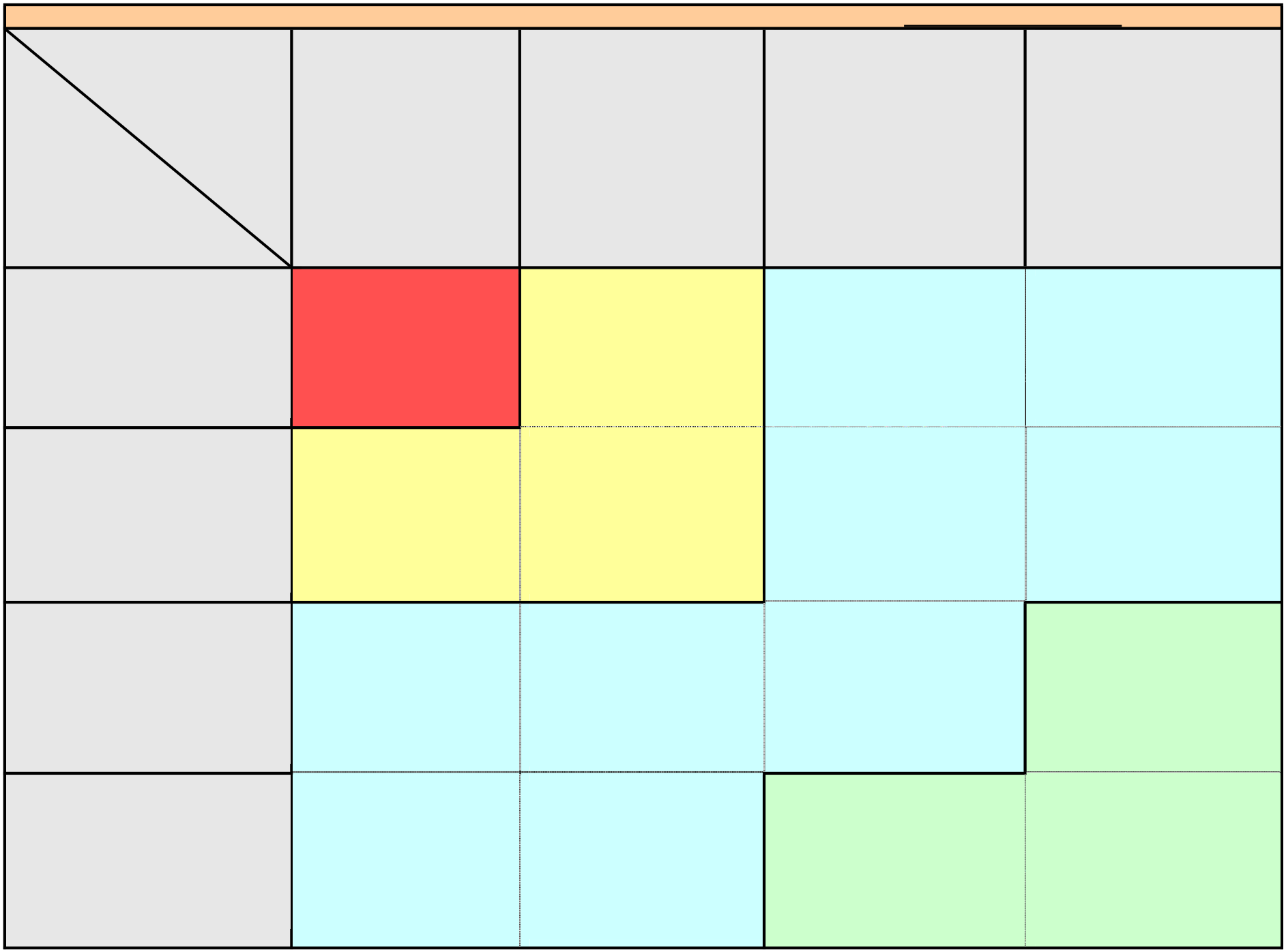
Accumulated Solids Removal. Provision shall be made for periodic removal of accumulated solids to preserve storage capacity. The anticipated method for doing this must be considered in planning, particularly in determining the configuration of ponds and type of liner, if any.

Safety. Design shall include appropriate safety features to minimize the hazards of the facility. Ramps used to empty liquids shall have a slope of 4 horizontal to 1 vertical or flatter. Those 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. Warning signs, fences, ladders, ropes, bars, rails, and other devices shall be provided, as appropriate, to ensure the safety of humans and livestock. Ventilation and warning signs must be provided for covered waste holding structures, 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. Ponds and uncovered fabricated structures for liquid or slurry waste with walls less than 5 feet above ground surface shall be fenced and warning signs posted to prevent children and others from using them for other than their intended purpose.

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

Table 2a- Criteria for Siting, Investigation, & Design of Liquid Waste Storage Facilities with a water depth greater than 2 feet.

Vulnerability ↓ / Risk→	Very High	High	Moderate	Slight
	Less than 500' upgradient from a public drinking water supply well; **OR** < 200' upgradient from a domestic well or Class 1 designated use surface water, **OR** 1st ground water is a Class IB aquifer.	Doesn't meet Very High Risk criteria; **AND** In a recharge area for Sole Source aquifers; **OR** 500'-1,000' upgradient from a public drinking water supply well, **OR** 200' - 600' upgradient from an domestic water supply well or Class 1 designated use surface water, **OR** 1st ground water is a Class IA or Class II aquifer.	Doesn't meet High Risk criteria; **AND** 600' - 1,000' upgradient from an domestic well or Class 1 surface water; **OR** < 600' upgradient from a non-domestic water supply well or Class 2-5 designated use surface water, **OR** 1st ground water is a Class III aquifer.	Doesn't meet Moderate Risk criteria; **AND** >1,000' upgradient from an domestic well or Class 1 surface water; **OR** > 600' upgradient from a non-domestic water supply well or Class 2-5 designated use surface water, **OR** 1st ground water is a Class IV aquifer.
Very High Large voids (e.g. karst limestones, lava tubes, improperly abandoned well); **OR** Highest anticipated groundwater elevation within 2' of pond bottom;	**Liner Requirements** ~ Relocate to another site or ~ Install steel or concrete tank with no discharge	**Liner Requirements** ~ Consider relocation to another site ~ Synthetic liner with specific discharge less than 1 x 10^{-11} $cm^3/cm^2/sec$ ~ Testing required on synthetic liner by a third party testing firm.	**Liner Requirements** ~ Specific discharge less than 1 x 10^{-7} $cm^3/cm^2/sec$ ~ No manure sealing credit ~ Design includes sampling and testing of earthen liner or in-place material including classification, standard Proctor compaction, in-place density, and sample permeability by a licensed testing firm.	**Liner Requirements** ~ Specific discharge less than 1 x 10^{-7} $cm^3/cm^2/sec$ ~ No manure sealing credit ~ Design includes sampling and testing of earthen liner or in-place material including classification, standard Proctor compaction, in-place density, and sample permeability by a licensed testing firm.
High Doesn't meet Very High Vulnerability criteria: **AND** Bedrock (assumed fractured) within 2' of pond bottom; **OR** Coarse soils/parent material (Permeability Group I soils as defined in AWMFH, always including GP, GW, SP, SW); **OR** Highest anticipated groundwater elevation is between 2' - 15' below pond bottom;	**Liner Requirements** ~ Consider relocation to another site ~ Synthetic liner with specific discharge less than 1 x 10^{-11} $cm^3/cm^2/sec$ ~ Testing required on synthetic liner by a third party testing firm.	**Liner Requirements** ~ Consider relocation to another site ~ Synthetic liner with specific discharge less than 1 x 10^{-11} $cm^3/cm^2/sec$ ~ Testing required on synthetic liner by a third party testing firm.	**Liner Requirements** ~ Specific discharge less than 1 x 10^{-7} $cm^3/cm^2/sec$ ~ No manure sealing credit ~ Design includes sampling and testing of earthen liner or in-place material including classification, standard Proctor compaction, in-place density, and sample permeability by a licensed testing firm.	**Liner Requirements** ~ Specific discharge less than 1 x 10^{-7} $cm^3/cm^2/sec$ ~ No manure sealing credit ~ Design includes sampling and testing of earthen liner or in-place material including classification, standard Proctor compaction, in-place density, and sample permeability by a licensed testing firm.
Moderate Doesn't meet High Vulnerability criteria; **AND** Medium soils/parent material (Permeability Group II soils as defined in AWMFH, usually including CL-ML, GM, SM, ML); **OR** Flocculated or blocky clays (typically associated with high Ca); **OR** Highest anticipated groundwater elevation is between 15'- 50' below pond bottom	**Liner Requirements*** ~ Specific discharge less than 1 x 10^{-7} $cm^3/cm^2/sec$ ~ No manure sealing credit ~ Design includes sampling and testing of earthen liner or in-place material including classification, standard Proctor compaction, in-place density, and sample permeability by a licensed testing firm. *The risk in some situations may warrant a synthetic liner.	**Liner Requirements*** ~ Specific discharge less than 1 x 10^{-7} $cm^3/cm^2/sec$ ~ No manure sealing credit ~ Design includes sampling and testing of earthen liner or in-place material including classification, standard Proctor compaction, in-place density, and sample permeability by a licensed testing firm. *The risk in some situations may warrant a synthetic liner.	**Liner Requirements** ~ Specific discharge less than 1 x 10^{-7} $cm^3/cm^2/sec$ ~ No manure sealing credit ~ Design includes sampling and testing of earthen liner or in-place material including classification, standard Proctor compaction, in-place density, and sample permeability by a licensed testing firm.	**Liner Requirements** ~ Specific discharge less than 1 x 10^{-6} $cm^3/cm^2/sec$ ~ No manure sealing credit ~ Design includes sampling and testing of earthen liner or in-place material including classification, standard Proctor compaction, in-place density, and sample permeability by a licensed testing firm.
Low Doesn't meet Moderate Vulnerability criteria; **AND** Fine soils/parent material (Permeability Group III and IV soils as defined in AWMFH, usually including GC, SC, MH, CL, CH); **AND** Highest anticipated groundwater elevation is > 50' below pond bottom	**Liner Requirements** ~ Specific discharge less than 1 x 10^{-7} $cm^3/cm^2/sec$ ~ No manure sealing credit ~ Design includes sampling and testing of earthen liner or in-place material including classification, standard Proctor compaction, in-place density, and sample permeability by a licensed testing firm.	**Liner Requirements** ~ Specific discharge less than 1 x 10^{-7} $cm^3/cm^2/sec$ ~ No manure sealing credit ~ Design includes sampling and testing of earthen liner or in-place material including classification, standard Proctor compaction, in-place density, and sample permeability by a licensed testing firm.	**Liner Requirements** ~ Specific discharge less than 1 x 10^{-6} $cm^3/cm^2/sec$ ~ No manure sealing credit ~ Design includes sampling and testing of earthen liner or in-place material including classification, standard Proctor compaction, in-place density, and sample permeability by a licensed testing firm.	**Liner Requirements** ~ Specific discharge less than 1 x 10^{-6} $cm^3/cm^2/sec$ ~ No manure sealing credit ~ Design includes sampling and testing of earthen liner or in-place material including classification, standard Proctor compaction, in-place density, and sample permeability by a licensed testing firm.



Criteria for Siting, Investigation, & Design of Liquid Waste Storage Facilities
Definitions

AWMFH. NRCS Agricultural Waste Management Field Handbook (210-VI-651). *Individual chapters online at http://www.info.usda.gov/CED/* .

Domestic Water Supply Well. A well from which water is used for household use or human consumption.

Groundwater. Groundwater in this case is defined as the first water and in reference to elevation it is the elevation of the seasonal high water table.

Permeability Group (I through IV) Soils. Empirically-derived permeability classification of soils based on percent passing the 200 sieve and Plasticity Index (PI). *Specific criteria for each of the four classes are listed in Table 10D-1 of Appendix 10D of the AWMFH (http://www.info.usda.gov/CED/ftp/CED/neh651-ch10.pdf).*

Public Drinking Water Supply Well. A public drinking supply well is a well, either publicly or privately owned, providing water through constructed conveyances for human consumption and other domestic uses, which has at least 15 service connections or serves an average of at least 25 individuals daily at least 60 days out of the year and includes collection, treatment, storage, or distribution facilities under the control of the operator and used primarily in connection with the system, or collection, pretreatment or storage facilities used primarily in connection with the system but not under his control. (*http://www.drinkingwater.utah.gov/system_classifications.htm*)

Risk. Risk categories (very high, high, moderate, and slight) are based on the potential impacts of seepage on designated uses of groundwater and hydraulically connected surface water resources. *Designated uses include drinking water supply, non-domestic water supply, and aquatic habitats including fisheries.*

Runoff Ponds. Runoff ponds are a non-vegetated nearly flat area where corral storm runoff water is temporarily stored. These are also referred to as corral berms or earth fills on the perimeter of corrals. *Vegetated areas should be treated as filter strips, and the manure application in a storm event must not exceed agronomic rates.*

Sole Source Aquifer. An EPA-administered program that requires EPA review of all Federal financially assisted projects which have the potential to contaminate officially designated Sole Source Aquifers (*http://www.epa.gov/safewater/ssanp.html*). *Currently there are three Sole Source Aquifers in Utah. Information about these aquifers can be found at (*http://www.epa.gov/safewater/swp/ssa/reg8.html*).*

Unconfined Aquifer. An aquifer containing water that is not under pressure; the water level in a well is the same as the water table outside the well *(http://www.epa.gov/OCEPAterms/uterms.html). Compared to confined aquifers, unconfined aquifers tend to be close to the ground surface and lack a low permeability confining layer that reduces seepage of potential contaminants from surface sources.*

Utah Ground Water Quality Classes are established as follows: Class IA - Pristine Ground Water; Class IB - Irreplaceable Ground Water; Class IC - Ecologically Important Ground Water; Class II - Drinking Water Quality Ground Water; Class III - Limited Use Ground Water; Class IV - Saline Ground Water. *Specific criteria for each of the four classes of ground water can be found in Utah Admin Code R317-6-3 at http://www.rules.utah.gov/publicat/code/r317/r317-006.htm#T3. Contact the DEQ Division of Water Quality at (801) 538-6146 for a determination of ground water quality class.*

Utah Surface Water Designated Uses are established as follows: Class 1 – Protected for use as a raw water source for domestic water systems; Class 2 - Protected for recreational use and aesthetics; Class 3 – Protected for use by aquatic wildlife; Class 4 – Protected for agricultural uses; Class 5 – The Great Salt Lake. *Specific criteria for each of the five designated uses of a particular body of water can be found at: http://www.rules.utah.gov/publicat/code/r317/r317-002.htm#T7*

Vulnerability. Vulnerability categories (very high, high, moderate, and low) are based on geologic and hydrogeologic conditions at the site that influence seepage rates from the surface to the aquifer. *Geologic and hydrogeologic conditions include the texture and plasticity of the soil and geologic material in the vadose zone; and the separation distance between the pond bottom of the proposed storage facility and the water table.*

Liners. Liners shall meet or exceed the criteria in Pond Sealing or Lining (521) and the liner requirements in Table 2.

Additional Criteria for Waste Storage Ponds

Soil and foundation. The pond shall be located in soils with an acceptable permeability that meets all applicable regulation, or the pond shall be lined. Information and guidance on controlling seepage from waste impoundments can be found in the Agricultural Waste Management Field Handbook (AWMFH), Appendix 10D.

The pond shall have a bottom elevation that is a minimum of 2 feet above the seasonal high water table unless features of special design are incorporated that address buoyant forces, pond seepage rate and non-encroachment of the water table by contaminants. The water table may be lowered by use of perimeter drains, if feasible, to meet this requirement.

Maximum Operating Level. The maximum operating level for waste storage ponds shall be the pond level that provides for the required volume less the volume contribution of precipitation and runoff from the 25-year, 24-hour storm event plus the volume allowance for residual solids after liquids have been removed. A permanent marker or recorder shall be installed at this maximum operating level to indicate when drawdown should begin. The marker or recorder shall be referenced and explained in the O&M plan.

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

Embankments. The minimum elevation of the top of the settled embankment shall be 1 foot above the waste storage pond's required volume. This 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 1. 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 3 – Minimum Top Widths

Total embankment Height, ft.	Top Width, ft.
15 or less	8
15 – 20	10
20 – 25	12
25 – 30	14
30 – 35	15

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

Additional Criteria for Runoff Ponds

Location. Runoff Ponds are flat earthen areas located on the perimeter of corrals where only corral storm runoff water is directed to temporarily store storm water or collect and direct it to other waste storage facilities.

Embankments. Runoff Ponds are limited to earth fills with a maximum height of 2 feet. The minimum top width shall be 4 feet. The side slopes of the settled embankment shall not be steeper than 2 horizontal to 1 vertical. The maximum temporary design water depth against the embankments shall be 1 foot or less. Facilities requiring higher embankments or deeper water storage shall meet the applicable criteria. The design freeboard for runoff ponds shall be no less than 1 foot. In most cases livestock shall be excluded from the embankments to prevent degradation of the embankment.

Soil and foundation. Runoff ponds shall be designed per the liner requirements listed in Table 2.

Additional Criteria for Manure Staging Areas

Location. Established locations outside the manure production area that can be used to store solid manure during periods when manure cannot be land applied. Manure Staging areas are located:

1. Where there is low risk of pollution to any down slope water conveyance system, waterbody, well, or other water source
2. Outside of wetlands, watercourses, and 100 year flood plains
3. Where clean water can be diverted from the area
4. On slopes from 1 to 3%, where access is practicable during poor weather conditions such as when the ground is snow covered, icy, or muddy
5. Outside of a public drinking water source protection Zone 1 or 2 as defined in the Utah Administrative Code R309-600
6. Where soils have slow to moderate permeability to minimize the potential for groundwater contamination
7. Outside of areas where soils (within 3 feet of the soil surface) are sandy, gravelly, or where a high water table or bedrock exists

Embankments. Embankments shall be constructed to contain the 25 year 24 hour storm event plus the average amount of precipitation expected during the storage period. The design freeboard shall be no less than 6 inches. All side slopes on embankments will be less than 3 horizontal to 1 vertical. Where the Manure Staging Area is greater than 1 acre in size the portion of the Manure Staging Area designed to contain the runoff from the area shall follow the criteria for Runoff Ponds.

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 4 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 4 - Presumptive Allowable Bearing Stress Values[1]

Foundation Description	Allowable Stress
Crystalline Bedrock	12000 psf
Sedimentary Rock	6000 psf
Sandy Gravel or Gravel	5000 psf
Sand, Silty Sand, Clayey Sand, Silty Gravel, Clayey Gravel	3000 psf
Clay, Sandy Clay, Silty Clay, Clayey Silt	2000 psf

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

Liquid Tightness. Applications such as tanks, that require liquid tightness shall be designed and constructed in accordance with standard engineering and industry practice 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,

and frost or ice pressure and load combinations in compliance with this standard and applicable local building codes.

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. If soil strength tests are not available, the presumptive lateral earth pressure values indicated in Table 5 shall be used.

TABLE 5 – LATERAL EARTH PRESSURE VALUES[1]

		Equivalent fluid pressure (lb/ft^2/ft of depth)			
Soil		Above seasonal high water table[2]		Below seasonal high water table[3]	
Description[4]	Unified Classification[4]	Free-standing walls	Frame tanks	Free-standing walls	Frame tanks
Clean gravel, sand or sand-gravel mixtures (maximum 5% fines)[5]	GP, GW, SP, SW	30	50	80	90
Gravel, sand, silt and clay mixtures (less than 50% fines) Coarse sands with silt and and/or clay (less than 50% fines)	All gravel sand dual symbol classifications and GM, GC, SC, SM, SC-SM	35	60	80	100
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	90	105
Low to medium plasticity silts and clays with little sand and/or gravel (50% or more fines)	CL, ML, CL-ML	65	85	95	110
High plasticity silts and clays (liquid limit more than 50)[6]	CH, MH	-	-	-	-

[1] For lightly-compacted soils (85% to 90% maximum standard density.) Includes compaction by use of typical farm equipment.
[2] Also below seasonal high water table if adequate drainage is provided.
[3] Includes hydrostatic pressure.
[4] All definitions and procedures in accordance with ASTM D 2488 and D 653.
[5] Generally, only washed materials are in this category
[6] Not recommended. Requires special design if 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 5 under the column "Frame tanks," which gives pressures comparable to the at-rest condition.
- **Flexible or yielding wall.** Use the values shown in Table 5 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 will be operated near the wall, an additional two feet of soil surcharge shall be considered in the wall analysis.

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 EP 393.2, 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.

If the facility is to have a roof, snow and wind loads shall be as specified in ASAE EP288.5, Agricultural Building Snow and Wind Loads. If the facility is to serve as part of a foundation or support for a building, the total load shall be considered in the structural design.

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 standard plans.

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.

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.
- 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. Where applied point loads are minimal and liquid-tightness is not required, such as barnyard and feedlot slabs subject only to precipitation, and the subgrade is uniform and dense, the minimum slab thickness shall be 4 inches with a maximum joint spacing of 10 feet. Joint spacing can be increased if steel reinforcing is added based on subgrade drag theory.

For applications where liquid-tightness is required such as floor slabs of storage tanks, the minimum thickness for uniform foundations shall be 5 inches and shall contain distributed reinforcing steel. The required area of such reinforcing steel shall be based on subgrade drag theory as discussed in industry guidelines such as American Concrete Institute, ACI 360,

"Design of Slabs-on-Grade".

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 shall be used.

CONSIDERATIONS

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

Non-polluted runoff should be excluded from the structure to the fullest extent possible except where its storage is advantageous to the operation of the agricultural waste management system.

Freeboard for waste storage tanks should be considered.

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

Due consideration should be given to environmental concerns, economics, the comprehensive nutrient management plan, and safety and health factors.

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 6 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 6 may be significantly affected:

1. An auxiliary (emergency) spillway
2. Additional freeboard
3. Storage for wet year rather than normal year precipitation
4. Reinforced embankment -- such as, additional top width, flattened and/or armored downstream side slopes
5. Secondary containment

Table 6 - 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 4 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 Minimizing the Potential of Waste Storage Pond Liner Failure.

Sites with categories listed in Table 7 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 7 may be significantly affected.

Table 7 - 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 7 be affected, consideration should be given to the following:

1. The liner is designed in accordance with Table 2.
2. A flexible membrane liner over a clay liner
3. A concrete liner designed in accordance with slabs on grade criteria for fabricated structures requiring water tightness

Considerations for Improving Air Quality

To reduce emissions of greenhouse gases, ammonia, volatile organic compounds, and odor, other practices such as Anaerobic Digester – Controlled Temperature (366), Waste Facility Cover (367), Solid/Liquid Waste Separation Facility (632), and Composting Facility (317) can be added to the waste management system.

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

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

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.

OPERATION AND MAINTENANCE

An operation and maintenance plan shall be developed that is consistent with the purposes of the practice, its intended life, safety requirements, and the criteria for its design.

The plan shall contain the operational requirements for emptying the storage facility. This shall include the requirement that waste shall be removed from storage and utilized at locations, times, rates, and volume in accordance with the overall comprehensive nutrient management plan.

In addition, for ponds, the plan shall include an explanation of the permanent marker or recorder installed to indicate the maximum operating level.

The plan shall include a strategy for removal and disposition of waste with the least environmental damage during the normal storage period to the extent necessary to insure the pond's safe operation. This strategy is for the removal of the contribution of unusual storm events that may cause the pond to fill to capacity prematurely with subsequent design inflow and usual precipitation prior to the end of the normal storage period.

Development of an emergency action plan should be considered for waste storage facilities where there is a potential for significant impact from breach or accidental release. The plan shall include site-specific provisions for emergency actions that will minimize these impacts.

CERTIFICATION

Certification documentation upon completion requires:

- Location of facility
- Source of material to be stored
- Backfill class and Material class (if applicable)
- Compaction method (if applicable)
- Volume of Concrete
- Concrete batch tickets or testing results
- Volume of earth work
- Number and type and size of valves
- Number of type and size of other appurtenances.
- Conservation measures implemented