Utah Guidance for Constructing Liquid Waste Storage Facilities for Animal Feeding Operations

sponsored by

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INTRODUCTION

The purpose of this document is to provide technical and regulatory guidance for agricultural producers, farmers, ranchers, state agencies, private consultants and the public for designing and constructing liquid waste (manure) handling and storage sytems at small and large animal feeding operations. Liquid waste handling systems use water to transport manure to a storage lagoon or pond using conveyance channels and settlement basins. The purpose of a lagoon system is to store livestock wastewater and provide treatment to reduce the organic compounds and nitrogen content of the wastewater. There are advantages and disadvantages to all methods of handling wastewater. You may also consider other waste management alternatives. All liquid manure handling systems need to be evaluated as an important part of an entire farming or ranching operation.

This guidance also addresses the state approval process for small and large operations using liquid manure handling systems with emphasis on the technical and regulatory requirements for ground water quality protection. This process is separate from the federally mandated concentrated animal feeding operation (CAFO) permitting program under the National Pollutant Discharge Elimination System (NPDES) for surface waters. The last page of this guidance provides contact information for the USDA Natural Resources Conservation Service (NRCS), Utah Division of Water Quality (DWQ) and Utah State University Cooperative Extension Service (USU Extension) for additional assistance.

APPROVALS AND PERMITS

Depending on the total number of animal units at an animal feeding operation, the design for a liquid manure handling system must receive approval prior to construction from either the NRCS or DWQ Ground Water Protection Section. Early consultation with agencies is encouraged as you plan and design your system, so please contact NRCS or DWQ for details. One animal unit is equivalent to one slaughter steer. Table 1 below lists various animal unit equivalents for facilities that utilize liquid waste handling systems.

Table 1: Number of Animal Units That Define a Large Concentrated Animal Feeding Operation

Animal Type	Beef Cattle	Swine[(a)]	Dairy Cattle	Sheep	Turkeys	Ducks	Hens or Broilers[(b)]	Horses
Equivalent to 1,500 Animal Units	1,500	3,750 over 55 pounds each	1,050	15,000	82,500	7,500	45,000	750

(a) If swine are under 55 pounds, the number of animals is 18,750.
(b) If continuous overflow watering is used and wastes are dry handled, the animal number is 150,000.

Specifically, the NRCS may approve designs for small operations with less than 1,500 animal units, which equals 1,050 dairy cows or 3,750 swine hogs. Larger operations that exceed 1,500 animal units must be approved only by the DWQ Ground Water Protection Section. Large animal feeding operations must obtain a Construction Permit in accordance with DWQ UAC R317-1, Definitions and General Requirements, and a Ground Water Quality Discharge Permit in accordance with DWQ UAC R317-6, Ground Water Quality Protection. A Construction Permit can be obtained from DWQ by submitting the necessary engineering design drawings,

construction specifications, and operation and maintenance information to DWQ. An application for a Ground Water Discharge Permit and a DWQ Ground Water Quality Protection Permitting Information Booklet can be obtained from the Ground Water Protection Homepage at http://www.waterquality.utah.gov/GroundWater/gwPermitAp.htm. These permitting documents are also available at no charge from the DWQ office in Salt Lake City. As indicated above, the process for obtaining a Construction Permit and Ground Water Discharge Permit is separate from and should not be confused with the federal NPDES CAFO program. Also, you should contact your local county planning commission and health department to determine if any local ordinances or requirements apply.

GOVERNMENTAL AGENCIES PROVIDING TECHNICAL ASSISTANCE

Technical assistance may be provided by the NRCS, DWQ, USU Extension, and private engineering consultants. The NRCS may provide direct planning, design and field construction inspection assistance on a limited basis. Local NRCS offices exist throughout the state. Your local USU Extension office can provide access to agents, specialists, and information regarding your options in livestock waste management. Available information includes technical advice, building plans, handbooks, fact sheets and management systems. The Utah Department of Agriculture and Food may also provide some assistance.

COST ESTIMATES

Contact the NRCS, USU Extension, or your professional engineering consultant for assistance with cost estimates.

REFERENCE LITERATURE

The NRCS *Agriculture Waste Management Field Handbook* is a reference on lagoons, ponds, and impoundments that is written on a technical engineering level. USU Extension has resource materials available for Agricultural Waste Management on the internet at the following address: http://extension.usu.edu/htm/publications/by=category/category=84

TECHNICAL REQUIREMENTS

It is important that impoundments be constructed using technically sound engineering practices. The majority of lagoon and pond design requirements can be found in the latest edition of the NRCS *Agricultural Waste Management Field Handbook*. Specifically, NRCS Conservation Practice Standard 313, Waste Storage Facility (August 2006) addresses waste storage impoundments such as wastewater lagoons and runoff ponds, and includes the criteria tables for determining what type of liner is required. Site-specific subsurface information should be obtained to determine the appropriate liner for a lagoon or pond, such as the soil profile of the unsaturated zone between the ground surface and the water table, the depth to the water table or shallow ground water, and the background water quality of the shallow ground water including total dissolved solids and nitrate concentrations. The depth of one soil exploration must be at least four feet below the final elevation of the lagoon or pond bottom, and the seasonal high water table must be at least two feet below the lagoon or pond bottom. Structural stability and the proposed lagoon dimensions must be evaluated based on these findings.

Liner Criteria Tables

Liners are installed to minimize seepage of wastewater through the bottom of a lagoon or pond to protect the beneficial uses of ground water. Tables 2a, 2b, and 2c below are liner criteria tables that were developed by the best available technology agricultural stakeholder work group in 2006 and were published in Utah NRCS Conservation Practice Standard 313, Waste Storage Facility (August 2006). DWQ incorporated the NRCS liner criteria tables into rule by reference in UAC R317-1 for Construction Permits and R317-6 for Ground Water Discharge Permits. The NRCS liner criteria tables should be used to determine the appropriate liner for any wastewater lagoon or pond by applying site-specific data to determine the risk and vulnerability of contamination to waters of the state, including ground water. Important parameters used in the liner criteria tables include distance to Class 1 surface waters, distance to drinking water wells, unsaturated zone soil lithology and structure, depth to shallow ground water, shallow ground water quality, wastewater lagoon depth, and runoff pond depth and residence time.

Utah Bulletin UT210-06-09 was published by the NRCS on September 11, 2006 to provide guidance on using the liner decision tables in Conservation Practice Standard 313, Waste Storage Facility, (August 2006). The following information was obtained from the bulletin and should be used for small animal feeding operations with animal units below the thresholds in Table 1. Large animal feeding operations with animal units above the threshold in Table 1 will need to work with DWQ to obtain a Construction Permit and Ground Water Discharge Permit in accordance with R317-1 and R317-6 requirements.

Determining Ground Water Quality Class - Documentation of the designer's decision-making process in determining vulnerability and risk to waters of the state must be included in the design report. One of the key items is determining the risk to ground water is to determine the ground water class. For small animal feeding operations that do not require a DWQ Construction Permit and Ground Water Discharge Permit, there are currently two ways to determine the ground water class without having to install and sample monitoring wells.

1. The first method, if available in your area, is to utilize aquifer ground water classifications available on the Utah DEQ website. The web address is: http://www.waterquality.utah.gov/GroundWater/aquifermap.htm.
   There are currently 10 aquifers with ground water classification maps including: Cache Valley in Cache County, Cedar Valley in Utah County, Heber Valley in Wasatch County, Lower Castle Valley in Grand County, Moab-Spanish Valley in Grand and San Juan Counties, Morgan Valley in Morgan County, Navajo/Kayenta and Ash Creek Aquifers in Washington County, Ogden Valley in Weber County, Sanpete Valley in Sanpete County, and Tooele Valley in Tooele County.

   This determination may not be appropriate to use if the aquifer classification applies only to the deep confined aquifer instead of the shallow aquifer. The quality of the shallow ground water may differ from the quality of the deep confined aquifer. It is up to the designer to evaluate and document accordingly if the aquifer classification applies to the shallow or deep aquifer.

2. If the shallow aquifer has not been classified, send an email to Rob Herbert, DWQ Ground Water Protection Section Manager, at rherbert@utah.gov with the Section, Township, and Range location and a 1:24,000 topographic map (like the SHPO map) with an outline of where the storage facility is to be constructed. Specify that you are requesting the ground water class of the shallow aquifer to use in the design of an animal liquid waste storage facility. You can also call Rob Herbert at (801) 538-6038 or Dan Hall at (801) 538-9153 at the DWQ Ground Water Protection Section in Salt Lake City.

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.

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

Risk→ / Vulnerability ↓	**Very High** 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.	**High** 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.	**Moderate** 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.	**Slight** 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** ~ Strongly 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^{-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.
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** ~ 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.
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^{-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.	**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.
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^{-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.	**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.

Table 2c- Criteria for runoff ponds with a water depth of 2 feet or less and a storage period less than 90 days annually.

Vulnerability ↓ \ Risk→	**Very High** 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.	**High** 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.	**Moderate** 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.	**Slight** 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** ~ Consider relocation to another site ~ Specific discharge less than 1 x 10^{-7} $cm^3/cm^2/sec$ ~ 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 ~ Published permeability data and construction method specifications may be used.	**Liner Requirements** ~ Specific discharge less than 1 x 10^{-5} $cm^3/cm^2/sec$ ~ No manure sealing credit ~ Published permeability data and construction method specifications may be used.	**Liner Requirements** ~ Specific discharge less than 1 x 10^{-5} $cm^3/cm^2/sec$ ~ No manure sealing credit ~ Published permeability data and construction method specifications may be used.
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** ~ Specific discharge less than 1 x 10^{-6} $cm^3/cm^2/sec$ ~ No manure sealing credit ~ Published permeability data and construction method specifications may be used.	**Liner Requirements** ~ Specific discharge less than 1 x 10^{-6} $cm^3/cm^2/sec$ ~ No manure sealing credit ~ Published permeability data and construction method specifications may be used.	**Liner Requirements** ~ Specific discharge less than 1 x 10^{-5} $cm^3/cm^2/sec$ ~ No manure sealing credit ~ Published permeability data and construction method specifications may be used.	**Liner Requirements** ~ Specific discharge less than 1 x 10^{-5} $cm^3/cm^2/sec$ ~ No manure sealing credit ~ Published permeability data and construction method specifications may be used.
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^{-5} $cm^3/cm^2/sec$ ~ No manure sealing credit ~ Published permeability data and construction method specifications may be used.	**Liner Requirements** ~ No liner required.	**Liner Requirements** ~ No liner required.	**Liner Requirements** ~ No liner required.
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^{-5} $cm^3/cm^2/sec$ ~ No manure sealing credit ~ Published permeability data and construction method specifications may be used.	**Liner Requirements** ~ No liner required.	**Liner Requirements** ~ No liner required.	**Liner Requirements** ~ No liner required.

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.*

Determining Surface Water Class - Documentation of the designer's decision-making process in determining vulnerability and risk must be included in the design report. Another key item is determining the appropriate surface water class. The first step is to determine the nearest body(s) of water downgradient from the liquid waste storage facility . Then go to the DEQ rules located at: http://www.rules.utah.gov/publicat/code/r317/r317-002.htm#T7

Locate "R317-2-13. Classification of Waters of the State" which includes a table listing each river reach and reservoir in the state.

Here are some example determinations:

1. The UV Dairy is proposing to construct a 10-foot deep waste storage facility that sits on a hillside 550 feet away from the South Fork of the Ogden River in Huntsville. Go to the "R317-2-13. Classification of Waters of the State" table and look up "13.4 Weber River Basin" then proceed down the table until reaching "a. Weber River Drainage". Then proceed down the table until reaching the section that best applies. The section that best applies in this case is "All tributaries to Pineview Reservoir 1C, 2B, 3A, 4". The most limiting being Class 1C. Entering this into the liner decision table, it is determined that the facility is a "*high risk*".
2. The B-Bar Ranch in Santa Clara is proposing to construct a 2-foot deep runoff pond on the low end of the feedlot. At the base of the feedlot there is an irrigation ditch that runs into a neighbor's pasture where the ditch terminates. Since irrigation water is defined as Class 4 surface water and the facility is 20 feet away from the ditch, the facility would be a *"moderate risk"*.
3. Assume the same situation above except that the irrigation ditch empties into the Santa Clara River. In a flood the irrigation ditch becomes a tributary to the Santa Clara River. The facility now would be a *"high risk"* since the table says that the Santa Clara River and tributaries are Class 1C surface waters.

Difference Between Public Drinking Supply Well and Domestic 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. A domestic supply well is any well supplying water for household use or human consumption. The designer should question the landowner as to the location of any known wells within 1000 feet of the waste storage facility.

Testing Requirements on Earthen Liner Material - Prior to constructing the liner, a falling head permeability test must be run from samples of the proposed liner material. This can be done for NRCS assisted projects at no cost by sending a five-gallon bucket full of the proposed liner material, and a short letter detailing what tests are needed, along with your contact information including address and phone number to the following address in Lincoln, Nebraska:

NRCS Soil Mechanics Center
512 South 7th Street
Lincoln, NE 68508

This testing will verify if the proposed borrow source will yield the required permeability when compacted properly. If bentonite, soda ash, or other amendments are needed to attain the required permeability or compaction, the Soil Mechanics Center will also need to have a sample of the amendment material. Allow six to 12 weeks for a report. The report will provide the appropriate guidance for constructing the liner. The Soil Mechanics Center will specify a range of moisture content to attain the necessary compaction thereby yielding the required permeability. Special care needs to be taken during liner construction to assure that the soil has the specified moisture content and proper compaction.

If the liner requirement states, "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" then the landowner is responsible for hiring a geotechnical testing firm (look under engineering or testing in the yellow pages) and have the testing firm run a falling head permeability test on the as-built material, and determine the as-built permeability and compaction. A minimum of 3 as-built samples per acre of water surface area should be taken, with at least 1 of the samples being from the sloped embankment. For example, if the surface area of the waste storage facility is 3 acres, then 9 samples would need to be taken; 3 of them being from the embankment. The testing firm must send a transmittal letter that includes the test permeability data to the landowner, documenting compliance with State law.

A copy of the Soil Mechanics Center's findings, the designer's decision-making process and the engineering testing firm's results must be included in the project design report.

If the liner requirements states, "Published permeability data and construction method specifications may be used" then the designer may use the data in the AWMFH or a Soil Mechanics Center report to design a method specification. A Construction Inspection Plan/Quality Assurance Plan must be developed to confirm that the method specification was followed. A record of the design process and the Quality Assurance Plan must be included in the design report.

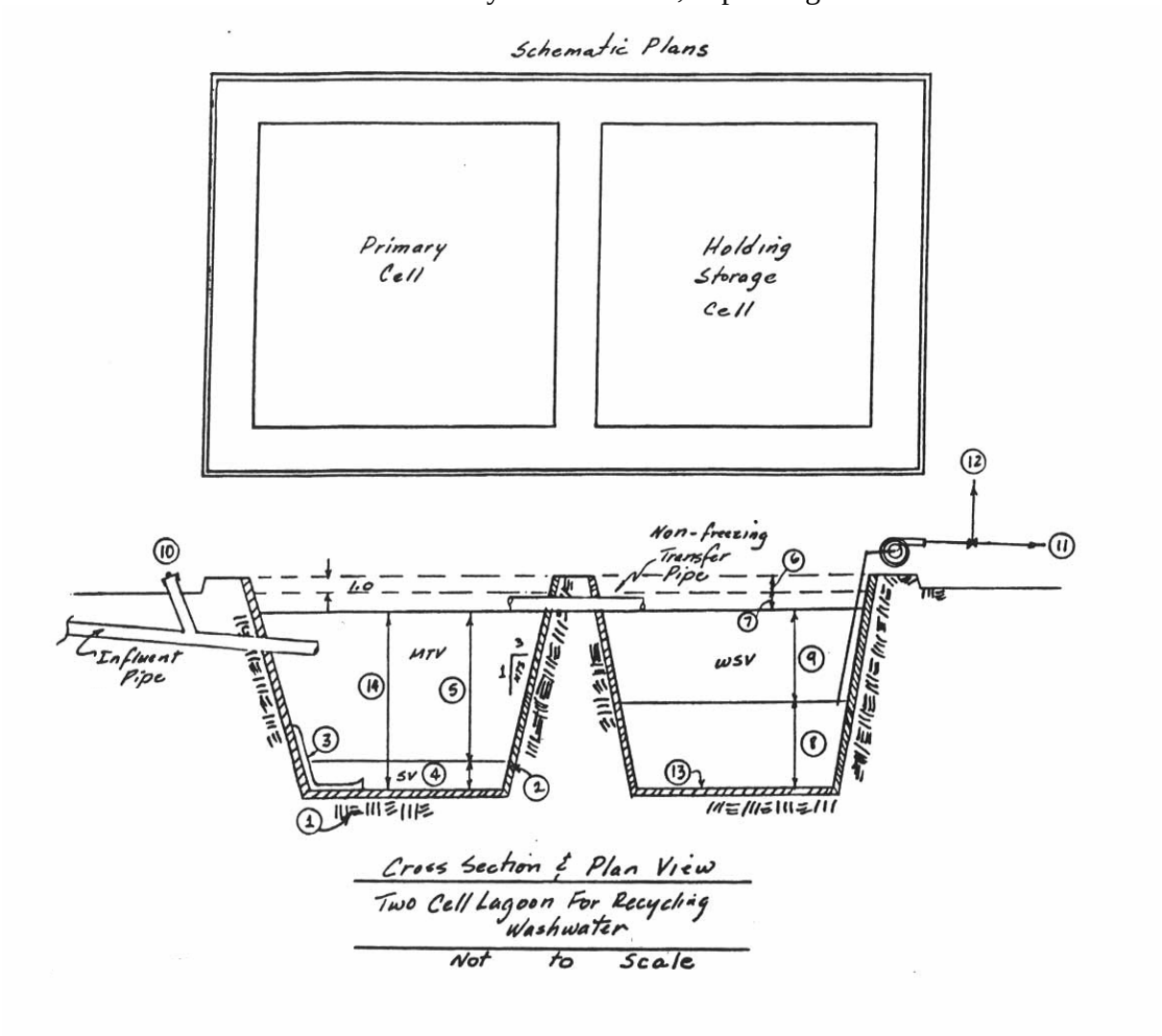
Determining if Waste Storage Facility is Near a Well - The first step is for the designer to ask the landowner of the existence of any known wells near the area. If a well is within 1000 feet of the facility, then more information must be obtained. Determine if the well is part of the community drinking water system and document accordingly. Well logs and other information can be found to assist in gathering information about the well and ground water on the State Water Rights website: http://nrwrt1.nr.state.ut.us/

Engineering Design Plans and Specifications

Complete plans and specifications must be submitted for review and approval to the NRCS for operations under 1,500 animal units or to the DWQ Ground Water Protection Section for operations equal to or greater than 1,500 animal units. Complete design plans and specifications for a liquid waste handling and storage facility must be certified by a Registered Professional Engineer licensed to practice in the state of Utah. This pertains to the construction of the wastewater handling and storage system including channels, conveyences, transfer structures, solid separating structures, lagoons, runoff ponds, liners, dikes, berms, and wastewater related piping, pumping, and recycling.

Conceptual Design Plans

The following conceptual drawings are provided to help a potential anaerobic lagoon system owner understand some of the major theory of design and requirements of construction drawings prior to retaining professional assistance. A two cell lagoon is depicted below. Two cell lagoons are recommended for facilities which recycle washwater, depending on size.



Key to Drawing Numbers

1. Compacted Subgrade.
2. Pre- and post-construction tested soil liner.
3. Splashblocking and rip-rapping required for both lagoon cells.
4. Sludge Storage Volume (SV).
5. Manure Treatment Volume (MTV).
6. Freeboard 1.0 feet minimum.
7. Site specific inflow + precipitation – evaporation depth + 25-year, 24-hour storm. Annual maximum monthly depth.
8. Minimum depth for vegetation and odor control (3-feet plus).
9. Seasonal storage volume (WSV). Usually 120-180 days operating volume.
10. Clean-out for plugged pipe. The discharge should be above high water level or below the seasonal ice sheet.
11. Irrigation discharge.
12. Flush and recycle water.
13. Elevation may be higher than first cell if necessary.
14. Minimum year-round operating depth. 10-feet design goal suggested. 6-feet absolute minimum required (MTV+ SV).

Embankments and Dikes

Embankment Parameters	Dike Slopes	Top of Dike Width	Materials	Compaction	Rip-Rap Wave Shield
Required	3 Horizontal to 1 Vertical	8-feet	Relatively Impermeable	Compaction Plan or NRCS Supervision	None
Recommended [a]	Same	Same	Same	90% Standard Proctor	For large lagoons with erodible soils

(a) Contact DWQ or NRCS for further information. Usually required for ground water discharge permits.

Piping

Inlet and outlet piping must be specified on the plans . All pipes must be protected from freezing and plugging. Usually, piping should discharge above the high water line, but where freezing is expected to cause plugging problems, the pipe could be installed below the expected elevation of the winter ice sheet, as shown on page four.

Odor Management

Odor Management Parameter	**Physical Separation from other habitation**	**Year-round Operating Depth (Anaerobic Lagoons)**	**Number of Lagoon Cells**	**Volatile Solids Loading Rate for Anaerobic Lagoons**
Required	As required by local ordinances	6-feet minimum	One	Varies from 4.5 to 5.5# per 1000 cubic feet. See AWMFH [b]
Recommended [a]	1,320 feet; also see AWMFH [b] and local siting standards	10-feet minimum	Two, depending on size	37.5% Minimum Reduction [c]

(a) Contact DWQ or NRCS for further information. Usually required for ground water discharge permits. Mechanical aeration can also help control odors using NRCS guidance of 1 pound of oxygen per 1 pound biological oxygen demand (BOD).
(b) AWMFH NRCS Agricultural Waste Management Field Handbook
(c) Mechanical aeration can also help control odors.

Miscellaneous

1. An operation and maintenance (O&M) manual must be submitted prior to final inspection and approval to operate.
2. A statement of intent to submit a comprehensive nutrient management plan (CNMP) in accordance with CAFO program regulations must be developed with the specifications. A CNMP must be written by NRCS or other qualified specialist. Field application of livestock waste must comply with CNMP requirements.
3. Impoundment contents shall not be discharged to surface waters. They must be located so they do not contaminate drinking water wells, springs or pipelines. Check with NRCS, local health department or DWQ for guidance.
4. Saturated manure, such as that immediately removed from solid separation facilities, must not be piled on unprotected surfaces. All drainage from saturated manure must be routed to a lined structure. Drained “non-bleeding” manure may be relocated.
5. Address safety considerations. This shall include fencing and signage, as necessary.

6. Thorough compaction of the impoundment subgrade material must be provided. Field testing assistance for this may be provided by testing laboratories or NRCS. See the conceptual drawings above.
7. A minimum fifteen (15) years of sludge storage volume is required for lagoons. This volume varies by animal type. See the NRCS *Agricultural Waste Management Field Handbook* for the particular rate of sludge acculumation for each animal type.
8. Lagoons should be sized to store waste during the nongrowing season, where land application is to be used. This is usually between 120 and 180 days.

Requirements and Planning Checklist

1. If the property has not been purchased yet, evaluate the site suitablity for a liquid waste handling and storage facility using Tables 2a, 2b, and 2c in the Utah NRCS Conservation Practice Standard 313, Waste Storage Facility, (August 2006). If site-specific soil and ground water data are not available, a limited subsurface investigation should be conducted as described below.
   a. One soil boring advanced to the water table to determine the depth to ground water and to obtain a ground water quality sample for analysis of total dissolved solids and nitrate to determine the ground water quality class at the site.
   b. Soil should be continuously sampled and logged to determine the soil profile using the Unified Soil Classification System (USCS) and a boring log should be produced.
   c. Based on the soil boring log, depth to ground water, and ground water quality class, determine if the site is suitable for a liquid waste handling and storage facility.
2. If the site is environmentally suitable for a liquid waste handling and storage facility, or the property has already been purchased, determine the appropriate liner system using Tables 2a, 2b, and 2c in the Utah NRCS Conservation Practice Standard 313, Waste Storage Facility, (August 2006).
3. Evaluate if adequate water rights and supply are available to run the proposed operation.
4. Calculate the number of animal units for the operation. Consider the number of animals and the time to full buildout.
5. If the operation is 1,500 animal units or more, contact DWQ to apply for a Construction Permit and Ground Water Discharge Permit permit.
6. If the operation is less than 1,500 animal units, you have the choice of getting design review and approval to construct from NRCS, or applying for a Construction Permit from DWQ. Please contact NRCS or DWQ as soon as possible.
7. Draw a preliminary site sketch and layout.
8. Locate and dimension the system, to include the requirements from the NRCS *Agricultural Waste Management Field Handbook* and this guidance document, for odor control, conveyances, piping, settlement basins, compost drain pads, embankments, and piping.
9. Draft design plans and specifications for the system showing the location of all essential structures, materials, equipment, dimensions, and elevations. The specifications should describe the materials and installation requirements needed to complete the plans.
10. Update the cost estimate to the current draft plans and review financial issues.
11. If land application of waste nutrients is necessary, the nutrient management plan must conform to comprehensive nutrient management plan (CNMP) requirements.
12. The agency will review the plans and ask for adjustments to the design, or will issue an approval letter or permit to you. Ground water discharge permits require a 30-day public comment period prior to permit issuance for operations ≥ 1,500 animal units.
13. After agency approval notify your agency contact of the date you begin construction.
14. Normally, the agency will do some periodic inspection during construction.
15. Notify the agency when construction is complete to request final inspection and certification.

16. Receive final approval of completed construction prior to discharging water into the system.
17. Prepare a set of as-built plans for you and the approving agency.

CONTACT INFORMATION

Utah Natural Resource Conservation Service (NRCS)
Web Site: http://www.ut.nrcs.usda.gov
Salt Lake City office (801) 524-4550

State Environmental Engineer	Bronson Smart	(801) 524-4589	bronson.smart@ut.usda.gov
State Agronomist	Niels Hansen	(801) 524-4568	niels.hansen@ut.usda.gov

Utah Department of Environmental Quality, DWQ Ground Water Protection Section
Web Site: http://www.waterquality.utah.gov/GroundWater/index.htm
Salt Lake City office (801) 538-6146

Ground Water Manager	Rob Herbert	(801) 538-6038	rherbert@utah.gov
Environmental Engineer	Woody Campbell	(801) 538-6067	wwcampbell@utah.gov
Environmental Scientist	Dan Hall	(801) 538-9153	dhall@utah.gov

Utah Department of Agriculture and Food, Division of Conservation and Resource Management
Web Site: http://ag.utah.gov/conservation/conservation.html
Salt Lake City office (801) 538-7177

Environmental Scientist	Roy Gunnel	(801) 538-7174	rgunnel@utah.gov

Utah State University (USU) Extension
Web Site: http://extension.usu.edu/
Logan office (435) 797-3396

REFERENCES

NRCS Agricultural Waste Management Field Handbook, http://www.info.usda.gov/CED/

Utah NRCS Conservation Practice Standards 313 (Waste Storage Facility), 359 (Waste Treatment Lagoon), 632 (Solid/Liquid Separation Facility), and 634 (Manure Transfer).

Utah DWQ Ground Water Discharge Permit Application and DWQ Ground Water Quality Protection Permitting Information Booklet http://www.waterquality.utah.gov/GroundWater/gwPermitAp.htm

Aquifer Ground Water Classification Maps
http://www.waterquality.utah.gov/GroundWater/aquifermap.htm

Utah DWQ Rules
http://www.waterquality.utah.gov/documents/DOC_RULE.htm

Utah Division of Water Rights
http://www.waterrights.utah.gov/

USU Extension Agricultural Waste Management publications
http://extension.usu.edu/htm/publications/by=category/category=84