NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

WASTE TREATMENT LAGOON
(Number)
Code 359

DEFINITION

An impoundment made by excavation or earthfill for biological treatment of animal or other agricultural waste.

PURPOSE

To biologically treat organic waste, reduce pollution, and protect the environment.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where: (1) an overall waste management system has been planned; (2) waste generated by agricultural production or processing needs treatment; (3) soils are suitable for retaining the waste or can be sealed; and (4) where livestock are concentrated.

This standard establishes the minimum acceptable requirements for design, construction, and operation of waste treatment lagoons. Embankments are limited to hazard class (a). This standard does not apply to waste storage ponds or to waste storage structures.

CRITERIA

Location. The lagoon should be located near the source of waste and as far from neighboring dwellings as practical. If possible, locate the lagoon where prevailing winds will carry odors away from residences and public areas. Runoff from outside drainage areas should not enter the lagoon. The lagoon shall not be located in a flood plain unless it is protected from inundation or damage by a flood event that occurs once every 25 years. ***LAGOONS FOR SWINE SHALL NOT BE LOCATED IN THE 100-YEAR FLOODPLAIN.***

Minimum distance from wells and other water sources must be in compliance with state and local ordinances. It is the responsibility of the designer to ensure that current state and local distance requirements are met. The following table shows minimum distances.

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Minimum Distance Table for all Animals Except Swine Facilities Sited Under General Statute 106-801 thru 805

Public or Private use Facilities	Minimum Distance From Facilities	
	Operation existing prior to 04/15/87 (No enlargement) (No increase in SSLW) [1]	New operation or existing operation that is enlarging SSLW [1]
Any public use area, church, picnic area, playground, etc.	300 Ft.	750 Ft.
Residence or place of habitation other than owner or his tenant	300 Ft.	750 Ft.
Wells (For Human Consumption)	100 Ft. minimum - General Statutes 87-87 and 87-88. 152A2C.0107 (a)(1)(c)	
Area specified by state or local ordinance	Greater of state/local or NRCS distance shown above.	
Perennial Waters	100 ft. (New or Expanding Operations)	

[1] SSLW - Steady State Live Weight = Ave. wt. per unit x no. of units @ capacity

Any exception to the above distances must be approved by the ASTC(FO) with concurrence from the State Conservation Engineer.

The 750 ft. minimum distance must exist the day of the site investigation. Site evaluations are valid for 12 months.

The Minimum Distance for Swine Operations is Dictated by General Statute 106 - 801 thru 805 as amended by HB-515 (Applies to swine operations sited on or after 8/27/97).

Swine House or Lagoon

≥ 1,500 feet from any occupied residence 2,500 feet from any school, hospital, church , ***outdoor recreational facility, national park, historic property, or child care center.***
500 feet from any property boundary.
500 feet from any well supplying water to a public water system.
500 feet from any well that supplies water for human consumption on property not owned or controlled by the swine producer.

Land Application Site

75 feet from any residential property boundary (Any property with a residence on it)
75 feet from any perennial stream or river other than irrigation ditch or canal.

(Note: Waste Treatment Lagoons and Waste Storage Ponds are the same in respect to SB-1080.)

Odor Control

As a minimum the following will be used to reduce odor on all lagoons:

- New or emptied lagoons shall be precharged with a volume of water equal to one-half of the treatment volume before wastes are introduced, so that solids discharged into the lagoon are submerged.
- Pipes discharging wastes into the lagoon shall be extended beneath the surface of the lagoon to avoid releasing gases from agitated wastes.
- Intake pipes for effluent removal shall be placed in the aerobic layer of liquid approximately 18 inches below the surface. A floating intake may be used.

When practicable a dense stand of trees and shrubs strategically placed around lagoons, production facilities, and fields can reduce or redirect winds helping to contain or disperse odors.

Emergency Action Plan

An Emergency Action Plan shall be prepared for each lagoon. The plan will outline steps to be followed in case of an emergency with the lagoon such as overflow, breaching, leakage, need for emergency land application, etc. As a minimum it will contain the following items for the owner/operator to carry out in the event of an emergency:

- Call the Division of Water Quality (DWQ) to report the problem. Include name and phone number of the appropriate regional office. If outside normal business hours, call the N. C. Emergency Management

Office in Raleigh and ask them to contact DWQ. Give the name of the facility, location and DWQ registration/certification number.

- Call 911 or the Sheriff's Department if there is danger to downstream property (residences, road, etc.). Include phone number.

- Contact the contractor of owner's choice to begin repair of problem to minimize off-site damage. Include names and phone number(s).

- Contact the technical specialist who certified the lagoon (NRCS, Consulting Engineer, etc.). Include phone number. If this specialist is no longer working, contact one who has design approval.

A copy of this plan with telephone numbers filled in must be available at each site. It should be posted in a readily accessible location.

Site Investigation

A detailed site investigation shall be made for each lagoon prior to design. This investigation should include, but not be limited to evaluation of, distance from residences, proximity to the 100-year floodplain, blue line streams, zoning jurisdiction of municipalities, utilities in the construction area, wetlands, available land for disposal, soils, and other environmental factors. Form NC-CPA-17 may be used. When requested by the technical specialist, the owner shall furnish the distance from nearest residences or other private or public use facilities. At the discretion of the technical specialist, a survey by a registered land surveyor may be required to establish the distances.

During the site investigation, it must be verified that no subsurface tile lines are present. On sites that are located on cropland or land that has been cropped in the past and is land with soil types that respond to subsurface drainage, an observation trench along the entire length of the embankment shall be constructed to a minimum of five feet in depth. The observation trench may be excavated during the soils investigation phase or during construction. The trench shall have a bottom width adequate to accommodate the equipment used for excavation, backfill, and compaction operations and the side slopes shall be 1:1 or flatter. If any tile lines are present in the area of the embankment, they must be removed for a minimum distance of 15 feet beyond the downstream embankment toe. If a tile line exists above the embankment it shall be rerouted around the lagoon.

If wetlands may be involved, contact the Corps of Engineers and/or NRCS for a wetland determination/delineation. If wetlands are involved, a 401 water quality certification and a 404 permit may be needed.

Written notice of swine farms

Any person who intends to construct a swine farm whose animal waste management system is subject to a permit shall, after completing a site evaluation and before the farm site is modified, notify all adjoining property owners; all property owners who own property located across a public road, street, or highway from

the swine farm; the county or counties in which the farm is located; and the local health department or departments having jurisdiction over the farm site of that person's intent to construct the swine farm. This notice shall be by certified mail sent to the address on record at the property tax office in the county in which the land is located. Notice to a local health department shall be sent to the local health director. The written notice shall include all of the following:

1. ***The name and address of the person intending to construct a swine farm.***
2. ***The type of swine farm and the design capacity of the animal waste management system.***
3. ***The name and address of the technical specialist preparing the waste management plan.***
4. ***The address of the local Soil and Water Conservation District Office.***
5. ***Information informing the adjoining property owners and the property owners who own property located across a public road, street, or highway from the swine farm that they may submit written comments to the Division of Water Quality, Department of Environment and Natural Resources.***

Hazard Classification

The area downstream of the embankment must be evaluated carefully to determine the impact from a sudden breach of the proposed embankment on both structural and environmental features. This evaluation must consider all existing improvements and those improvements that may reasonably be expected to be made during the useful life of the structure. The results of this examination provide for the proper hazard class of the embankment. Only hazard class (a) embankments are to be designed under this standard. See Engineering Notekeeping, Field Office Technical Guide Practice Standard 378 or National Engineering Manual 520.21 for guidance concerning documentation of hazard class determination.

Soil and foundation

Locate the lagoon on soils of slow to moderate permeability or on soils that can seal through sedimentation and biological action. Avoid gravelly soils and shallow soils over fractured or cavernous rock.

A detailed soils investigation with special attention to the water table and seepage potential must be a part of each plan and design. The soils investigation must extend at least two feet below the planned bottom. In the vicinity of the embankment, but not under it, the soils investigation will extend to a depth equal to the height of the embankment or until rock is encountered. When poor foundation conditions are anticipated, the investigation shall extend to the depth determined by the designer.

When an embankment is involved samples of the proposed fill material should be obtained and tested. Tests required are at the discretion of the designer. The test results shall be used to determine the design requirements for the embankment.

A minimum of five test pits or 1 per 10,000 ft^2 of lagoon bottom is recommended.

Liners

If rapid self sealing is not probable, special considerations such as mechanical treatment, lining, or other techniques must be considered. A liner, or equivalent sealant, is required in SP, SW, GP, and GW, or other problem soils as

classified according to the Unified Soil Classification System. A liner is also required for most SM soils. A determination as to whether a liner is needed for other soils will be made during the on-site soils investigation prior to the design.

If a liner is required and a clay liner is the sealant of choice it will be designed and installed in accordance with NRCS South National Technical Center (SNTC) Technical Note 716 (Revised September 1993). A qualified construction inspector designated by the designer must be on site during construction as necessary to verify proper liner construction in accordance with Technical Note 716. In the absence of supervision of construction by a qualified inspector, the liner must be tested to verify a maximum hydraulic conductivity of 1.25×10^{-6} cm/sec. (.003 ft/day)

Since soils are not always consistent, during construction small areas not evident during the investigation may be found. These areas should be over excavated and lined with clay or other suitable sealant material **as specified by the designer**. Other sealant or lining techniques should be planned according to industry accepted design, installation, operating procedures appropriate for the selected technique.

Waste production

Waste treatment lagoons are designed on the basis of 5-day biochemical oxygen demand (BOD5) or volatile solids (VS) loading. Design loading shall be based on the maximum steady state live weight of animals using the lagoon and on the waste produced. Information on waste production is provided in Chapter 4 of the Agricultural Waste Management Field Handbook (AWMFH).

The values for waste production and the characteristics of fresh livestock manure given in Table 1 are from the North Carolina Cooperative Extension Service and should be used except for specific situations which deviate from normal. It should be noted that the amount of nutrients available for crops is different from the amount produced. See Waste Utilization (633) and Nutrient Management (590) for plant available nutrients and nutrient uptake values by various crops. Site specific data, when available may be used in lieu of the information given in the table.

Domestic and industrial waste from washdown facilities, showers, toilets, sinks, etc., shall not be discharged into the animal waste management system.

Table 1. LIVESTOCK FRESH MANURE CHARACTERISTICS

	Average Animal Weight	Manure Production (Feces & Urine)		Nitrogen		Phosphorus P_2O5	Potassium K_2O
				Total N	Ammonia NH_3N		
	(lb)	(gal/day)	(ton/yr)	<==========(lbs/ton)==========>			
Dairy	1400	14.6	21.9	10.5	1.8	5.0	8.2
Beef	800	5.53	7.9	11.9	3.0	7.3	8.8
Veal	200	1.49	2.0	8.6	4.0	4.9	11.0
Swine	135	1.37	1.9	12.4	6.8	9.6	8.3
Sheep	60	0.28	0.4	20.8	6.2	9.9	19.4
Goat	140	0.69	1.1	21.8	6.5	12.1	17.7
Horse	1000	5.95	9.2	12.0	2.4	6.5	12.0
Rabbit	10	0.08	0.06	23.0	6.9	20.6	10.8
Layer	4	0.03	0.05	26.2	6.6	21.1	11.4
Broiler	2	0.25	0.03	26.0	6.5	16.3	11.2
Turkey	15	0.08	0.12	26.7	3.4	22.5	12.3
Duck	3	0.04	0.05	27.8	5.3	22.5	15.6

Fresh Water
The following amount of excess water is to be added to the temporary storage:

Type of Operation	Live Weight	Excess Water
Nursery	30 lbs	0.2 gals/hd/day
Finishing	135 lbs	0.9 gals/hd/day
Farrow-Weanling	433 lbs	2.9 gals/sow/day
Farrow-Feeder	522 lbs	3.5 gals/sow/day
Farrow-Finish	1,417 lbs	9.5 gals/sow/day
Boar-Stud	400 lbs	2.7 gals/animal/day
Gilt	150 lbs	1.0 gals/animal/day
Dairy	1,400 lb	6.0 gals/animal/day
Layers	4 lbs	0.013 gals/bird/day

Anaerobic waste treatment lagoons are designed on the basis of daily Volatile Solids (VS) loading per 1,000 ft^3 of lagoon volume. Maximum loading for anaerobic lagoons shall be as indicated in Figure B (See Fig. 10-22, page 10-29 of AWMFH) or Table 2. Animal weights are expressed as average values for the purpose of lagoon design.

TABLE 2. LIVESTOCK ANAEROBIC LAGOON CRITERIA

Animal Type	Unit[a]	Average Live Animal Weight	Feces, Urine and Excess Wash Water[b]	Lagoon Liquid Capacity					
				Design Treatment Volume		Sludge Storage Volume[c,d]		Temp Storage	Total Volume
		(lbs)	gals/day	ft³/lb	ft³/Unit	ft³/lb	ft³/Unit		
Dairy	per head	1400	22.0	1.0	# 1400		1300	*	**
Beef	per head	800	6.6	.75	600		530	*	**
Veal	per head	200	1.9	.75	150		145	*	**
Swine									
Wean/Feed	per head	30	0.5	1.0	30	.25	7.5	*	**
Feed/Fin	per head	135	2.3	1.0	135	.25	34	*	**
Far/Wean	per sow	433	7.2	.67	290	.17	74	*	**
Far/Feed	per sow	522	8.0	.67	350	.17	89	*	**
Far/Fin	per sow	1417	23.0	1.0	1417	.25	354	*	**
Gilt Dev.	per head	150	2.5	1.0	150	.25	37.5	*	*
Boar/Stud	per head	400	6.7	0.5	200	.125	50.0	*	*
Poultry									
Layer	per bird	4.0	.045	2.5	10		1.1	*	**
Pullet	per bird	1.5	.017	2.5	3.8		3.2	*	**

[a]One-time animal or bird capacity
[b]Does not include fresh flush water or drainage area runoff
[c]No manure solids removal prior to lagoon input
[d]Sludge accumulation for approximately 5 years. Accumulation rates are without solids removal.

* Temporary storage consists of 1) manure, 2) excess wash water, 3) rainfall in excess of evaporation, 4) 25-year, 24-hour storm, 5) "Heavy Rain" Factor , 6) outside runoff, if any .

** Total volume consists of design treatment volume, sludge storage, temporary storage and 25 year, 24 hours storm. Does not include Freeboard and depth of flow in spillway (if applicable)

Minimum Volume for Dairy and Beef may be decreased when the solids are removed.

Naturally aerobic lagoons are designed on the basis of daily BOD_5 loading per acre of lagoon surface. The maximum aerobic lagoon loading rate for North Carolina is 50 lb. of BOD_5 per acre per day shall be as indicated in Figure C (See Figure 10-25, page 10 of the NRCS Agriculture Waste Management Field Handbook. One 1400 lb. dairy cow requires 2000 ft² of surface area while one finishing hog requires 365 ft².

Mechanically aerated lagoons using floating surface aerator technology for odor control are designed to satisfy 50% of the waste COD based on an oxygen transfer rate of 3 lbs per horsepower-hour and require 1000 ft^2. of surface area maximum per horsepower of aeration. Refer to the design procedures provided in the Agricultural Waste Management Field Handbook or to Cooperative Extension Service Research Data. Alternate aeration waste treatment technologies should be planned, installed, and operated according to proper design and operating procedures.

Sludge

Any anaerobic lagoon will accumulate significant amounts of sludge regardless of the bacterial digestion efficiency. This accumulation of sludge in time will diminish the treatment capacity of the lagoon unless the lagoon is designed with enough storage capacity to avoid having to remove the bottom sludge throughout the life of the lagoon. Table 2 shows the required volume for sludge accumulation in anaerobic lagoons. The volume of sludge storage required in Table 2 is equal to approximately 5 years accumulation.

Sludge storage is required in the lagoon design. The amount of sludge accumulation shall be calculated and included in the producer's Waste Utilization Plan. The plan will include a statement that sludge should be tested before land application. The Waste Utilization Plan will include the number of acres required for land application of sludge in the future based on current agronomic rates.

Waste Storage Volume. The maximum operating level shall be set to provide the designed loading (treatment volume)plus a volume sufficient to store the following:

1. Manure and waste water[1]
2. Excess wash water
3. Normal precipitation less evaporation on lagoon surface[1]
4. Solids accumulation[2]

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[1]Accumulated between periods of drawdown
[2]For the period between solids or sludge removal

Mechanically aerated lagoons are designed on the basis of BOD_5 or ultimate BOD loading and on the basis of the equipment manufacturer's performance data for oxygen transfer and mixing. If used for odor control, aeration equipment shall provide a minimum of 0.5 kg (1 lb) of oxygen for each half kilogram (pound) of BOD_5 contributed daily. For complete treatment, refer to the design procedures provided in the Agricultural Waste Management Field Handbook.

The maximum operating level shall be sufficient distance below any automatic outflow device, pipe or emergency spillway to provide storage for the 25-year, 24-hour precipitation on the lagoon surface plus a heavy rainfall equal to or greater than an additional 25-year, 24-hour storm. The maximum operating level shall be marked with a highly visible marker set in the lagoon.

The minimum operating level after drawdown should normally be that level needed for the design loading (treatment volume plus sludge) except when the lagoon is in drawdown to permit sludge removal or addition of dilution water. This level shall be marked with a highly visible marker.

Temporary Storage Volume

In addition to the required treatment volume, waste treatment lagoons shall be provided with temporary storage. The volume of temporary

storage provided shall be consistent with the planned pumping interval incorporated into the waste utilization plan. In soils with high water tables all temporary storage shall be above the seasonal high water table. A minimum of at least six months temporary storage is recommended except when special management practices or techniques permit otherwise.

The minimum volume of temporary storage is the total of the following:

With Outside Drainage Area

1. Manure and excess water[1]
2. Normal precipitation that falls on lagoon surface less evaporation on lagoon surface for time of year which results in greatest storage requirement[1].
3. Undiverted runoff from drainage area for normal rainfall during storage period.
4. 25-year, 24-hour precipitation on lagoon surface.
5. Undiverted runoff from 25-year, 24-hour storm from drainage area.

Without Outside Drainage Area

1. Manure and excess water[1].
2. Normal precipitation that falls on lagoon surface less evaporation on lagoon surface for time of year which results in greatest storage requirement[1].
3. 25-year, 24-hour precipitation on lagoon surface + additional "Heavy Rain"[2] factor which exceeds the long-term rainfall average.

[1]*Accumulated during the period between times of excess effluent removal.*
[2]*The "Heavy Rain" Factor shall be equal to or greater than the 25-year, 24-hour storm.*
Note: Additional temporary storage may be provided to meet management goals or regulations.

Depth

The minimum depth of liquid shall be 6 feet for mechanically aerated and anaerobic lagoons, and 2 feet for aerobic lagoons. The maximum depth for mechanically aerated and anaerobic lagoons is dictated by the site and the equipment. The maximum operating depth for aerobic lagoons shall be 5 ft.

Foundation Cutoff (Keyway, Cutoff, or Core Trench)

A cutoff of relatively impervious material shall be provided under the embankment if necessary for seepage control. The cutoff shall be located at or upstream from the centerline of the dam. It shall extend up the abutments as required and be deep enough to extend into a relatively impervious layer or provide for a stable embankment when combined with seepage control. The cutoff trench shall have a bottom width adequate to accommodate the equipment used for excavation, backfill, and compaction

operations, and the side slopes shall be 1:1 or flatter.

All foundation cutoffs shall be dewatered before backfilling.

Bottom and edges
The bottom of all lagoons shall be approximately level. The side slopes of all lagoons shall be uniform from top to bottom and shall be stable for existing soil conditions.

Scarify the bottom and cut slopes of the lagoon a minimum depth of six inches and compact to decrease the permeability of the soil. Compaction shall be with a sheepsfoot roller or tamping roller.

In certain soils a liner will be required. Special consideration must be spelled out in the design. (See page 359-4, Liners)

Earth embankment
For this standard, the maximum effective height of the dam is 35 feet. The allowance for settlement shall be no less than 5 percent. The side slopes of the settled embankment shall not be less than 3 horizontal to 1 vertical. All slopes must be designed to be stable. The minimum elevation of the top of the settled embankment shall be one foot above the maximum design water surface in the lagoon.

The minimum top width for embankments are shown in the following table. If the embankment top is to be used as a public road, the minimum width shall be 16 feet for one-way traffic and 26 feet for two-way traffic. Guardrails or other safety measures shall be used where necessary and shall meet the requirements of the responsible road authority. When the embankment top is used as a road, provision shall be made for protecting the emergency spillway, if any, from damage.

Total height of Embankment (ft)	Minimum Top Width (ft)
up to 20	10
20 to 24	12
24 to 34	14
35	15

The design height of the embankment shall be increased by the amount needed to insure that the design top elevation will be maintained after all settlement has taken place.

Compaction of the fill material shall be in accordance with the specified design requirements for compaction and moisture content. As a minimum compaction shall be equivalent to, or better than, the following: 1). layers of fill material shall not exceed 9 inches in thickness before compaction, 2). the routing of the hauling and spreading equipment over the fill must be in such a manner that every point on the surface of each layer of fill will be traversed by not less than one tread track of the loaded equipment traveling in a direction parallel to the main axis of the fill. 3). Clayey soils shall be compacted with a "sheepsfoot" or tamping roller.(See SNTC Technical Note 716 for guidance on compaction.)

A qualified inspector as designated by the designer must be on site during construction as necessary to verify proper construction. Testing will be required as deemed necessary by the inspector and/or designer.

When testing is required the owner will be responsible for furnishing test results and certification that the fill meets the design

requirements. Any tests and certification should be performed by a certified laboratory.

If needed to protect the face of the embankment, special measures, such as berms, rock riprap, sand-gravel, soil cement, or special vegetation shall be provided (TR-56 and TR-59).

Inlet
If freezing is not a problem, an open inlet, such as a concrete channel, may be used. If freezing is a problem, the inlet shall consist of a pipe having a minimum diameter of 6 inches and a minimum slope of 1 percent, except that a minimum diameter of 4 inches may be used for milking center waste. The inlet pipe shall terminate a sufficient distance from the shoreline to insure good distribution. It should be far enough below the surface to avoid freezing or be provided with other protective measures. Access should be provided to the pipe for rodding in case of blockage.

Inlet Pipes
Pipes that convey waste from the houses to the lagoon shall be designed and installed in a manner that will prevent erosion of the lagoon side slope. This will be accomplished by extending the pipe beyond the slope of the lagoon, and discharging the waste below the surface.

Other Pipes
Pipes such as those that are used for recycling effluent to use as flush water and irrigation intakes shall be placed as far from the inlet pipes as possible in order to provide a cleaner effluent for flushing and to reduce odors when irrigating on land.

When these pipes are to be placed through the embankment the location and method of installation shall be approved by the designer of the embankment or a technical specialist designated by the soil and water conservation commission to design and approve waste treatment lagoons. Installation shall be certified by the technical specialist.

Emergency Spillways
Lagoons with an outside drainage area having a maximum design liquid level of 3 feet or more above natural ground shall be provided with an emergency spillway. The crest of the emergency spillway shall be located at the same elevation as the top of the 25-year, 24-hour storm storage. The emergency spillway shall be placed in undisturbed soil when possible. When it must be placed in fill material, precautions shall be taken to insure the integrity of the structure.

The emergency spillway shall pass a 25-year, 24-hour storm without over topping the embankment. There shall be a minimum of 1 foot of freeboard above the designed depth of flow in the emergency spillway. Where lagoons empty into waste storage ponds or secondary lagoons and the liquid level is positively controlled by an adequately sized overflow pipe, no emergency spillway is required for the primary lagoon.

All lagoons with 1 million cubic feet of Waste Storage Volume (volume below maximum elevation for pump ON) shall have an emergency spillway. Lagoons without an outside drainage area and less than 1 million cubic ft. of Waste Storage Volume are not required to have an emergency spillway; however, the landowner shall be given the option to install an emergency spillway to prevent catastrophic occurrences.

Other Outlets
Where excess effluent is not to be removed from the lagoon by pumping, an overflow pipe shall be installed to discharge into another lagoon or a waste storage pond. The overflow pipe shall have a minimum diameter of 6 inches and shall have sufficient capacity to prevent over topping of the lagoon during peak inflow periods. The overflow pipe shall be installed so that effluent is discharged from a minimum of 6 inches below the surface. An "elbow" or "tee" pipe fitting or similar device on the inlet end of the overflow pipe may be used for this purpose.

When pumps and sumps are needed to lift waste from a lower elevation to a higher elevation, provisions must be made to prevent overflow of the sump in case of power or pump failure. The sump shall be covered or fenced for safety.

Protection
If the lagoon will create a safety hazard, it shall be fenced and warning signs posted to prevent children and others from using it for purposes other than intended.

The lagoon shall be fenced, if necessary, to protect the vegetation and the embankment.

Erosion and Sediment Control Measures
Plans for waste treatment lagoons shall include temporary measures for the control of erosion and sedimentation during the construction period. Such measures shall be maintained for efficient operation. Permanent vegetation shall be established on all disturbed areas in compliance with Critical Area Treatment standards (342-II) of the Technical Guide.

CONSIDERATIONS

If the embankment is over 15 feet high and impounds over 10-acre feet of effluent, a permit must be obtained as required by the North Carolina Dam Safety Law.

Types
Waste treatment lagoons are of three general types--anaerobic, naturally aerobic, and mechanically aerated. Anaerobic lagoons require less surface area than naturally aerobic lagoons but may give off odors. Naturally aerobic lagoons are relatively odor free. Mechanically aerated lagoons are comparable in size to anaerobic lagoons and are generally odor free, but they require energy for aeration.

Anaerobic lagoons are most commonly used for livestock waste treatment.

Since the anaerobic process is not dependent on maintaining free oxygen, lagoons can be deeper and require less surface area. Anaerobic decomposition of livestock waste can result in the production and emission of odorous gases; however, an anaerobic lagoon that is properly sized can be managed to keep odors to a minimum. Figure A is an example of a typical anaerobic lagoon.

Naturally aerobic lagoons tend to be relatively odor free because bacterial digestion tends to be more complete. Aerobic lagoons are designed on the basis of surface area instead of volume. Aerobic lagoons may require up to 25 times as much land area as anaerobic lagoons and are usually not recommended for livestock and poultry waste treatment in North Carolina because of space requirements.

Mechanically aerated lagoons combine the best features of aerobic and anaerobic; that is, good odor control with small surface area

requirements. They may also be used for nitrogen removal where land area for disposal is limited. The major disadvantage of mechanically aerated lagoons is the high cost of electric energy for continuous operation of the aerators.

Due consideration should be given to facility access, ease of loading and unloading wastes, the overall waste management plan, and health and safety factors. Non-polluted runoff shall be excluded from the lagoon if not included in the design capacity. The Waste Treatment Lagoon should be located so that prevailing winds, vegetative screening, and building arrangement minimize odor and visual resource problems.

Solids removal

To reduce sludge buildup, remove solids from waste of animals, such as dairy cattle, fed high roughage rations. A solids trap or a separator may be provided between the waste sources and the lagoon. This may be a concrete or earth structure that can be emptied periodically. The sizing of these structures will be such that a waste utilization plan can be developed. If earth structures are used, a minimum of two should be planned so that one can be dried and cleaned while the other is functioning.

Organic nitrogen compounds and phosphorous compounds tend to accumulate in sludge. In addition to nitrogen levels up to 13 times higher than lagoon liquid and phosphorous levels up to 45 times higher than lagoon liquid concentrations, sludge may also contain significant levels of heavy metals, salts, and other trace elements.

PLANS AND SPECIFICATIONS

Plans and specifications for installing waste treatment lagoons shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

Plans and specifications for a waste treatment lagoon will only be prepared when it is a part of a complete waste management system including a waste utilization plan.

OPERATION AND MAINTENANCE

A written Operation and Maintenance (O & M) Plan shall be prepared for each lagoon. The O & M Plan shall be incorporated into the design prepared for the Waste Management System. A copy will be given to the landowner and discussed with him. As a minimum, the O & M Plan shall contain the following:

1. A waste utilization plan that is in accordance with FOTG Practice Standards for Waste Utilization (633) and Nutrient Management (590). (Note: A more detailed plan may be required if controlling nutrient is other than N.)

2. Precharge with a volume of water equal to one-half of the treatment volume before wastes are introduced.

3. Highly visible markers shall be installed to mark the upper and lower elevations of the Temporary Storage (pumping Volume). Pumping shall be done as necessary to maintain the liquid level between these markers.

4. Recommendations for inspection and maintenance of embankment and other structures.

5. Recommendations for inspection and maintenance of vegetation.

6. Information on sampling and testing of effluent.

7. After five years the waste treatment lagoon shall be checked for sludge accumulation annually. If sludge has encroached into the treatment volume, the sludge will be removed and applied at agronomic rates based on analysis of the sludge. Treatment volume must have a minimum of 4 feet of depth free of sludge at all times.

8. Others, as appropriate.

Temporary Adjustments
The O&M procedure may be modified to allow an optional, temporary, adjustment in the lagoon operating procedure. This adjustment in operating procedure allows the operator to pump into the top 8 inches of the treatment volume during the period of June 15 through October 31 to provide:

- Irrigation water during drought periods to establish or maintain vegetation in waste application areas.
- Additional temporary storage for excessive rainfall during the hurricane season and the following winter months.

The following restrictions shall apply:

1. Lagoon levels may be lowered a maximum of eight inches below the facility's stop pump mark during the period of June 15 through October 31.

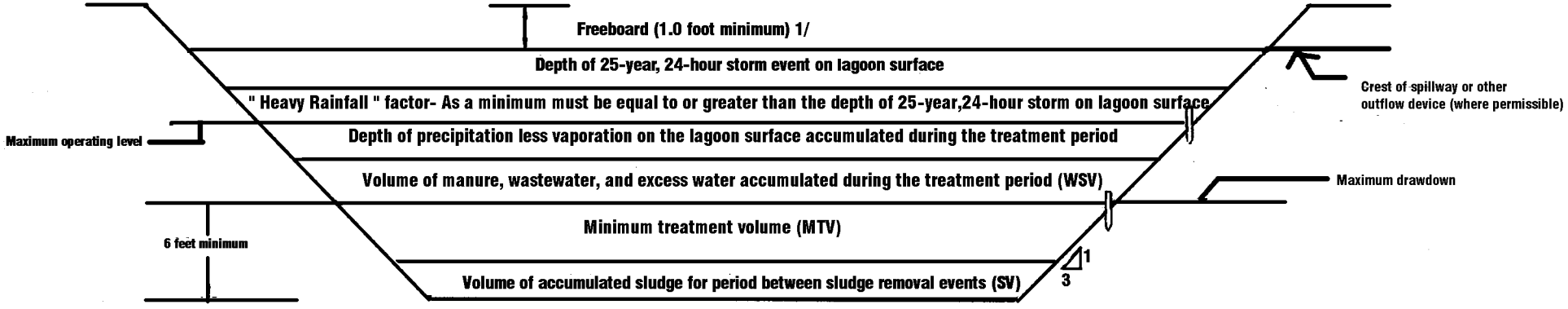
2. This option shall be limited to lagoons having a minimum of four feet of liquid above the sludge layer. The measurement shall be taken from the stop pump level, at the pump intake, prior to pumping below the stop pump level.

3. All applications must be in conformance with the CAWMP developed for the operation, including adherence to the planned nutrient application rates.

4. From November 1 through June 14 pumping from the lagoon will not be permitted when the lagoon level is at or below the stop pump elevation.

5. The following information concerning the pump down condition shall be recorded and maintained on site:

    - Date the lagoon was first pumped below the stop pump level.
    - Depth of liquid between the stop pump level and the sludge layer prior to pumping below the stop pump mark. Measured from the stop pump level near the pump intake location but off the inside slope of the embankment.
    - Date pump down was completed.
    - Depth of pump down below the stop pump level. Measured weekly until the lagoon returns to the stop pump level.



Note: The minimum treatment volume for an anaerobic waste treatement lagoon is based on volatile solids.

1/ If an emergency spillway is used the design depth of flow must be added to the freeboard.

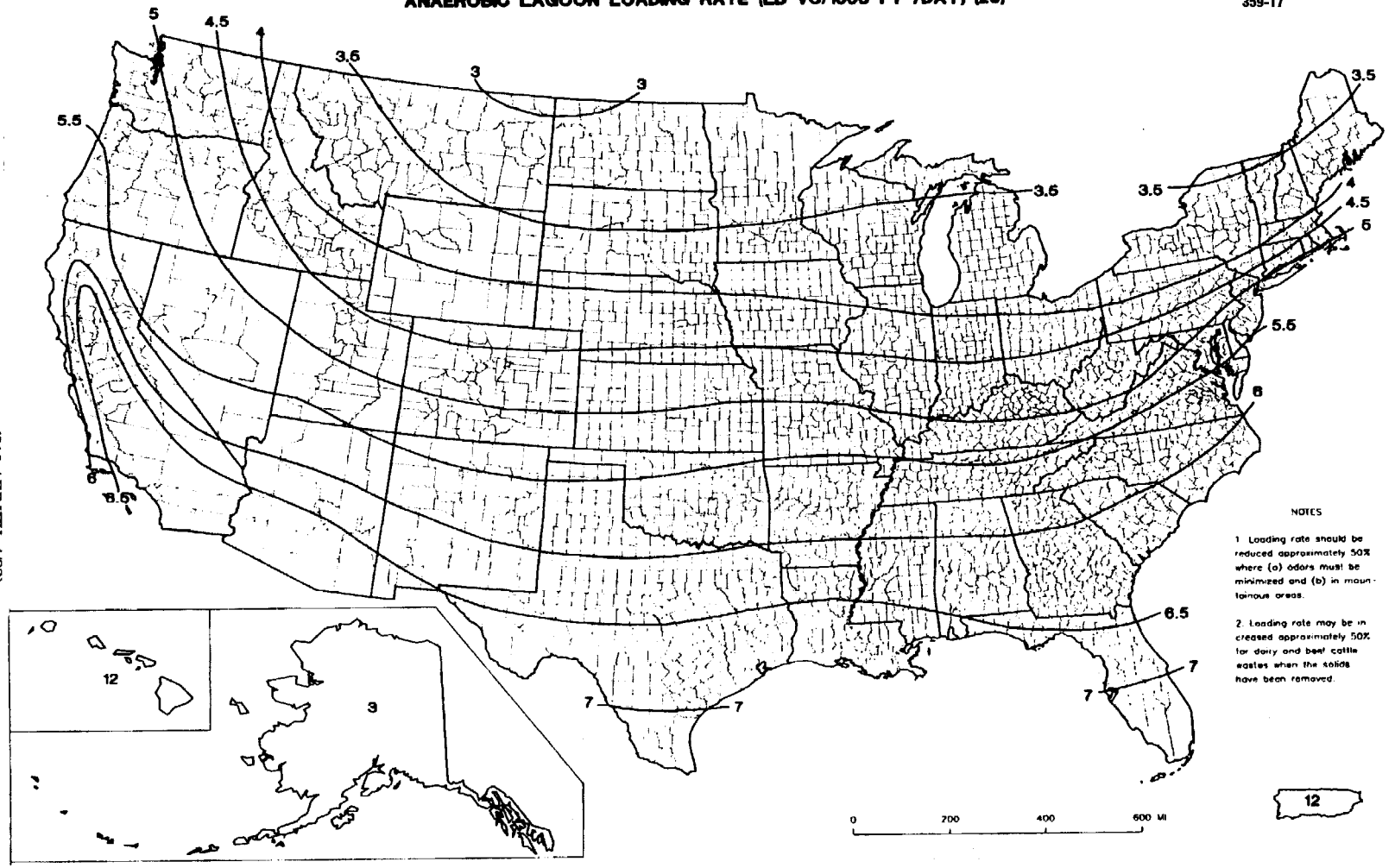
Figure A- Anaerobic Lagoon Cross Section

NRCS, NC
January, 1998
Rev. 4

FIGURE 10-22

ANAEROBIC LAGOON LOADING RATE (LB VS/1000 FT^3/DAY) (20)

359-17



NOTES

1. Loading rate should be reduced approximately 50% where (a) odors must be minimized and (b) in mountainous areas.

2. Loading rate may be increased approximately 50% for dairy and beef cattle wastes when the solids have been removed.

SOURCE:
CONSERVATION PRACTICE STANDARD 359. MAP COMPILED USING AUTOMATED MAP CONSTRUCTION. NATIONAL CARTOGRAPHIC CENTER, FORT WORTH, TEXAS 1991.

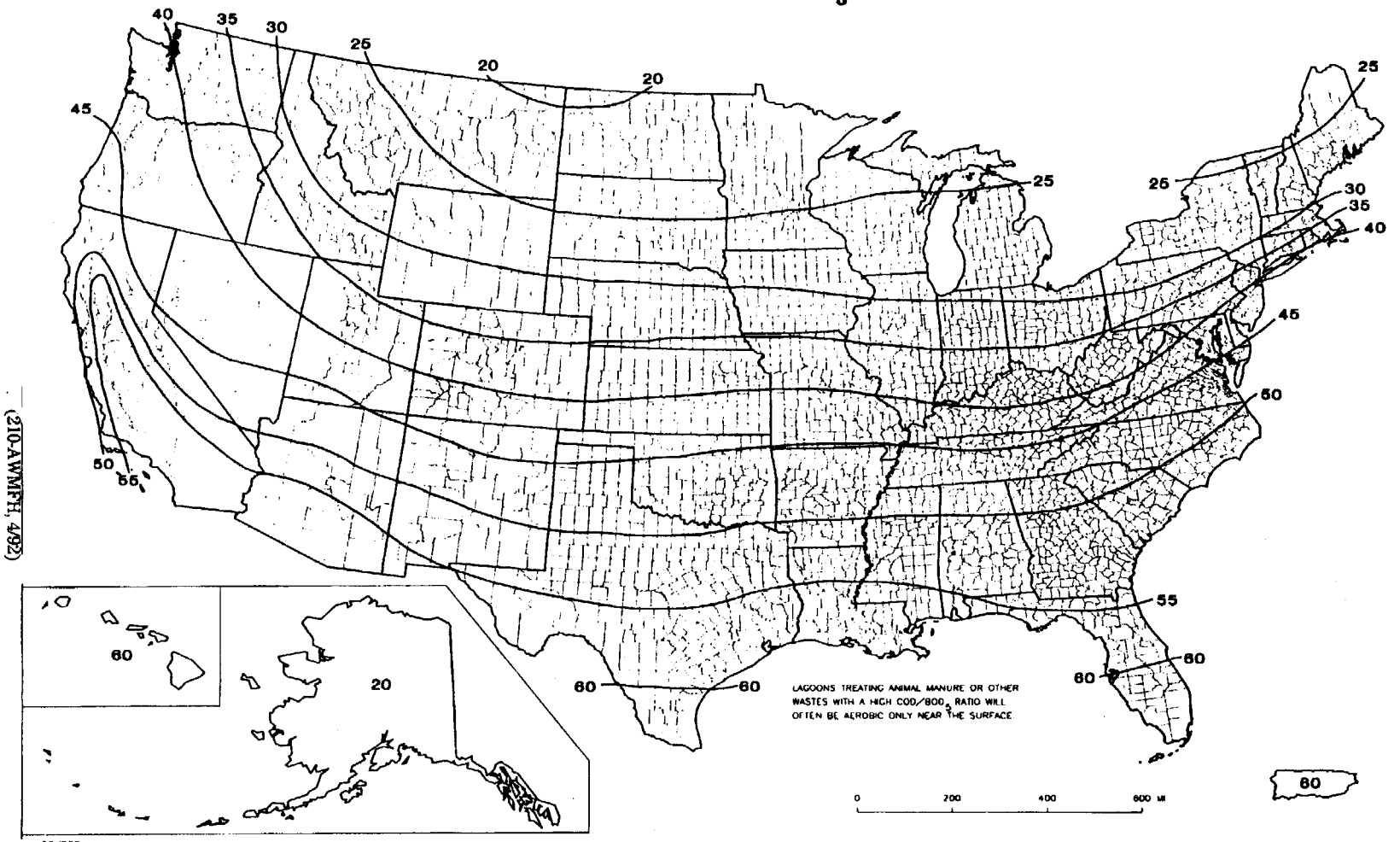
Figure B

REVISED MARCH 1991 1005008

(210-AWMFH, 4/92)

FIGURE 10-26

AEROBIC LAGOON LOADING RATE (LB BOD_5/ACRE/DAY) (20)



(210-AWMFH, 4/92)

SOURCE:
CONSERVATION PRACTICE STANDARD 359 MAP COMPILED USING AUTOMATED MAP CONSTRUCTION NATIONAL CARTOGRAPHIC CENTER, FORT WORTH, TEXAS 1991

Figure C

REVISED MARCH 1991 1005009

WASTE TREATMENT LAGOON ENGINEERING NOTEKEEPING

Design Survey, Design, and Plans

A. Engineering plans shall be prepared for each component of an animal waste management system. The design survey must be in sufficient detail to allow an accurate determination of waste inlet and outlet locations, and volume requirements. This may be accomplished by obtaining a centerline profile of the embankment location, along with some key elevations in and around the lagoon area when the embankment type lagoon is used, or sufficient cross-sections of the area involved to prepare a topographic map. Grid surveys of the area may be needed at times. Designs will include documentation showing how required volume is determined.

B. Record distance to nearest area for public use or residence of anyone other than the owner or his tenant.

C. Record both structural classification and site evaluation for all embankment lagoons. The structural classification should be recorded on Form NC-ENG-34 and the site evaluation should be recorded on Form NC-CPA-17, Site Evaluation.

D. A detailed soils investigation shall be made on all sites with special attention to the water table, seepage potential, and the need for a liner.

E. A detailed operation and maintenance plan shall be a part of every plan and design.

F. Source of water for initial filling of lagoon should be indicated.

G. Check height of embankment and volume of effluent to determine if a dam safety permit from the Department of Environment, Health and Natural Resources is required.

H. Show minimum thickness of liner and moisture requirements if applicable. Protection for liner during initial fill.

I. Emergency Action Plan

Construction Layout

Set enough well marked stakes to guide the contractor in constructing the lagoon according to plans.

Construction Check

As a minimum, the following data will be recorded:

A. Embankment Type

1. Record profile and cross-section of foundation cutoff trench.

2. Record a profile along centerline of embankment to determine if top elevation is adequate.

3. Record at least one cross-section of the embankment to determine construction top width and side slopes.

4. Record the elevation and bottom width of the emergency spillway, if applicable.

5. Statement as to the adequacy of construction of the embankment.

B. Excavated and embankment types

1. Take enough measurements to determine that depth, slope, and storage requirements have been met.

2. Record elevations of highly visible markers that delineate the top and bottom of the pumping volume. This is the temporary storage minus the 25-year, 24-hour storm and "Heavy Rain" factor.

3. Statement as to the adequacy of construction of the liner, if applicable. Show areas lined on "As Builts" and thickness of liner installed.

C. For ramps and/or waste inlet pipes, and overflow pipes, record the following:

1. Location.
2. Dimensions and kind of material used in structures.
3. Elevation of invert of discharge to the lagoon.
4. Elevation of overflow pipe.

D. Statement of the adequacy of control of outside runoff into the lagoon.

E. Statement of the adequacy of vegetative erosion control measures.

F. Statement to the effect that practice meets plans and specifications.

G. Date and signature of person making construction check.

Recording Data

Field notes will be recorded in a standard engineering field book or a standard design form.