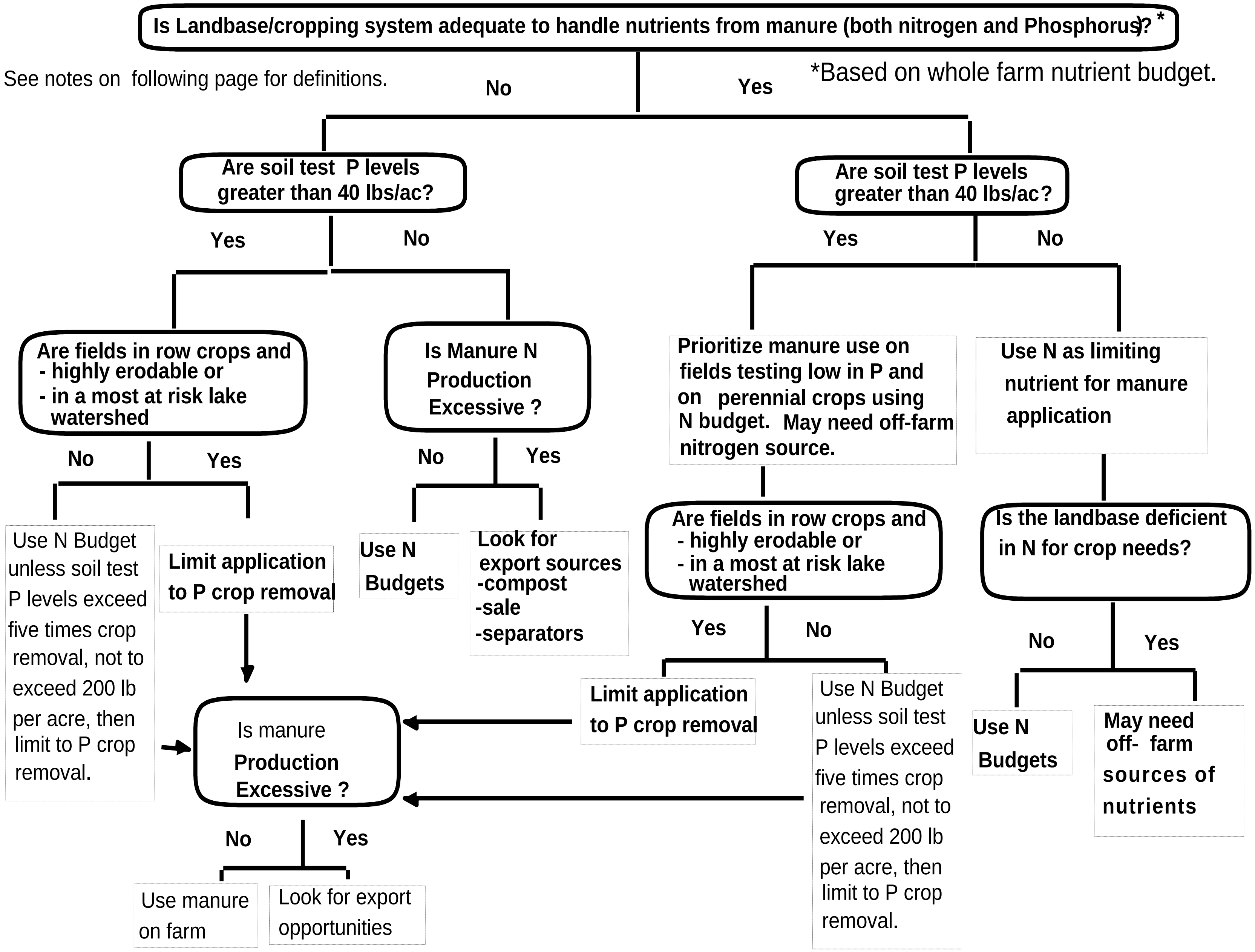
01-001 DEPARTMENT OF AGRICULTURE, CONSERVATION & FORESTRY

Chapter 565: NUTRIENT MANAGEMENT RULES

ATTACHMENTS

ATTACHMENT A

N and P Manure Priority Matrix



Priority Matrix

Notes

Definitions of terms used in the Matrix.

Fields in row crops - Fields that are currently in row crops or that are in rotation with row crops to meet soil loss requirements.

Highly erodable - Land that is determined to be highly erodable as defined in the NRCS Food Security Act Manual, 1985.

Most at risk lake watershed - Lakes that have been designated as most at risk from Development by DEP. See Attachment D.

Note: Soil test values are specifically derived by the “Modified Morgan”extraction method, the standard test method used by the University of Maine Soil Testing Service. Soil testing data from other laboratories must be measured using the Modified Morgan soil test method.

ATTACHMENT B

NRCS Codes 393 and 635

Filter Strips and Vegetated Treatment Areas
Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

FILTER STRIP

Code 393

(Ac)

DEFINITION

A strip or area of herbaceous vegetation that removes contaminants from overland flow.

PURPOSE

- Reduce suspended solids and associated contaminants in runoff and excessive sediment in surface waters.
- Reduce dissolved contaminant loadings in runoff.
- Reduce suspended solids and associated contaminants in irrigation tailwater and excessive sediment in surface waters.

CONDITIONS WHERE PRACTICE APPLIES

Filter strips are established where environmentally sensitive areas need to be protected from sediment, other suspended solids, and dissolved contaminants in runoff.

CRITERIA

General Criteria Applicable to All Purposes

Overland flow entering the filter strip will be uniform sheet flow.

Concentrated flow will be dispersed before it enters the filter strip.

The maximum gradient along the leading edge of filter strip will not exceed one-half of the up-and-down-hill slope percent, immediately upslope from the filter strip, up to a maximum of five percent.

Filter strips will not be used as a travel lane for equipment or livestock.

Additional Criteria to Reduce Dissolved Contaminants, Suspended Solids and Associated Contaminants in Runoff and Excessive Sediment in Surface Waters.

The filter strip will be designed to have a 10-year life span, following the procedure in Agronomy Technical Note No. 2, “Using Revised Universal Soil Loss Equation, Version 2 (RUSLE2) for the Design and Predicted Effectiveness of Vegetative Filter Strips (FVS) for Sediment,” based on the amount of sediment delivery to the upper edge of the filter strip and ratio of filter strip flow length to length of flow path from the contributing area. The minimum flow length through the filter strip will be 20 feet for suspended solids and associated contaminants in runoff and 30 feet for dissolved contaminants and pathogens in runoff.
http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=18578.wba

The filter strip will be located immediately downslope from the source area of contaminants.

The drainage area immediately above the filter strip will have a slope of one percent or greater.

Vegetation. The filter strip will be established to permanent herbaceous vegetation.

Species selected will be—

- Able to withstand partial burial from sediment deposition.
- Tolerant of herbicides used on the area that contributes runoff to the filter strip.
- Stiff stemmed and a high stem density near the ground surface.
- Suited to current site conditions and intended uses.
- Able to achieve adequate density and vigor within an appropriate period to stabilize the site sufficiently to permit suited uses with ordinary management activities.

Plant species, rates of seeding (lbs/ac), vegetative planting (plants/ac), minimum quality of planting stock (pure live seed [PLS] or stem caliper), and method of establishment shall be specified before application. Only viable, high quality seed or planting stock will be used.

BPerform site preparation and seeding/planting at a time and in a manner that best ensures survival and growth of selected species. Successful establishment parameters, (e.g., minimum percent ground/ canopy cover, percent survival, stand density) will be specified before application.

Schedule planting dates during periods when soil moisture is adequate for germination and establishment. Seeding will be timed so that tillage for adjacent crop does not damage the seeded filter strip.

Where the purpose is to remove phosphorus, remove (or harvest) the filter strip aboveground biomass at least once each year.

The minimum seeding and stem density will be equivalent to the seeding rate for a high quality grass hay seeding rate for the climate area or the density of vegetation selected in current water erosion technology to determine trapping efficiency, whichever is the higher seeding rate.

Additional Criteria **to Reduce Suspended Solids and Associated Contaminants in Irrigation Tailwater and Excessive Sediment in Surface Waters.**

Filter strip vegetation will be a small grain or other suitable annual plant.

The seeding rate shall be sufficient to ensure that the plant spacing does not exceed 4 inches (about 16–18 plants per square foot).

Establish filter strips prior to the irrigation season so that the vegetation is mature enough to filter sediment from the first irrigation. A minimum flow length of 20 feet is recommended.

CONSIDERATIONS

General Considerations.

Filter strip width (flow length) can be increased as necessary to accommodate harvest and maintenance equipment.

Filters strips with the leading edge on the contour will function better than those with a gradient along the leading edge.

Seeding rates that establish a higher stem density than the normal density for a high quality grass hay crop will be more effective in trapping and treating contaminants.

When needed, invasive plant species may be controlled through mowing, herbicides, and hand weeding.

Consideration for Reducing Suspended Solids and Associated Contaminants in Runoff.

Increasing the width of the filter strip beyond the minimum required will increase the potential for capturing more contaminants in runoff.

Considerations for Creating, Restoring or Enhancing Herbaceous Habitat for Wildlife and Beneficial Insects and Pollinators. Filter strips are often the only break in the monotony of intensively-cropped areas. The wildlife and pollinator benefits of this herbaceous cover can be enhanced by the following:

- When appropriate, use native grass species that fulfill the purpose(s) of the practice while also providing habitat for priority wildlife.

- Adding herbaceous plant species (including native forbs) to the seeding mix that are beneficial to wildlife and pollinators and are compatible for one of the listed purposes. Changing the seeding mix should not detract from the purpose for which the filter strip is established.
- Increasing the width beyond the minimum required. The additional area can increase food and cover for wildlife and pollinators.
- Management activities on filter strips (mowing, burning, or light disking), should not be done more often than every other year with frequency dependent on geographical location to maintain the purpose(s) of the practice.
- Management activities should be completed outside of the primary nesting, fawning, and calving seasons. Activities should be timed to allow for regrowth before the growing season ends.
- Organic producers should submit plans and specifications to their certifying agent for approval prior to installation, as part of the organic producer's organic system plan.

Considerations to Maintain or Enhance Watershed Functions and Values. Filter strips may be used to enhance connectivity of corridors and noncultivated patches of vegetation within the watershed, enhance the aesthetics of a watershed, and be strategically located to reduce runoff, and increase infiltration and groundwater recharge throughout the watershed.

Increase Carbon Storage. Increasing the width of the filter strip beyond the minimum required will increase potential for carbon sequestration.

PLANS AND SPECIFICATIONS

Specifications for establishment and operation of this practice will be prepared for each field or treatment unit. Record the specifications using the implementation requirements document. The specifications will identify at a minimum the following:

- Practice purpose(s).
- Length, width (width refers to flow length through the filter strip), and slope of the filter strip to accomplish the planned purpose(s).
- Plant species selection and seeding/planting/sprigging rates to accomplish the planned purpose.
- Planting dates and planting method(s).
- Specific care and handling requirements of the seed or plant material to ensure that planted materials have an acceptable rate of survival.
- A statement that only viable, high quality, and adapted seed will be used.
- Site preparation instructions sufficient to establish and grow selected species.

OPERATION AND MAINTENANCE

For the purposes of filtering contaminants and nutrients (phosphorus), permanent filter strip vegetative plantings will be harvested and removed as appropriate to encourage dense growth, maintain an upright growth habit and remove nutrients and other contaminants that are contained in the plant tissue.

Control undesired weed species, especially State-listed noxious weeds.

Inspect the filter strip after storm events and repair any gullies that have formed, remove unevenly deposited sediment accumulation that will disrupt sheet flow, reseed disturbed areas and take other measures to prevent concentrated flow through the filter strip.

Apply supplemental nutrients as needed to maintain the desired species composition and stand density.

Periodically regrade and reestablish the filter strip area when sediment deposition at the filter strip-field interface jeopardizes its function. Reestablish the filter strip vegetation in regraded areas, if needed.

If grazing is used to harvest vegetation from the filter strip, the grazing plan must ensure that the integrity and function of the filter strip is not adversely affected.

REFERENCES

Dillaha, T.A., J.H. Sherrard, and D. Lee. 1986. Long-Term Effectiveness and Maintenance of Vegetative Filter Strips. VPI-VWRRC Bulletin 153.

Dillaha, T.A., and J.C. Hayes. 1991. A Procedure for the Design of Vegetative Filter Strips: Final Report Prepared for U.S. Soil Conservation Service.

Foster, G.R. Revised Universal Soil Loss Equation, Version 2 (RUSLE2) Science Documentation (In Draft). USDA-ARS, Washington, DC. 2005.

Renard, K.G., G.R. Foster, G.A. Weesies, D.K. McCool, and D.C. Yoder, coordinators. 1997. Predicting Soil Erosion by Water: A Guide to Conservation Planning with the Revised Universal Soil Loss Equation (RUSLE). U.S. Department of Agriculture. Agriculture Handbook 703.

Revised Universal Soil Loss Equation Version 2 (RUSLE2) Web site (checked May 2007): http://fargo.nserl.purdue.edu/rusle2_dataweb/RUSLE2_Index.htm.

M.G. Dosskey, M.J. Helmers, and D.E. Eisenhauer 2008. A **Design Aid for Determining Width of Filter** Strips. Journal **of Soil and Water Conservation.** July/Aug **2008**—vol. 63, no. 4.

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

VEGETATED TREATMENT AREA

CODE 635

(Ac.)

DEFINITION

An area of permanent vegetation used for agricultural wastewater treatment.

PURPOSE

Improve water quality by using vegetation to reduce the loading of nutrients, organics, pathogens, and other contaminants associated with livestock, poultry, and other agricultural operations.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where:

- A vegetated treatment area (VTA) can be constructed, operated and maintained to treat contaminated runoff from such areas as feedlots, feed storage, compost areas, solid manure storage areas, barnyards, and other livestock holding areas; or to treat process wastewater from agricultural operations.
- A VTA is a component of a planned agricultural waste management system.

CRITERIA

Size the total treatment area for the VTA on both the contributing site water runoff and vegetation nutrient balances.

- Water balance is the soil's capacity to infiltrate and retain runoff within the root zone. Base the runoff determination on the most restrictive soil layer within the root zone regardless of its thickness. Use the soil's water holding capacity in the root zone, infiltration rate, permeability, and hydraulic conductivity to determine its ability to absorb and retain runoff.
- Nutrient balance utilizes the nutrients from the waste runoff to meet the nutrient removal requirements in the harvested vegetation. Base the nutrient balance on the most limiting nutrient (i.e. nitrogen or phosphorus).

Divert uncontaminated water from the treatment area to the fullest extent possible unless additional moisture is needed to manage vegetation growth in the treatment area.

Establish permanent vegetation in the treatment area. Use a single species or a mixture of grasses, legumes, and other forbs adapted to the soil and climate. Select species to meet the current site conditions and intended use. Selected species will have the capacity to achieve adequate density, vigor, and yield within an appropriate time frame to treat contaminated runoff. Complete site preparation and seeding at a time and in a manner that best ensures survival and growth of the selected species.

Select vegetation that will withstand anticipated wetting or submerged conditions. Harvest vegetation as appropriate to encourage dense growth, maintain an upright growth habit, and remove nutrients and other contaminants that are contained in the plant tissue.

Design the VTA based on the need to treat the runoff volume from the 25-year, 24-hour storm event from the agricultural animal management facility. Infiltrate a portion or the entire volume of the design storm, based on management objectives. Unless discharge is permitted by applicable regulations, store the non-infiltrated portion of the design volume for utilization or treatment.

Exclude all livestock, including grazing, from the VTA.

Apply discharge into and through vegetated treatment area as sheet flow. To encourage sheet flow across the treatment area, provide a means to disperse concentrated flow, such as a ditch, curb, gated pipe, level spreader, or a sprinkler system. Complete land grading and install structural components necessary to maintain sheet flow throughout the treatment area.

Limit the natural or constructed slope of the VTA from 0.3 to 6 percent. The minimum entrance slope to the VTA is 1 percent.

Use NRCS Conservation Practice Standard (CPS) Code 632, Waste Separation Facility, to pretreat influent with waste separation (i.e., settling basin) to reduce organic loading and nutrients to levels that are tolerated by the VTA and to prevent excessive accumulation of solids in the treatment area.

Utilize inlet control structures to control the rate and timing of inflow during normal operations and to control inflow as necessary for operation and maintenance.

Locate VTA outside of floodplains. However, if site restrictions require location within a floodplain, provide protection from inundation or damage from a 25-year flood event, or larger, if required by regulation.

Install VTA where the water table is either naturally deep or artificially lowered so that the infiltrated runoff does not mingle with the groundwater at the bottom of the root zone. Subsurface drainage within the VTA is not allowed. Subsurface drainage may be used to lower the seasonal high water table to an acceptable level provided the subsurface drain lines are at least 10 feet away from the VTA boundary.

Unless soil moisture can be maintained to prevent drying and cracking, do not plan infiltration areas where soil features such as cracking will result in preferential flow paths that transport untreated runoff from the surface to below the root zone.

Ensure that appropriate erosion control measures and sheet flow control measures (i.e., gravel or rock spreaders) are adequately addressed over the entire length of the VTA.

MAINE DESIGN CRITERIA

For the purposes of this standard, the following definitions apply:

-Intermittent or Perennial Stream: Any stream with a watershed greater than 100 acres.
-Sensitive Habitat: Rare or Exemplary natural communities or ecosystems as designated by the Maine Natural Areas Program or the U.S. Fish and Wildlife Service (USFWS), a pond or a fully functioning forested wetland as determined by the State Soil Scientist (SSS) or representative.

A VTA shall not be located within 300 feet of an intermittent or perennial stream or other sensitive habitat when used for any of the following:

- Treats runoff from a structure that services more than 15 animal units
- Treats runoff from a composting facility that contains carcasses, offal, or meat scraps

This includes, but is not limited to runoff from heavy use areas, waste storage facilities, compost facilities or silos.

If there are no other feasible means to address an existing water quality resource concern, exceptions can be made to the above criteria by the State Conservation Engineer (SCE).

All VTA's, regardless of number of AU served, shall use the following criteria based on water balance to size the VTA:

No VTA shall be wider than 60 feet. No flow length shall be greater than 100 feet. Therefore, no VTA shall be greater than 6,000 square feet.

To encourage sheet flow, provide retention of peak runoff, and allow for settling of incidental particulates, each VTA shall have a retention area prior to Level Lip Spreader. The retention area has to meet the same separation distances as the treatment strip. Use Table 1 to size the retention area.
Retention areas shall not be more than 60 feet long and should not be less than 6 feet wide. Maximum retention area width can be up to 10 feet wide to accommodate maintenance equipment needed to clean out the retention area. Use NRCS Conservation Practice Standard (CPS) Code 632, Waste Separation Facility, as needed, to pretreat influent with

waste separation (i.e. settling basin) to reduce organic loading and nutrients to levels that are tolerated by the VTA and to prevent excessive accumulation of solids in the retention area. NRCS CPS Code 629, Waste Treatment shall also be followed when treating silage leachate.

Table 1: Volume of Retention Area

Impervious surface use	Area of impervious surface used to calculate VTA size (y) Units = sq. ft.	Volume of retention area prior to sheet flow release (V) Units = cu. ft.
Animal feedlot	Area where animals have access	V = 0.125y
Silage storage	Area where silage is stored	V = 0.125y
Cull potato storage	Area where potatoes are stored	V = 0.125y
Manure storage	Area where manure is stacked	V = 0.125y
Compost amendment storage	Area where amendments are stacked	V = 0.125y
Composting	Area for composting	V = 0.06y

<u>TREATMENT STRIP SITING CRITERIA</u>

Consult with a Resource Soil Scientist to locate proposed VTA's and determine if any modifications are needed to meet separation distances and soils criteria.

- **SOIL PERMEABILITY:**

The design shall be based on the most restrictive soil layer within the root zone. The **Maximum Permeability** in the root zone shall be less than or equal to **2.0 in/hr**, **<u>UNLESS:</u>**

1. A natural or constructed barrier within the soil profile mitigates the potential of ground water contamination. In Maine, a natural barrier would be a dense substratum such as a glacial till hardpan or heavy marine or lacustrine sediment that results in a seasonally perched water table.

<u>OR</u>

2. Greater than or equal to **18 inches** of loamy fine sand or finer soil material (permeability $\leq$ 2.0 in/hr) exists over soil material with permeability > 2.0 in/hr such as sand or gravel.

OTHER VTA SITE/SOIL CHARACTERISTIC REQUIREMENTS:

- Minimum Depth to Bedrock: 18 inches
- Minimum Depth to Seasonal High Water Table: 15 inches
- Slope Range: 1 – 6 percent

SETBACKS FROM RESOURCE CONCERNS:

- Wells: 100 feet
- Receiving Surface Water: 100 ft. $\leq$ 15 animal units, 300 ft. > 15 animal units OR carcass/offal/meat composting
- Public Water Supply: 300 feet
- Other options or modifications, such as ROOFED AREAS, will be necessary if the above unsuitable conditions exist in potential treatment areas. See NRCS CPS 367, Roofs and Covers for details.

Use Table 2 to size the vegetated treatment area based on soil type.

Table 2: Vegetated Treatment Area Size Based on Soil Type

SOIL / PARENT MATERIAL TYPES	SOIL PERMEABILITY RANGE	SIZE RATIO OF IMPERMEABLE SURFACE (y) TO VEGETATED TREATMENT AREA
1. COARSE LOAMY & SANDY GLACIAL TILLS 2. COARSE SILTY SEDIMENTS 3. COARSE SILTY ALLUVIAL DEPOSITS	0.6 – 2.0 in/hr	1 : 1
FINE LOAMY AND SILTY GLACIAL TILLS	0.2 – 0.6 in/hr	1 : 1.5
FINE SILTY SEDIMENTS	0.06 – 0.2 in/hr	1 : 1.8

ADDITIONAL CRITERIA FOR DOSING SYSTEMS

Distribute the effluent over the VTA through sprinkler irrigation or other pressure dosing system. Match the application rate of sprinkler nozzles to the most restrictive soil infiltration rate or other factors to prevent effluent from discharging from the VTA.

CONSIDERATIONS

Direct contaminated effluent to a waste storage facility during excessively wet or cold climatic conditions.

Additional nutrient and infiltration design guidance in Vegetated Treatment Systems for Open Lot Runoff, (Koelsch, et. al., 2006).

Provide more than one VTA to allow for resting, harvesting vegetation, and maintenance, and to minimize the potential for overloading.

If impervious area requires more than 6,000 square feet of vegetated filter area for treatment, then consider installing multiple filter areas and divide impervious area flow accordingly.

Provide additional storage in the basin collection area to minimize or eliminate discharge into the VTA during rainfall events. Delay application until rainfall has ended to improve infiltration and nutrient uptake.

To maximize nutrient uptake, use warm and cool season species in separate areas to ensure that plants are actively growing during different times of the year.

Supplement water as necessary to maintain plants in a condition suitable for the treatment purpose.

Consider suspension of application to treatment area when weather conditions are not favorable for aerobic activity or when soil temperatures are lower than 39° F. When soil temperatures are between 39° F and 50° F, consider reducing application rate and increasing application period while maintaining a constant hydraulic loading rate.

Manage the VTA to maintain vegetative treatment effectiveness throughout the growing season. Time the harvest of the VTA plants so vegetation can regrow to a sufficient height to effectively filter effluent late in the growing season.

Install a berm around the lower end of the VTA to contain excess runoff that may occur.

Effluent from the VTA may be stored for land application, recycled through the wastewater management system, or otherwise used in the agricultural operation.

Install fences or other measures to exclude or minimize access of the VTA to humans or animals.

Install a pumping system at the bottom of the VTA to either recirculate the effluent to the top of the VTA or transfer to a waste storage facility.

PLANS AND SPECIFICATIONS

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

- Critical construction perimeters, necessary construction sequence, vegetation establishment requirements, retention area and level spreader mechanism requirements, associated practices and agronomic nutrient removal.
- Plan view showing the location of all components of the VTA.
- Details of the length, width, and slope of the treatment area to accomplish the planned purpose (length refers to

flow length down the slope of the treatment area).

- Herbaceous species, seed selection, and seeding rates to accomplish the planned purpose
- Planting dates, care, and handling of the seed to ensure that planted materials have an acceptable rate of survival.
- Site preparation sufficient to establish and grow selected species.

OPERATION AND MAINTENANCE

Develop an operation and maintenance plan consistent with the purposes of the practice, its intended life, safety requirements, and the criteria for its design. Include the following items as appropriate:

- Inspect and maintain retention and spreader area to ensure that sheet flow loading is maintained for the VTA.
- Inspect and repair treatment areas after storm events to address gullies, reseed disturbed areas, and prevent concentrated flow.
- Control undesired weed species, especially state-listed noxious weeds, and other pests that could inhibit proper functioning of the VTA.
- Exclude livestock from VTA.
- Apply supplemental nutrients and soil amendments as needed to maintain the desired species composition and stand density of herbaceous vegetation.
- Maintain or restore the treatment area as necessary by periodically grading or removing excess material when deposition jeopardizes its function. Reestablish herbaceous vegetation.
- Routinely dethatch or aerate a treatment area used for treating runoff from livestock holding areas in order to promote infiltration.
- Conduct maintenance activities only when the surface layer of the VTA is dry enough to prohibit compaction.
- Monitor all treatment areas to maintain optimal crop growth and environmental protection.

REFERENCES

USDA/NRCS, National Engineering Handbook, Part 651, Agricultural Waste Management Field Handbook.

Koelsch, R., B. Kintzer, and D. Meyer. (ed.) 2006. Vegetated Treatment Systems for Open Lot Runoff - A Collaborative Report. USDA, NRCS.

ATTACHMENT C

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

WASTE STORAGE FACILITY

Code 313

(No)

November 2017

DEFINITION

An agricultural waste storage impoundment or containment made by constructing an embankment, excavating a pit or dugout, or by fabricating a structure.

Purpose

To store manure, agricultural by-products, wastewater, and contaminated runoff to provide the agricultural operation management flexibility for waste utilization.

Conditions Where Practice Applies

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

For liquid waste storage facilities implemented with an embankment, this practice applies only to low hazard structures as defined in the NRCS National Engineering Manual (NEM), Part 520.23.

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

General Criteria Applicable to All Waste Storage Facilities.

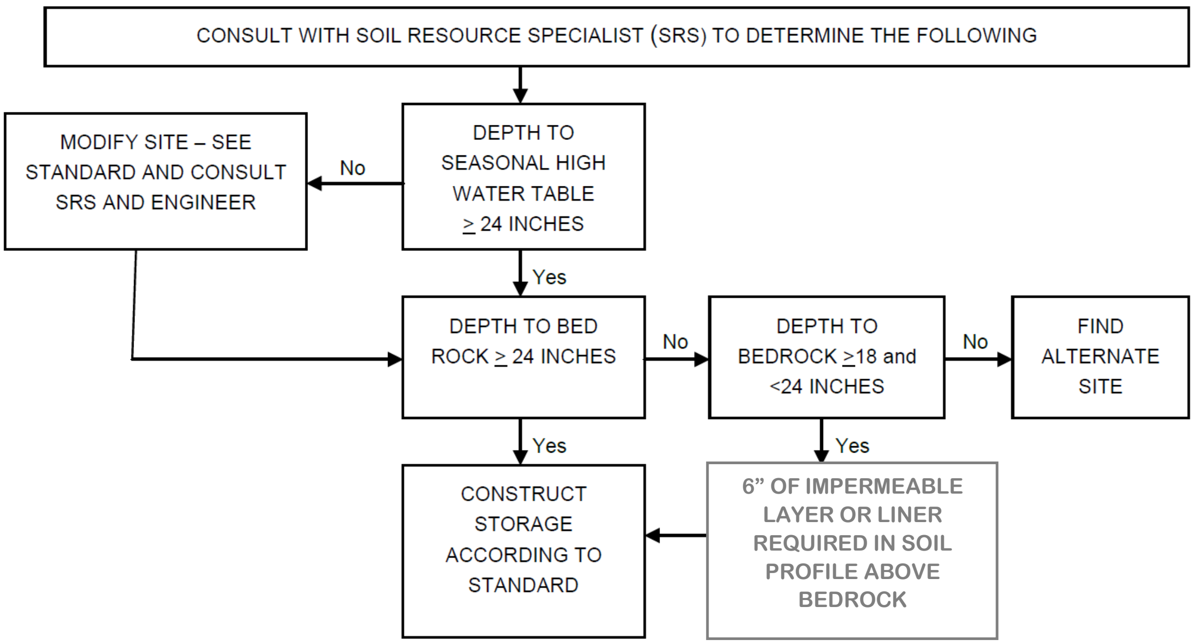
Laws and Regulations. Plan, design, and construct the waste storage facility to meet all Federal, State, and local laws and regulations.

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

Locate waste storage structures at least 100 feet from wells.

Waste storage facilities, other than field stacking facilities shall have a bottom elevation that is a minimum of 2 feet above the seasonal high water table. The storage shall have bottom elevation that is a minimum of 18 inches to bedrock. If the bedrock separation is less than 24 inches, then 6 inches of the separation profile must contain an impermeable layer. These separation distances and soils criteria are shown in Figure 1. The bottom elevation is defined as the lowest elevation manure is stored, for example, the top of the concrete floor.

Figure 1: Separation distances for all waste storage facilities other than field stacking facilities.



Soils that do not meet the criteria in Figure 1 can be modified. Modifications to the site in order to meet seasonal high water table separation distance criteria shall address buoyant forces, pond seepage rate, and non-encroachment of the water table by contaminants. These modifications may include lowering the water table by the use of perimeter drains, building up the soil profile to increase the separation distance, or increasing setback distances from resource concerns. Any impermeable layers used to meet bedrock separation distance criteria shall use material such as clay. Material must be reviewed and approved by Soil Resource Specialist. If a site cannot be modified a synthetic liner may be used meeting the requirements found under Liners within <u>Additional Criteria for Liquid Waste Storage</u>

Consult with a Soil Resource Specialist to locate proposed waste storage facility and determine any modification needed to meet separation distances and soils criteria. Comply with all local, state, and federal laws and regulations on separation distances from resource concerns such as wells, property lines, water bodies, and aquifers.

Storage Period. The storage period is the maximum length of time anticipated between emptying events. Base the minimum storage period on the timing required for environmentally safe waste utilization considering the climate, crops, soil, equipment, and local, State, and Federal regulations.

Design Storage Volume. Size the facility to store the following volumes as appropriate.

Operational Volume

- Manure, wastewater, bedding, and other wastes accumulated during the storage period.
- For liquid or slurry storage facilities, include normal precipitation (omit diverted roof runoff) less evaporation during the storage period.
- Normal runoff from the facility's drainage area during the storage period.
- Planned maximum residual solids. Provide a minimum of 6 inches for tanks unless a sump, ramp, or other device allows for complete emptying.
- Additional storage when required to meet management goals or regulatory requirements.

Emergency Volume (liquid storages only)

- 25-year, 24-hour precipitation on the surface of the liquid or slurry storage facility at the maximum level of the required design storage.
- 25-year, 24-hour runoff from the facility's drainage area.

Freeboard Volume (for liquid or slurry waste storage exposed to precipitation)

- Minimum of 6" for vertical walled tanks.
- Minimum of 12" for all other facilities.

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

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

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

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

Maximum Operating Level. The maximum operating level for liquid storage structures is the level that provides the operational volume.

Staff Gauge. For earthen waste storage structures place a staff gauge or other permanent marker in the liquid storage facility to clearly indicate the following elevations:

- Maximum operating level (top of the operational volume).
- Emergency level (top of the design storage volume).

For storages where the contents are not visible and a staff gauge would not be visible, such as below a slatted floor, identify the method for the operator to measure the depth of accumulated waste in the Operation and Maintenance Plan.

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

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

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

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

Place a fence around impoundments and uncovered tanks which have exposed walls less than 5 feet above ground surface. Use the NRCS CPS Fence (Code 382) for design of a fence that will prevent accidental entry by people or animals likely to be onsite. Except at pushoff and unloading locations, fencing around waste storage facilities shall be one of the following:

- Woven Wire, 6” grid, See typical drawing ME-FNC-WWF
- Chain Link, See typical drawing ME-FNC-CLF

At all push-offs, pumping pads, and agitation locations, install safety features to prevent equipment, people, and livestock from accidentally falling into storage. Gate panels are to be used at pumping and agitation locations. Rail or bars are to be used at push-off locations. Position bar or rail so that the bucket or scarper can pass underneath.

Post universal warning signs, if needed, to prevent children and others from entering liquid waste storage structures.

Roofs and Covers. Use NRCS CPS Roofs and Covers (Code 367) for design of waste storage facility covers or roofs, as needed.

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

Additional Criteria for Liquid Waste Storage

A liquid waste storage impoundment is a facility where the stored material does not consistently stack and is either a natural topographic depression, manmade excavation, or diked area formed primarily of earthen materials, such as soil (although the unit may be lined with manmade materials) .

Liners. Select a liner material that will meet the requirements of the management, waste consistency, loading method, and unloading method. Use liners which meet or exceed NRCS CPS Pond Sealing or Lining (Codes: 520 - Compacted Soil Treatment, 521 – Geomembrane or Geosynthetic, or 522 - Concrete). Design concrete liners for reduced seepage. For concrete liners use 3500 psi concrete, 5” thick, with #4 rebar spaced 12” each direction. No cut joints are needed or allowed. Water stops are required at any cold joint.

Foundation. Locate the impoundment in soils with a permeability that meets all applicable regulations or line the impoundment with suitable material.

Perform subsurface investigations for all waste storage impoundments sufficient in detail and analysis to support the design in accordance with NRCS NEM, Part 531, Geology. Describe the soil material encountered, location of any seeps, depth-to-high-water table, depth to bedrock, and presence of sink holes in karst topography.

For the design of a liner on a site located in a floodplain and other locations where there is potential for uplift, include an evaluation of all potential buoyant uplift forces on the liner. Limit projected uplift head under clay liners to a gradient of less than 0.5 ft/ft in the clay liner. The gradient is determined as the difference in total head between the top and the bottom of a clay liner when buoyant forces exist (such as when the floodplain is flooded) divided by the thickness of the clay liner.

Outlet. An outlet that can automatically release stored material is not permitted except for septic tanks that feed a treatment system such as a waste treatment strip or leaching field or outlets leading to another storage facility with adequate capacity. Design a permanent outlet that will resist corrosion and plugging. Provide a backflow prevention measure for an outlet that pumps wastewater to secondary storage located at a higher elevations.

Embankments. For an impoundment with greater than one acre of surface area and where wave action is a concern, increase the embankment height to account for calculated wave height. In all cases, increase the constructed embankment height by at least 5 percent to allow for settlement. Stabilize all embankments to prevent erosion or deterioration.

Minimum embankment top widths are shown in table 1. Design the combined side slopes of the settled embankment to be equal to or flatter than 5 horizontal to 1 vertical, with neither slope steeper than 2 horizontal to 1 vertical unless provisions are made for stability. The total embankment height (effective height) is the difference in elevation between the auxiliary (emergency) spillway crest or the settled top of the embankment if there is no auxiliary spillway and the lowest point in the cross section taken along the centerline of the embankment.

Table 1. Minimum Top Widths

Total embankment height (ft)	Top width (ft)
Less than 15	8
15–19.9	10
20–24.9	12
25–30	14
30–35	15

Spillway or Equivalent Protection. For a facility having a total embankment height greater than 20 feet, construct an auxiliary (emergency) spillway or route through the spillway or store below the spillway another volume equivalent to the emergency volume.

Excavations. Design excavated side slopes to meet the requirements of the liner used, see NRCS CPS Pond Sealing or Lining, Compacted Soil Treatment (Code 520), Pond Sealing or Lining, Geomembrane or Geosynthetic (Code 521) or Pond Sealing or Lining, Concrete (Code 522).

Additional Criteria for Fabricated Structures

Definition. Fabricated structures include steel prefabricated tanks and waste storage structures constructed from precast or cast in place concrete walls with a concrete floor.

Foundation. Based on subsurface investigation, provide a foundation for fabricated waste storage structures to safely support all superimposed loads without excessive movement or settlement. Perform subsurface investigations for all fabricated structures sufficient in detail and analysis to support the design in accordance with NRCS NEM, Part 531, Geology. Describe the soil material encountered, location of any seeps, depth to high water table, depth to bedrock, and presence of sink holes in karst topography.

Where a nonuniform foundation cannot be avoided or where applied loads may create highly variable foundation loads, calculate settlement based upon site-specific soil test data. Index tests of site soil may allow correlation with similar soils for which test data is available. If no test data are available, use presumptive bearing strength values for assessing actual bearing pressures obtained from table 2 or another nationally recognized building code. In using presumptive bearing values, provide adequate detailing and articulation to avoid distressing movements in the structure.

Table 2. Presumptive Allowable Foundation and Lateral Pressure[1]

Class of materials	Allowable foundation pressure (psf)	Lateral bearing (psf/ft) below natural grade	Coefficient of friction	Cohesion (psf)
Crystalline bedrock	12,000	1,200	0.70	-
Sedimentary and foliated rock	4,000	400	0.35	-
Sandy gravel or gravel (GW and GP)	3,000	200	0.35	-
Sand, silty sand, clayey sand, silty gravel, clayey gravel (SW, SP, SM, SC, GM and GC)	2,000	150	0.25	-
Clay, sandy clay, silty clay, clayey silt, silt and sandy silt (CL, ML, MH and CH)	1,500	100	-	130

[1] International Building Code (IBC), 2015, International Code Council (ICC)

Structural Loadings. Design the waste storage structure to withstand all anticipated loads in accordance with the requirements in NRCS NEM, Part 536, Structural Design. Such loads should include internal and external loads, hydrostatic uplift pressure, concentrated surface and impact loads, and water pressure due to seasonal high water table, frost or ice.

Calculate loading from lateral earth pressures using soil strength values determined from the results of appropriate soil tests and procedures described in Technical Release 210-74, Lateral Earth Pressures. Table 3 provides minimum lateral earth pressure values when soil strength tests are not available. If heavy equipment will operate near the wall, use an additional soil surcharge or an additional internal lateral pressure in the wall analysis as appropriate.

For the lateral load from stored waste not protected from precipitation, use a minimum 65 $lb/ft^2/ft$ of depth as the design internal lateral pressure. Use a minimum value of 60 $lb/ft^2/ft$ of depth for the lateral load from stored waste protected from precipitation and not likely to become saturated. Use a minimum internal lateral pressure of 72 $lb/ft^2/ft$ of depth for sand-laden manure storage if the percentage of sand exceeds 20%. Designers may use lesser values if supported by measurement of actual pressures of the waste to be stored.

Table 3. Minimum Lateral Earth Pressure Values[1]

Description of backfill material [c]	Unified soil classification	Design lateral soil load (lb/ft²/ft of depth) [a]	
		Active pressure	At-rest pressure
Well-graded, clean gravels; gravel-sand mixes	GW	30	60
Poorly graded clean gravels; gravel-sand mixes	GP	30	60
Silty gravels, poorly graded gravel-sand mixes	GM	40	60
Clayey gravels, poorly graded gravel-sand mixes	GC	45	60
Well-graded, clean sands; gravely sand mixes	SW	30	60
Sand-silt clay mix with plastic fines	SP	30	60
Silty sands, poorly graded sand-silt mixes	SM	45	60
Sand-silt clay mix with plastic fines	SM-SC	45	100
Clayey sands, poorly graded sand-clay mixes	SC	60	100
Inorganic silts and clayey silts	ML	45	100
Mixture of inorganic silt and clay	CL-ML	60	100
Inorganic clays of low to medium plasticity	CL	60	100
Organic silts and silt clays, low plasticity	OL	Note [b]	Note [b]
Inorganic clayey silts, elastic silts	MH	Note [b]	Note [b]
Inorganic clays of high plasticity	CH	Note [b]	Note [b]
Organic clays and silty clays	OH	Note [b]	Note [b]

[1] Table 1610.1, Lateral Soil Load, International Building Code (IBC), 2015, International Code Council (ICC).

[a] Design loads based on moist conditions for the specified soils at optimum density. Include the weight of the buoyant soil plus hydrostatic pressure for submerged or saturated soil.
[b] Unsuitable as backfill material.
[c] Base the definition and classification of soil in accordance with ASTM D 2487.

Structural Design. Design structures with reinforced concrete, steel, wood, or masonry materials in accordance with NRCS-NEM, Part 536, Structural Engineering. Account for all items that will influence the performance of the structure, including loading assumptions, durability, serviceability, material properties and construction quality. Ensure that the material used for a fabricated structure is compatible with the waste product to be stored. Design structures according the latest versions of the following standards:

Loads: ASCE 7
Reinforced Concrete Structures:

Structural Members: ACI 318
Concrete Slabs for reduced seepage applications: ACI 360R
Concrete Slabs for non-water tight applications: ACI 330R
Steel Structures: AISC Steel construction Manual
Wood Structures: American Wood Council National Design Specifications for Wood Construction
Masonry Structures: ACI 530

Tanks may be designed with or without a cover. Design openings in a covered tank to accommodate equipment for loading, agitating, and emptying. Equip these openings with fencing, grills or secure covers for safety, and for odor and vector control as necessary.

Sensitive Environmental Settings._Where liquid-storage is to be provided in sensitive environmental settings (i.e., tanks in areas with shallow wells in surface aquifers, high-risk karst topography, or other site-specific concerns), design the storage structure as a reinforced concrete hydraulic or environmental structure according to NRCS NEM, Part 536, Structural Design. Alternatively, use a flexible liner membrane, designed and constructed in accordance with standard engineering and industry practice, to provide secondary liquid containment for structures constructed with other methods described in NRCS NEM, Part 536, Structural Design.

Additional Criteria - Stacking Facilities

A stacking facility may be open, covered, or roofed and is used for wastes which behave primarily as solid. Determine the wall height using the anticipated stacking angle of the waste material. Construct a stacking facility of durable materials such as reinforced concrete, reinforced concrete block, or treated lumber. Design the stacking facility with adequate safety factors to prevent failure due to internal or external pressures, including hydrostatic uplift pressure and imposed surface loads such as equipment which may be used within, on, or adjacent to the structure.

Seepage and Internal Drainage._Prevent leachate in amounts that would pollute surface or groundwater with collection and disposal of liquids in a safe manner as necessary. Seepage control may not be necessary on sites that have a roof. Make provisions for drainage of leachate, including rainfall from the stacking area (especially those without a roof). Collect leachate in a tank or waste storage impoundment, or properly treat in a vegetated treatment area.

Field Stacking Facilities Criteria

Design Criteria. Locate field stacking facilities to minimize the risk of surface and ground water contamination. Design considerations shall include the following:

(a) Exclude unpolluted surface and ground water from facilities and loading areas.

(b) Locate stacking facilities a minimum of 100 feet away from wells and surface water bodies and a minimum of 300 feet away from Public Water Supplies (these may be wells, lakes, ponds, rivers, or springs). Consider increasing setbacks from resource concerns when they are located downslope from the stacking site.

(c) Locate field stacking facilities on soils that are 18 inches over bedrock and 15 inches to seasonal high water table. The soil shall have a maximum permeability of 2 inches/hour in the C Horizon or a minimum of 18 inches of loamy fine sand or finer material with a permeability of <= 2 inches/hour over the C Horizon. The maximum land slope shall be 8 percent. The site needs to be above the 25 year floodplain. These separation distances and soils criteria are also shown in Figure 2. Soils that do not meet the criteria in Figure 2 can be modified. Avoid placing field stacking facilities on soils that are less than 18 inches to bedrock nor soils that are less than 7 inches to the seasonal high water table (hydric soils) or hydraulically restrictive layer. Some possible modifications to field stacking sites include, but are not limited to:

1. Increase setback distances from resource concerns.

2. Dump and spread within 30 days.

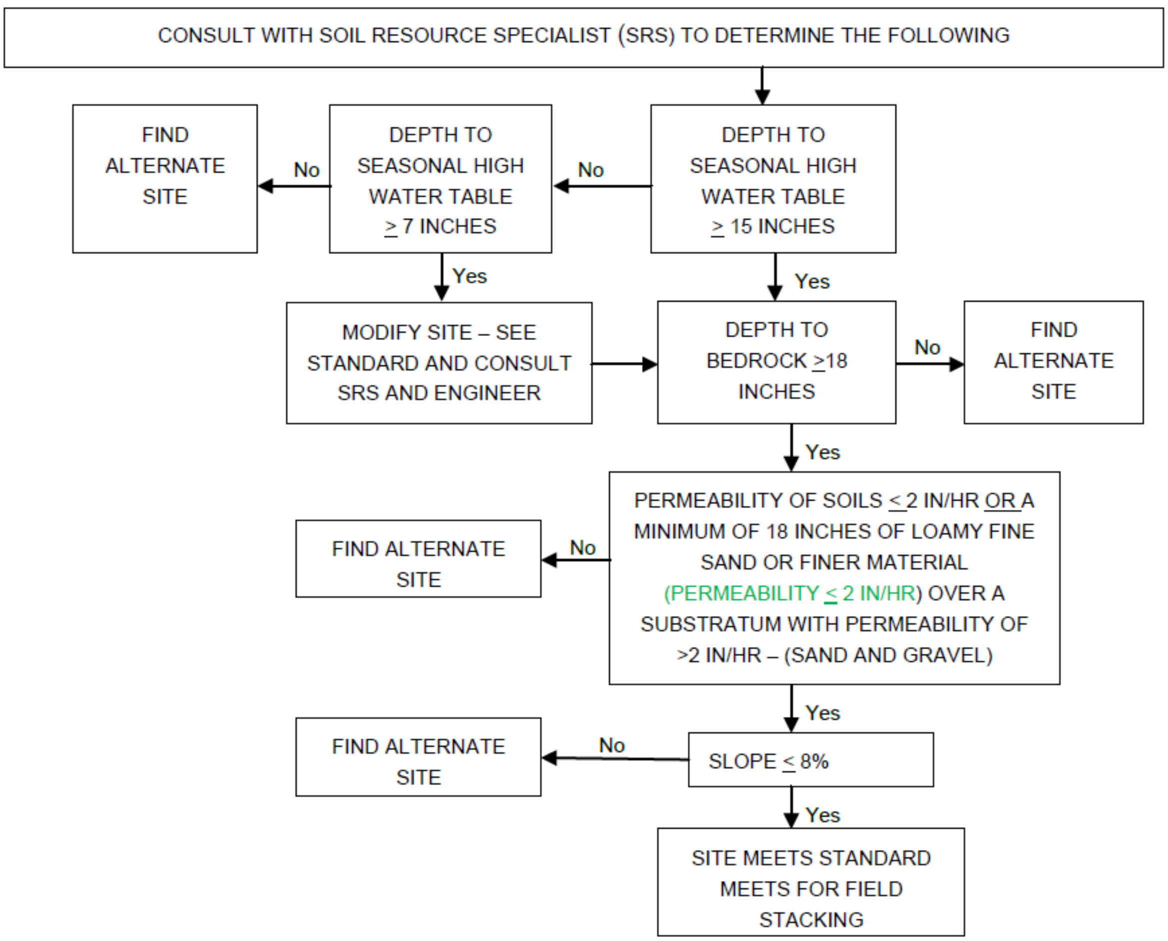
3. Berm around edges of the pile with hay bales, silt fence, earth, etc.

4. Create surface runoff diversions.

5. Build the soil up to increase separation distance from bedrock or water table.

(d) Consult with a Soil Resource Specialist to locate proposed field stacking facilities and determine any modifications needed to meet separation distances and soils criteria.

Figure 2: Separation distances and soils criteria for field stacking facilities.



ADDITIONAL CRITERIA FOR BEDDED PACKS

Sizing. Provide pack area for animals as listed in Table 4. If a heavy use area is used adjacent to the pack area and animals have free access to both areas, provide waste storage facility for manure collected on heavy use area. Size this waste storage facility to store up to 50 percent of the manure produced by the animals and 10 percent of the bedding used while they are using the pack and heavy use area.

Surface the pack area with concrete. Surround the pack area with reinforced concrete walls at least 6' tall.

Table 4:

Animal Type	Pack Area (sq ft/ animal)
Dairy Cow	85 – 100
Beef Cow	85 – 100
Beef Steer	75 - 85
Swine	55 - 65
Sheep and Goats	45 - 55

ADDITIONAL CRITERIA FOR CULL POTATO STORAGE

Acceptable surface treatments for cull potato storage facilities include an impervious soil barrier such as bituminous pavement or concrete. Handling and storage of cull potatoes shall be in accordance with the Maine Department of Agriculture Cull Potato Disposal Rules and Best Management Practices

The storage volume occupied by the cull potatoes is based on the needed volume for the livestock being fed or the amount of potatoes stored. Sites can be relocated if resource concerns can be more economically addressed. All leachate concerns will be addressed according to practice standard Waste Treatment (629). NRCS conservation practice standards Waste Transfer (634), Heavy Use Area Protection (561), Subsurface Drain (606), Vegetated Treatment Area (635), Diversion (362), or any other pertinent practice standard that can be used as companion practices may also apply to the collection and treatment of cull potato leachate. Relocating the structure can be used where the high water table and bedrock separation distances cannot be met as specified in Figure 1. For proposes of designing leachate storage or treatment assume cull potatoes will produce 20 gallons of leachate per ton of cull potatoes stored.

CONSIDERATIONS

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

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

Due consideration should be given to environmental concerns, economics, the overall waste management system plan, and safety and health factors.

Considerations for Siting

Consider the following factors in selecting a site for waste storage facilities:

- Proximity of the waste storage facility to the source of waste.
- Access to other facilities.
- Ease of loading and unloading waste.
- Compatibility with the existing landforms and vegetation, including building arrangement, to minimize odors and adverse impacts on visual resources.
- Adequate maneuvering space for operating, loading, and unloading equipment.

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

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

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

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

Consider the following either singly or in combination to minimize the potential of or the consequences of sudden breach of embankments:

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

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

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

Considerations for Minimizing the Potential of Waste Storage Pond Liner Failure.

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

Potential impact categories for liner failure are—

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

For a site with one or more of these site conditions, consider providing a leak detection system in conjunction with the planned liner to provide an additional measure of safety.

Considerations for Stacking Facilities

Internal seepage collection within a stacking facility can be accomplished by use of a timber wall with the boards installed vertically, leaving 3/4-inch cracks. The timber wall drainage section may be included in a concrete or masonry block wall. Use the design criteria for timber walls.

For any facility that is an organic producer or that sells manure to organic producers, consider using rot-resistant or treated lumber that meets the requirements for organic production. The producer should consult with the organic certifier as to the use and acceptability of treated lumber for waste storage.

Considerations for Improving Air Quality

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

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

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

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

Maintain appropriate manure moisture content for solid manure storage facilities. Excessive moisture will increase the potential for air emissions of volatile organic compounds, ammonia, and nitrous oxide, and may lead to anaerobic conditions, which will increase the potential for emissions of methane and hydrogen sulfide. Too little moisture will increase the potential for particulate matter emissions.

PLANS AND SPECIFICATIONS

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

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

OPERATION AND MAINTENANCE

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

Include the operational requirements for emptying the storage facility including the expected storage period. Begin removal of the liquid storage facility as soon as practical after the maximum operating level has been reached. Also include the requirement that waste be removed from storage and utilized at locations, times, rates, and volume in accordance with the overall waste management system plan.

For impoundments and other liquid storages include an explanation of the staff gauge or other permanent marker to indicate the maximum operating level. For storages where the contents are not visible and a staff gauge would not be visible, such as below a slatted floor, identify the method for the operator to measure the depth of accumulated waste.

Include a provision for emergency removal and disposition of liquid waste in the event of an unusual storm event that may cause the waste storage structure to fill to capacity prematurely.

Include instructions as needed for ventilating confined spaces according to ASABE Standard S607, Venting Manure Storages to Reduce Entry Risk.

Develop an emergency action plan for waste storage facilities where there is a potential for significant impact from breach or accidental release. Include site-specific provisions for emergency actions that will minimize these impacts.

Include a description of the routine maintenance needed for each component of the facility. Also include provisions for maintenance that may be needed as a result of waste removal or material deterioration.

REFERENCES

American Society for Testing and Materials. Annual Book of ASTM Standards. Standards D 653, D 698, D 1760, D 2488. ASTM, Philadelphia, PA.

USDA NRCS. 1992. Agricultural Waste Management Field Handbook. USDA-NRCS, Washington, DC.

USDA NRCS. General Manual. USDA-NRCS, Washington, DC.

USDA NRCS. National Engineering Manual. USDA-NRCS, Washington, DC.

USDA Soil Conservation Service. 1989. Technical Release Number 74, Lateral Earth Pressures, USDA-SCS, Washington, DC.

References for
NRCS Code 313

These Codes reference the following publications:

- -- National Handbook of Conservation Practices. 2015. USDA NRCS
- -- Fencing USDA NRCS Maine Code 382. 08/14.
- -- Vegetated Treatment Areas USDA NRCS MaineCode 393. 02/17
- -- Agricultural Waste Management Field Handbook, Chapter 7. USDA NRCS. 4/92.
- -- American Society of Agricultural Engineers. EP288.5, Agricultural Building Snow and Wind Loads. 2001.

ATTACHMENT D

Chapter 502: DIRECT WATERSHEDS OF LAKES MOST AT RISK FROM NEW DEVELOPMENT, AND URBAN IMPAIRED STREAMS

SUMMARY: This chapter describes the criteria used to identify the direct watersheds of lakes most at risk from new development and urban impaired streams and lists these waterbodies.

1. Applicability. This chapter applies to (A) a project that requires a stormwater permit pursuant to 38 M.R.S.A. §420-D, and (B) a development that may substantially affect the environment and requires a site location of development (Site Law) permit pursuant to 38 M.R.S.A. §§ 481 - 490.

2. Definitions. Unless the context otherwise indicates, definitions of terms in chapter 500 apply to terms used in this chapter. See "Definitions", 06-096 CMR 500.3.

3. Criteria. The criteria in this section are used to identify the direct watersheds of lakes most at risk from new development and urban impaired streams.

The criteria apply for both projects requiring a stormwater permit and developments requiring a site location of development permit, unless otherwise specifically stated.

A. Direct watershed of a lake most at risk from new development. A lake is considered most at risk from new development if it meets the criteria below. Lakes most at risk from new development are listed in Appendix A of this chapter if it is

(1) A public water supply; or

(2) Identified by the department as being in violation of class GPA water quality standards or as particularly sensitive to eutrophication based on

(a) Current water quality,

(b) Potential for internal recycling of phosphorus,

(c) Potential as a cold water fishery,

(d) Volume and flushing rate, or

(e) Projected growth rate in the watershed.

Severely blooming lakes are a subset of lakes most at risk. A severely blooming lake has a history of algal blooms, and the reduction of existing watershed phosphorus sources sufficient to eliminate those algal blooms is expected to be so difficult that the addition of new, incompletely mitigated development sources may prevent successful restoration of the lake.

B. Urban impaired streams. A stream is considered impaired if it fails to meet water quality standards because of effects of stormwater runoff from developed land. Additional stormwater treatment controls are necessary in urban watersheds of impaired streams because proposed stormwater sources in urban and urbanizing areas contribute to the further degradation of stream water quality. Impaired streams are listed in Appendix B of this rule and include all streams listed under Category 4-A or Category 5-A in the 2004 Integrated Water Quality Monitoring and Assessment Report that have urban non-point source (NPS) indicated as a potential source.

APPENDIX A

Lakes Most at Risk from New Development

(x) = Severely Blooming

LAKE	TOWN
ADAMS POND	BOOTHBAY
ADAMS POND	NEWFIELD
ADAMS POND	BRIDGTON
ALLEN POND	GREENE
ANASAGUNTICOOK LAKE	CANTON
ANDERSON POND	AUGUSTA
ANDROSCOGGIN LAKE	WAYNE
ANNABESSACOOK LAKE (X)	WINTHROP
BARTLETT POND	WATERBORO
BAUNEG BEG POND	SANFORD
BAY OF NAPLES	NAPLES
BEAVER POND	BRIDGTON
BERRY POND	WINTHROP
BERRY POND	GREENE
BIRCH HARBOR POND	WINTER HARBOR
BLACK POND	SWEDEN
BONNY EAGLE LAKE	BUXTON
BOULTER POND	YORK
BOYD POND	LIMINGTON
BRANCH LAKE	ELLSWORTH
BRANCH POND	CHINA
BRETTUNS POND	LIVERMORE
BUKER POND	LITCHFIELD
BUNGANUT POND	LYMAN
BURNTLAND POND	STONINGTON
CARLTON POND	WINTHROP
CHAFFIN POND	WINDHAM
CHASES POND	YORK
CHICKAWAUKIE POND	ROCKPORT
CHINA LAKE	CHINA
CITY POND	SANDY RIVER PLANTATION
COBBOSSECONTEE LAKE	WINTHROP
COCHNEWAGON LAKE	MONMOUTH
COFFEE POND	CASCO
COLD RAIN POND	NAPLES
CRAWFORD POND	WARREN
CRESCENT POND	RAYMOND
CRYSTAL LAKE	GRAY
CRYSTAL POND	TURNER
DAM POND	AUGUSTA
DAMARISCOTTA LAKE, MIDDLE AND SOUTH BASINS	NOBLEBORO
DAVIS POND	HOLDEN
DEER POND	HOLLIS

DEERING POND	SANFORD
DESERT POND	MOUNT VERNON
DEXTER POND	WINTHROP
DODGE POND	RANGELEY
DUCKPUDDLE POND	WALDOBORO
DUMPLING POND	CASCO
DUTTON POND	CHINA ALBION
EAGLE LAKE	BAR HARBOR
EAST POND	SMITHFIELD
ECHO LAKE	PRESQUE ISLE
ELL POND	SANFORD
ESTES LAKE	SANFORD
ETNA POND	STETSON
FAIRBANKS POND	MANCHESTER
FLOODS POND	OTIS
FOLLY POND	VINALHAVEN
FOREST LAKE	WINDHAM
FRESH POND	NORTH HAVEN
GARDINER POND	WISCASSET
GARLAND POND	GARLAND
GRANNY KENT POND	SHAPLEIGH
GRASSY POND	ROCKPORT
GREAT MOOSE LAKE	HARTLAND
GREAT POND	BELGRADE & ROME
GREAT POND	CAPE ELIZABETH
GREELEY POND	AUGUSTA
GREEN POND	OXFORD
HALEY POND	RANGELEY
HALF MOON POND	PROSPECT
HALL POND	PARIS
HANCOCK POND	EMBDEN
HATCASE POND	DEDHAM
HERMON POND	HERMON
HIGHLAND LAKE	BRIDGTON
HIGHLAND LAKE	WINDHAM
HOBBS (LT PENNESSE.)	NORWAY
HOGAN POND	OXFORD
HOLBROOK POND	HOLDEN
HOLLAND POND	LIMERICK
HORNE POND	LIMINGTON
HOSMER POND	CAMDEN
HUTCHINSON POND	MANCHESTER
INGALLS POND	BRIDGTON
INGHAM POND	MOUNT VERNON
ISINGLASS POND	LIMINGTON
JACOB BUCK POND	BUCKSPORT
JIMMIE (JAMIES) POND	MANCHESTER
JIMMY POND	LITCHFIELD
JORDAN POND	MOUNT DESERT
KENNEBUNK POND	LYMAN
KEZAR POND	WINTHROP
KILLICK POND	HOLLIS
KNICKERBOCKER POND	BOOTHBAY
KNIGHT POND	SOUTH BERWICK
LAKE AUBURN	AUBURN
LAKE GEORGE	SKOWHEGAN
LAKE WOOD	BAR HARBOR
LILLY POND	ROCKPORT
LILY POND	SIDNEY
LILY POND	NEW GLOUCESTER
LITTLE COBBOSSEE	WINTHROP

LITTLE DUCK POND	WINDHAM
LITTLE MEDOMAK POND	WALDOBORO
LITTLE OSSIPEE	WATERBORO
LITTLE POND	DAMARISCOTTA
LITTLE PURGATORY POND	MONMOUTH
LITTLE SABATTUS	GREENE
LITTLE SEBAGO LAKE	WINDHAM
LITTLE TOGUS POND	AUGUSTA
LITTLE WATCHIC POND	STANDISH
LITTLE WILSON POND	TURNER
LONG LAKE	BRIDGTON
LONG POND	BELGRADE
LONG POND	MOUNT DESERT
LONG POND	BUCKSPORT
LONG POND	SULLIVAN
LOON POND	SABATTUS
LOON POND	LITCHFIELD
LOVEJOY POND	ALBION
LOWER AND UPPER PONDS	SKOWHEGAN
LOWER HADLOCK POND	MOUNT DESERT
LOWER NARROWS POND	WINTHROP
LOWER RANGE POND	POLAND
MACES POND	ROCKPORT
MANSFIELD POND	HOPE
MARANACOOK LAKE	WINTHROP
MARSHALL POND	OXFORD
MCGRATH POND	OAKLAND
MEDOMAK POND	WALDOBORO
MEGUNTICOOK LAKE	LINCOLNVILLE
MESSALONSKEE LAKE	BELGRADE
MIDDLE BRANCH POND	ALFRED
MIDDLE RANGE POND	POLAND
MIRROR LAKE	ROCKPORT
MOODY POND	LINCOLNVILLE
MOODY POND	WATERBORO
MOOSE HILL POND	LIVERMORE FALLS
MOOSE POND	OTISFIELD
MOUNT BLUE POND	AVON
MOUSAM LAKE	SHAPLEIGH
MUD POND	WINSLOW
MUD POND	CHINA
MUD POND	WINDSOR
MUD POND	OXFORD
MURDOCK POND	BERWICK
NEQUASSET POND	WOOLWICH
NICHOLS POND	SWANVILLE
NO NAME POND	LEWISTON
NOKOMIS POND	NEWPORT
NORTH POND	NORWAY
NORTH POND	SUMNER
NORTH POND	SMITHFIELD
NORTON POND	LINCOLNVILLE
NOTCHED POND	RAYMOND
NUBBLE POND	RAYMOND
OAKS POND	SKOWHEGAN
OTTER POND	BRIDGTON
OTTER PONDS #2	STANDISH
PANTHER POND	RAYMOND
PARADISE POND	DAMARISCOTTA
PARKER POND	CASCO
PARKER POND	JAY

PARKER POND	LYMAN
PATTEE POND	WINSLOW
PATTEN POND	HAMPDEN
PEMAQUID POND	WALDOBORO
PENNESSEEWASSEE	NORWAY
PETINGILL POND	WINDHAM
PLEASANT POND	TURNER
PLEASANT POND (X)	RICHMOND
POVERTY POND	NEWFIELD
QUIMBY POND	RANGELEY
RAYMOND POND	RAYMOND
RICH MILL POND	STANDISH
ROBERTS WADLEY POND	LYMAN
ROCKY POND	ROCKPORT
ROUND POND	RANGELEY
RUNAROUND POND	DURHAM
SABATTUS POND (X)	GREENE
SABBATHDAY LAKE	NEW GLOUCESTER
SALMON L (ELLIS P)	BELGRADE
SALMON STREAM POND	GUILFORD
SAND POND	MONMOUTH
SAND POND	LIMINGTON
SANDY BOTTOM POND	TURNER
SANDY POND	FREEDOM
SAWYER POND	GREENVILLE
SCITUATE POND	YORK
SEBAGO LAKE	SEBAGO
SEBASTICOOK LAKE	NEWPORT
SECOND POND	DEDHAM
SEWALL POND	ARROWSIC
SHAKER POND	ALFRED
SHERMAN LAKE	NEWCASTLE
SHY BEAVER POND	SHAPLEIGH
SILVER LAKE	BUCKSPORT
SPECTACLE POND	VASSALBORO
STARBIRD POND	HARTLAND
SWAN POND	LYMAN
SWETTS POND	ORRINGTON
SYMMES POND	NEWFIELD
TAYLOR POND	AUBURN
THOMAS POND	CASCO
THOMPSON LAKE	OXFORD
THREECORNERED POND	AUGUSTA
THREEMILE POND (X)	WINDSOR
TOGUS POND	AUGUSTA
TOLMAN POND	AUGUSTA
TOOTHAKER POND	PHILLIPS
TRAVEL POND	JEFFERSON
TRICKEY POND	NAPLES
TRIPP POND	POLAND
ND	MANCHESTER
UNITY POND	UNITY
UPPER NARROWS POND	WINTHROP
UPPER RANGE POND	POLAND
WADLEY POND	LYMAN
WARD POND	SIDNEY
WARDS POND	LIMINGTON
WARREN POND	SOUTH BERWICK
WASSOOKEAG LAKE	DEXTER
WATCHIC POND	STANDISH
WEBBER POND (X)	VASSALBORO

WEST GARLAND POND	GARLAND
WEST HARBOR POND	BOOTHBAY HARBOR
WHITES POND	PALMYRA
WHITNEY POND	OXFORD
WHITTIER POND	ROME
WILEY POND	BOOTHBAY
WILSON POND	WAYNE
WOOD POND	BRIDGTON
WOODBURY POND	MONMOUTH
WORTHLEY POND	POLAND
YORK POND	ELIOT
YOUNGS LAKE	WESTFIELD

APPENDIX B

Urban impaired streams

STREAM	TOWN
LOGAN BROOK	AUBURN
UNNAMED TRIBUTARY TO BOND BROOK (entering below I-95)	AUGUSTA
PENJAJAWOC STREAM, including MEADOW BROOK	BANGOR
BIRCH STREAM (OHIO STREET)	BANGOR
UNNAMED BROOK (PUSHAW ROAD)	BANGOR
ARCTIC BROOK (VALLEY AVENUE)	BANGOR
SHAW BROOK	BANGOR, HAMPDEN
MARE BROOK	BRUNSWICK
UNNAMED TRIBUTARY TO ANDROSCOGGIN RIVER (near Jordan Avenue)	BRUNSWICK
UNNAMED TRIBUTARY TO ANDROSCOGGIN RIVER (near River Road)	BRUNSWICK
UNNAMED TRIBUTARY TO ANDROSCOGGIN RIVER (near Water Street)	BRUNSWICK
CARIBOU STREAM	CARIBOU
FROST GULLY BROOK	FREEPORT
CONCORD GULLY	FREEPORT
DILL BROOK	LEWISTON
JEPSON BROOK	LEWISTON
BROWN BROOK	LIMERICK
MATTANAWCOOK STREAM	LINCOLN
UNNAMED STREAM (Route 196)	LISBON FALLS
CAPISIC BROOK	PORTLAND
FALL BROOK	PORTLAND
NASONS BROOK	PORTLAND
GOOSEFARE BROOK	SACO
TROUT BROOK (including KIMBALL BROOK)	SOUTH PORTLAND
BARBERRY CREEK	SOUTH PORTLAND
LONG CREEK	SOUTH PORTLAND
PHILLIPS BROOK	SCARBOROUGH
RED BROOK	SCARBOROUGH, SOUTH PORTLAND
WHITTEN BROOK	SKOWHEGAN
UNNAMED TRIBUTARY TO ANDROSCOGGIN RIVER (near Topsham Fair Mall)	TOPSHAM
MILL STREAM	WINTHROP

AUTHORITY: 38 M.R.S.A. §§ 341-D, 420-D, and 484

EFFECTIVE DATE: December 31, 1997
REPEALED AND REPLACED: November 16, 2005, filing 2005-418
AMENDED: December 27, 2006 , filing 2006-531

ATTACHMENT E

EPA Definition of a Concentrated Animal Feeding Operation[1]

2.2 Animal and Concentrated Animal Feeding Operations

A facility (e.g., farm, livestock market) that houses animals must meet both of the following criteria to be considered an animal feeding operation [40 CFR 122.23(b)(1)]. The facility must:

- ☒ Stable, confine, and feed or maintain animals for a total of 45 days or more in any 12-month period; and
- ☒ Not sustain crops, vegetation forage growth, or post-harvest residues in the normal growing season over any portion of the facility.

The first part of this definition means that animals must be kept on the lot or facility for a minimum of 45 days. However, it does not mean that the <u>same</u> animals must remain on the lot for 45 days or more; only that <u>some</u> animals are fed or maintained on the lot 45 days out of any 12-month period. The 45 days do not have to be consecutive, nor does the 12-month period have to correspond to the calendar year. For example, the 12-month period may be counted from June 1 to the following May 31.

The regulations give the permitting authority a fair amount of discretion under 40 CFR 122.23(b)(1); EPA interprets "maintained" to mean that the animals are confined in an area where waste is generated and/or concentrated. Maintained also can mean that the animals in the confined area are watered, cleaned, groomed or medicated. This interpretation allows the permitting authority to regulate animal operations such as dairy farms, stockyards, and auction houses where animals may not be fed, but are confined temporarily. The important consideration in this interpretation is the waste is generated in an area where animals are concentrated.

The second part of the definition distinguishes feedlots from pasture land, which is not subject to the NPDES program. This part of the definition narrows the geographic scope of the regulations to the portion of the facility where animals are confined and where natural forage or planted vegetation does not occur during the normal growing season (for that geographic area). Feedlots with constructed floors, such as solid concrete or metal slats, clearly satisfy this part of the definition. Other feedlots may have open dirt areas. These "open dirt" feedlots may have some vegetative growth along the edges while animals are present or during months when animals are kept elsewhere. EPA interprets the regulations to mean that if a facility maintains animals in an area without vegetation, including dirt lots, the facility meets the second part of the definition.

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[1]An animal feeding operation that meets the EPA definition of a Concentrated Animal Feeding Operation as provided by the U. S. Environmental Protection Agency in 40 CFR Parts 9, 122 and 412 - Revised National Guidelines for Concentrated Animal Feeding Operations in Response to the Waterkeeper Decision; Final Rule dated December 22, 2008.

A concentrated animal feeding operation (CAFO) is an animal feeding operation (i.e., it meets the two criteria above) and also meets the animal numbers and polllutant discharge criteria provided by the U. S. Environmental Protection Agency in 40 CFR Parts 9, 122, and 412- Revised National Guidelines for Concentrated Animal Feeding Operations in Response to the Waterkeeper Decision: Final Rule Dated December 22, 2008.

ATTACHMENT F

BEST MANAGEMENT PRACTICES FOR ANIMAL CARCASS COMPOSTING

Bill Seekins

October, 2011

Maine Department of Agriculture, Conservation & Forestry

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BEST MANAGEMENT PRACTICES FOR ANIMAL CARCASS COMPOSTING

Bill Seekins
Maine Department of Agriculture
October, 2011

Introduction

Maine's Animal Carcass Disposal Rules, Chapter 211, allow for the use of composting as a method for managing animal carcasses generated on farms and farm operations. (The rules also apply to composting of pets and other domestic animals.) When the rules were drafted and adopted in 1996, composting was applied primarily to poultry and other small animals. As a result of the Foot and Mouth Disease outbreak in Great Britain in 2001 and other disasters that left hundreds or even thousands of large animal carcasses, there has been interest in extending this methodology to larger animals.

Research and demonstration work has been conducted in Maine and in several other states since that time. Work by the Maine Compost Team (see references) demonstrated that large animal carcasses can be successfully composted using a variety of compost feedstocks. The research led to the development of the approach called 'Pre-condition and Turn' which has been tried on a variety of different carcass types. This work has shown that composting is a feasible and in many cases a preferable approach to managing larger carcasses. In many situations, burial is discouraged due to shallow soils or water tables near the surface or due to any number of other factors that render a site unsuitable for burial. Often, these same sites may be used for composting. One advantage often cited is the ability to reuse the compost site over and over, unlike burial sites which should not be used again for many years.

The 2011 update to Chapter 211 contains references to a number of carcass composting techniques and sets standards for siting and operation of each. This document contains the basic information on materials and pile construction and management techniques needed to properly implement several of these composting approaches. Special attention is given to the technique that is referred to as the 'Pre-condition and Turn Method' since that appears to be the most versatile method of composting animal carcasses and applies to the widest range of circumstances. Two other techniques, the static pile and the turned windrow, are also discussed. Information on how to set up and manage a Maryland Bin system is also described. Anyone interested in pursuing that approach will find more detailed information available in publications listed in the Bibliography.

This set of best management practices (BMPs) is the accumulation of information about composting techniques that have been found to be environmentally sound, economical to implement and are unlikely to result in significant nuisance problems if carried out properly. As with any new area of research and demonstration, there is still much to be learned about this process, so that updates of these BMPs are likely over time.

Definitions

Animal Carcass(es) - Body(ies) or body parts of dead animals, including but not limited to pets, livestock and poultry. Carcasses may be mixed with manure and bedding or other organic materials which cannot be separated from the animal carcasses.

Animals/ carcasses, Large- Animals such as cows and horses weighing 500 lbs or more.

Animals/ Carcasses, Medium-size - Animals such as sheep, goats and deer weighing between 100 and 500 lbs.

Animals/ carcasses, Small - Animals which weigh 100 lbs. or less.

BMP - Best Management Practice - The term "Best Management Practice," or BMP, originated in the Clean Water Act of 1972, and is now commonly used in the language of environmental management. In agriculture, these are practices, methods or techniques that have been found by the Commissioner of Agriculture to be the most effective and practical means in achieving an objective (such as preventing or minimizing pollution or negative impacts on human or animal health) while making the optimum use of the farm's resources.

BMP, General - Best Management Practices that have been approved by the Commissioner of Agriculture for general use. A list of general BMPs serves as a menu of acceptable options that the farmer, business owner or individual may choose from. Not all general BMPs would apply to any specific situation.

BMP, Site Specific - Best Management Practices that are developed or approved by the Commissioner of Agriculture to resolve specific problems based on the conditions observed on a particular site.

Bulking Agent - Relatively dry porous material used to give a compost pile structure and to absorb moisture. Most bulking agents are relatively high in carbon and are also a carbon source. Examples of bulking agents are sawdust, shavings, dry animal bedding and straw.

Compost Medium/Material - The relatively dry bulky organic material that forms the matrix within which carcasses or offal are composted.

Composting - The biological decomposition and stabilization of organic matter under mostly aerobic conditions of high temperature (120°F or higher). When oxygen, moisture, nitrogen and carbon are available in the right proportions, the degradation generates considerable quantities of heat, reaching temperatures of 130° to 170° F. This sustained high temperature is responsible for the virtually complete destruction of pathogenic organisms and weed seeds in the composted material. The process also results in a humus-like product that has its nutrients in a much more stable form than the uncomposted wastes making it safer and easier to store and use.

Chronic Wasting Disease -A neurological disease of members of the deer family. (See Transmissible Spongiform Encephalopathy (TSE))

Emergency - An unexpected occurrence or set of circumstances demanding immediate action, e.g., fire, major disease outbreak, flood, etc. An emergency exists when multiple carcasses result from a single, unplanned occurrence, such as a fire, disease outbreak, flood or other disaster.

Offal - Unwanted or unused body parts remaining from butchering or slaughtering animals.

Scrapie - A neurological disease of sheep and goats. (See Transmissible Spongiform Encephalopathy (TSE))

Transmissible Spongiform Encephalopathy (TSE) - One of several similar neurologic diseases thought to be caused by a mis-folded protein (prion) in the nervous tissue which results in slow degeneration of the nervous system and ultimately in death. These diseases include Scrapie, 'Mad Cow Disease' and Chronic Wasting Disease.

Applicability.

The primary approach described in this document is the 'pre-condition and turn' method of composting that has been developed as a result of the research noted above. This approach is suitable for composting large animal carcasses as well as smaller animals. It may also be adapted for composting animal parts such as those generated from slaughterhouses and butcher shops. The pre-condition and turn approach is well suited to either routine disposal or large scale disaster disposal situations. Although the other methods described may be used in all these situations, each has certain limitations in some scenarios. For example, the Maryland Bin System would be impractical to set up in an emergency situation since there would not be time to pour cement and construct enough bins to handle a large mortality event. On the other hand, the turned windrow system does not lend itself well to composting large carcasses unless they have been cut into smaller pieces that can be mixed with a compost medium and turned. In instances where the carcasses are the result of a disease outbreak, certain materials and methods are preferred over others. These will be identified in the sections addressing these items.

Description of Composting Systems

Several compost systems are available. The most common are the University of Maryland Compost Bin System, the turned windrow system, the aerated static pile system, the pre-condition and turn system and in-house composting. A less common approach is the use of some type of in-vessel system.

a. **University of Maryland Bin System** - The University of Maryland Bin Composting System uses wooden or concrete block bins to compost poultry, other small carcasses or poultry offal. The composting is done in two active stages plus a curing stage. This system only applies to small carcasses or small body parts. (Other bin systems are also possible.)

b. **Turned Windrow** - The turned windrow system is an approach, in which the compost mixture is placed in rows and turned periodically during the compost cycle. The turning action supplies oxygen through gas exchange, thereby creating natural ventilation. The frequent turning insures the production of a uniform product at the end of the compost process. Success with this system depends on the ability to achieve a thorough mix and aeration through repeated turning. This system only applies to small carcasses, small body parts or ground carcasses.

c. **Static Pile -** The static pile method uses a pile of composting material that is not agitated or turned. The initial thorough mixing of the carcasses or body parts with the compost media is essential to create a uniform mix and contact between all carcasses and the media. Porosity in the pile must be sufficient to allow proper air flow and effective composting. Aerobic conditions are maintained by natural ventilation of the pile that is enhanced by using materials that maintain relatively high pile porosity. The pile is covered with an insulating blanket of four to six inches of finished compost, compost media, or other suitable material to ensure proper temperatures are attained at outer edges of pile. This approach applies primarily to poultry and other small carcasses.

d. **Aerated Static Pile -** In the aerated static pile method (also known as the Beltsville Method or Rutgers Method), the compost is not agitated or turned. The initial mixing of the carcasses with the bulking agent must be sufficient to allow proper air flow and effective composting. Aerobic conditions are maintained by mechanically drawing, or blowing air through the pile. The pile is covered with an insulating blanket of four to six inches of finished compost, compost media, or other suitable material to ensure proper temperatures are attained at outer edges of pile. This approach applies primarily to poultry and other small carcasses.

e. **Precondition and Turn Method** - The pre-condition and turn system was developed specifically for management of animal carcasses and slaughterhouse wastes.

In this method, the carcass or body parts are placed between layers of dry absorbent bedding or other compost media. The carcasses or body parts are then allowed to decompose without disturbance for a period of time, which varies with carcass size and other factors. (See Table 1.) Once this pre-conditioning period is done, the pile or windrow is then turned similar to the turned windrow system. This method may be used for both routine and emergency situations and for both large and small carcasses and slaughterhouse wastes (offal) of all types. It has the advantage that early in the process, the carcasses or offal remain buried deeply in the compost media until a significant amount of decomposition has occurred. This significantly reduces nuisances in these early stages, but allows the advantages of thorough mixing and aeration in the later stages.

f. **In-house Composting -** This option uses one of the windrow or pile based compost methods such as the turned windrow or the pre-condition and turn approaches except that the windrow or pile would be formed inside the barn using the litter from the barn and, usually, some additional bulking agent as the compost medium. This approach applies primarily to poultry that are raised on the floor of the poultry barn with litter although it could also be used for other small or medium size animals kept in loose housing.

g. **In-vessel Composting -** Many different in-vessel compost systems have been developed for a variety of purposes. Some are static systems with air introduced with blowers. Others are mechanically agitated or tumbled to mix and aerate the contents. The common factor in all these systems is that the composting is done within a container. Several compost systems that incorporate some type of vessel in the compost process are available. Most of these systems use some form of active aeration to provide the needed oxygen. One system that has been used to compost poultry mortalities from an avian influenza outbreak utilized the large plastic 'bags' designed for feed storage with aeration tubes inside. These systems offer the advantage that they are completely enclosed and so promise greater control over odors, vectors and loss of leachate than open windrow methods. Most of these systems are best suited to small carcasses or carcasses that have been ground or cut into pieces.

Siting Carcass Compost Operations

Because carcass composting has the potential to impact the environment, most states have standards for locating carcass compost sites. The standards include setback distances to sensitive features such as water bodies and separation distances to groundwater and bedrock. Maine's standards are spelled out in Tables 4 through 8 at the end of the Chapter 211 Rules. Composters are advised to check with the standards for their own state prior to establishing a carcass compost site.
Here is some general guidance in siting a compost facility:

1. Excess water is the composter's enemy. Setting up your site to be sure that the compost is never sitting in water and that your equipment is not working in mud is a key to successful composting.

2. The soil or other working surface should have a minimum slope of 2 percent and a maximum slope of 6 percent that slopes to move water off from the site rather than let is stand. Sites on natural soils need to have a little more slope than paved sites since ruts are more likely on the soil surface.

3. Composting sites should be located as near the source of carcasses as practical and in accordance with the regulatory setback requirements. (For Maine composters, the requirements are laid out in the Carcass Disposal Rules, Chapter 211.) Whenever possible, the siting should also be done so that the prevailing winds will not carry odors from the site to nearby neighbors.

4. Surface water should be diverted away from the facility.

5. The compost pad and any area surrounding it that will have equipment traffic should be designed so that it can handle traffic involved in the compost process.

6. You should have a vegetated filter strip or other approved area downslope from the compost pad to receive and treat any leachate or runoff that might be generated.

Space Requirements

Once a potential compost site has been identified, the amount of space required to accommodate the number of carcasses should be calculated. See Diagram 1 for guidance in doing this calculation for large animal carcasses. For medium size carcasses, assume that the space requirements per animal will be about half those for a large carcass. Space requirements for small carcasses should be based on an animal unit basis, where each 1000 lbs of small carcasses is the equivalent of one animal unit. The guidance in Diagram 3 may be used to estimate space for small animal carcasses by replacing one carcass with one animal unit. Once this is done, the site should be checked to be sure sufficient space is available. If it is not, an additional area(s) will need to be identified.

Materials/ Compost Media for Animal Carcass and Offal Composting

The media used for composting carcasses or offal should provide the conditions that will support hot aerobic composting

Characteristics: Animal carcasses and offal can be successfully composted in a variety of media. The ability to achieve temperatures proven to kill most pathogens will depend more on the conditions in the media than on the source of the media. Those conditions that appear to be most conducive to rapid and sustained heating are:

a. Porosity – The compost media should have sufficient porosity that it will allow air to be drawn into the pile through natural ventilation but not so porous as to cause excessive drying or cooling. Piles with a predominance of very fine textures or very wet materials fail to heat due to lack of oxygen. Piles with a very high porosity, such as wood chips, heat rapidly but are unable to sustain the high temperatures. Mixtures having a large proportion of particles between 1/8 inch and one inch appear to give the optimum results.

b. C:N ratio – As with all composting, piles with C:N ratios too high (over 40:1) tend to heat slower than those with a lower C:N. In order to accommodate the nitrogen from the carcass, the C:N ratio in the compost media should be between 25:1 and 50:1, with the preferred range being between 25:1 and 40:1.

c. Moisture - The compost media should have a moisture content between 40 and 65% with the preferred range being between 50 and 60%. This may be assessed through the use of the squeeze test or other acceptable test procedures. A material that is so wet that water will run out when squeezed is not likely to aerate well and will result in anaerobic conditions in the pile.

d. Biological activity - The compost media should be biologically active such that it will reach temperatures of at least 120°F when placed in a pile at least 6 ft (two meters) in diameter and 3.5 ft (one meter) high. Materials such as sawdust or woodchips that have limited biological activity and will not heat on their own should be amended with other ingredients (such as manure or waste feed) to create a biologically active environment.

e. Age of material – The compost media for carcass composting should be fresh, active material. Materials that have been composting for several months do not have the amount of energy or activity needed to sustain the temperatures within the carcasses when compared to relatively fresh active compost piles.

<u>Compost Media Recommendations for Animal Carcasses.</u> The following media have been tested and found to give excellent results for composting animal carcasses and offal:

- hot municipal sludge compost
- fresh dry horse bedding
- mixture of waste feed (1/4 to 1/3 of the mix) and dry horse, heifer or calf bedding(2/3 to 3/4 of the mix)

- mixture of fresh fall leaves and poultry manure (in a ratio of 10 to 1 leaves to manure)

NOTE: Hot municipal sludge compost is recommended in emergency situations in the State of Maine since it is readily available in large quantities and has been proven to create the conditions necessary to compost both large and small carcasses.

Any other media that meets the requirements in the section above should also perform well for composting either carcasses or offal.

Compost Management

Processes. Several compost systems or processes are discussed in this document. The process recommended for most situations may be described as a static compost pile followed by the turned windrow method. In Maine, this has been named the 'Precondition and Turn Method' of composting. In this system, a large carcass or carcasses would be placed in a pile of actively composting material and allowed to decompose undisturbed for up to 10 to 12 weeks. (This can be shorter if investigation of the pile shows that very little soft tissue remains.) Other systems discussed in later sections include the static pile system, turned windrow system, the Maryland Bin System, in-vessel composting and in-house composting.

Turning. Compost piles are often turned to mix the various ingredients and to introduce air space to allow for aeration. This may be done with a tractor or other piece of equipment with a loader. Compost turning machines that are designed specifically for this purpose are also available. Turning may be problematic early in the compost process because of the difficulty of moving the carcasses while keeping them properly covered. Many compost turners would not be able to turn an object the size of a large farm animal while it was intact. After turning, care should be taken to make sure there is no soft tissue on the surface of the pile. Bones on the surface of the pile with any soft tissue should be reburied in the compost pile immediately. (Note: Static pile systems and many in-vessel systems do not include turning as part of the process.)

Odor, Insect and Vector Control. Animal carcass compost sites and operations should be managed to minimize odors and the attraction of insects and other vectors. The first step toward doing this would be to make sure no carcass is left uncovered long enough to attract vectors. Generally, if carcasses are covered within 6 hours vector attraction will be minimal. Offal, however, is more odorous so that it attracts vectors quicker and should be covered as soon as possible. (Note: Maine's carcass disposal rules, Chapter 211 require that carcasses be covered within 24 hours and that offal be covered within four hours.). Proper pile construction with sufficient material both below and above the carcass is critical. (See pile construction section.) Good pile management and good housekeeping are also very important. As the carcass(es) decomposes, especially within the first 5 or 6 days, the pile is likely to settle dramatically. It is essential to check the pile and re-cover any part of the carcass(es) that may become exposed. The settling process may also create cracks in the material, especially just above the carcass(es). These cracks should be filled since they can form channels for odor to escape the pile, attracting insects, birds, dogs and other scavengers.

In some cases, it may be necessary to discourage animals such as turkeys, dogs or coyotes from digging in fresh piles. Draping the orange plastic 'safety fencing' over freshly built piles has proven to be an effective deterrent to digging.

Types of Carcasses. Compost techniques have been successfully used with adult cattle, calves, horses, pigs, sheep, poultry and other less common types of farm animals. Some work has also shown success with composting large marine mammals. At this time, composting is not being recommended for the disposal of animals showing symptoms of neurological diseases such as Chronic Wasting Disease or Scrapie. Research is currently being done to assess the extent of destruction of the causal agent for these types of diseases so this recommendation may change in the future.

Carcass Preparation. In general, no preparation is necessary for the most compost systems to work. In many cases there are a couple of steps that may be taken to enhance the composting process. 1. Venting the abdomen of large animals helps reduce bloating and so reduces the chance of exposure of parts of the carcass in the first few days of the compost process. For cattle, effort should be made to vent the abdomen in several places since a single vent hole will not release gas from all parts of the abdomen. 2. Some farms have reported that cutting a large carcass, such as a dairy cow in half or quarters speeds up the decomposition process. A modification of this would be to split open the abdomen to allow more contact with air and the compost mixture.

Neither venting nor cutting is required for the overall success of this process. In the case of carcasses with highly contagious diseases, such as Foot and Mouth Disease, it is recommended that the carcasses not be vented or cut in order to minimize the chance of transferring the disease organism.

If large or medium size carcasses are to be composted using a turned windrow system, then grinding the carcasses or reducing them to smaller pieces in some way is highly recommended. Otherwise turning will be very difficult at the outset.

Pile Construction and Management.

Proper pile construction is a key to composting animal carcasses without causing environmental problems or nuisances. Diagrams 2 and 3 illustrate the recommended approach to constructing compost windrows for large animal carcasses. Diagrams 4 through 6 illustrate the recommended layout for medium size carcasses, small carcasses and offal, respectively. Diagrams 7 through 9 illustrate the layout for Turned Windrow, Static Pile and Maryland Bin systems.

Taking Temperatures

Systematically taking and recording temperatures is an important tool in managing any kind of compost pile. Here are the MAINE COMPOST SCHOOL RECOMMENDATIONS for taking pile temperatures:

1. For a Windrow:
TAKE 5 OR MORE READINGS FOR EACH WINDROW
READINGS SHOULD BE EVENLY SPACED ALONG THE WINDROW
RECORD INDIVIDUAL READINGS AND AVERAGE FOR THE WINDROW
TAKE READINGS FROM SAME LOCATIONS EACH DAY!

2. For a Round Pile:
TAKE 2 OR MORE READINGS
READINGS SHOULD BE FROM OPPOSITE SIDES OF PILE
RECORD INDIVIDUAL READINGS AND AVERAGE FOR THE PILE
TAKE READINGS FROM SAME LOCATIONS EACH DAY!

3. At each location, TAKE TEMPERATURES AT DEPTHS OF
    1 FOOT (30 cm) - HOTTEST LEVEL
    3 FOOT (1 meter) OR CORE
    RECORD TEMPS AT EACH DEPTH SEPARATELY

You should record the pile temperatures as often as possible, preferably every day you are on the compost site. Keep in mind that you will need to keep records at least until a pile meets the time/temperature requirements in CHAPTER 211. In addition to pile temperatures, you should record management information such as pile turning or addition of water or other ingredients. To complete the record, you should keep track of any rainfall or other significant weather event that has happened since the last time temperatures were recorded. This will help in interpreting your temperature data when you look at it at a later date.

Meeting Time/Temperature Standards.

In order to distribute compost made from animal carcasses to the public, the compost process must meet certain time and temperature standards. These standards differ depending on the type of compost system being used. Maine's time/temperature standards as laid out in Chapter 211 are as follows:

1. **Maryland Bin Composters -**: Temperature shall be monitored and recorded on a daily basis at least until the time/temperature standard has been met. Temperature readings shall be taken at a point near the center of the bin. The compost shall attain a minimum temperature of 131° F (55° C) for a minimum of one day in Stage I and for a minimum of three days in Stage II. Batches that fail to meet this temperature requirement shall be incorporated into subsequent batches and re-composted or be spread on the owner's land;

2 Windrow Composting Method - Temperature shall reach a minimum of 131° F (55° C) for at least 15 days during the composting period. During the high temperature period there must be a minimum of five (5) turnings of the pile. Once this temperature requirement is met, the windrow shall be turned at least once per week. Once the temperature in the windrow drops below 110°F and does not increase after turning, the windrow may be placed in a curing pile.

3. Static Pile or Aerated Static Pile. The pile shall be maintained at a temperature of 131° F (55° C) or greater for at least three (3) days at both the three foot and one foot depths in the pile. Detention time in the static pile or aerated static pile shall be at least 21 days, after which the pile may be dismantled and moved to curing;

4. Pre-Condition and Turn Method. The compost shall attain a minimum temperature of 131° F (55° C) at the three foot depth at each location for a minimum of three days in the pre-condition stage (Stage I) or for a minimum of fifteen days at either depth during the turning stage (Stage II). The windrow must be turned at least five times during the high temperature period.

5. In-vessel Compost Systems. The contents of the vessel shall be maintained at a temperature of 131° F (55° C) or greater for at least three (3) days throughout the vessel. The composting mixture shall remain in the vessel until all soft tissue is gone but in no case shall it be retained for less than 21 days, after which the contents may be removed to a compost pile or placed in curing;

Minimum Volumes

For all composting methods other than the Maryland Bin System, a minimum pile volume of five (5) cubic yards is required for the process to be effective. Piles with larger carcasses will, of course, require a much larger volume in order to adequately cover the carcass (es). See the pile construction diagrams at the end of this document for guidance in estimating volumes needed.

Curing

For all compost systems, the compost should be cured for three (3) to six (6) months once the active compost phase has been completed or after the pile has cooled to less than 110°

F(43°C). Compost that is to be field applied may be utilized immediately after the active compost stage or may be cured for a shorter time before use.

Pre-condition and Turn Method Step by Step Process

Step 1. Lay out a bed of dry compost media mix. It is important to make sure there is at least 18 inches of dry absorbent material below the carcass. This minimizes the amount of fluids that are released as the animal decomposes from reaching the ground water or exiting the pile. The bed of material upon which the carcass is laid, should extend at least two feet beyond the carcass in every direction. For most dairy cows, this would require a bed about 8' by 10' – 12'. The size will need to be adjusted based on the size of the carcass.

If multiple carcasses are to be composted at the same time, the base of a windrow can be formed by creating a bed about 8 to 10 feet wide and as long as needed to accommodate the number of animals to be composted. See Diagram 1.

Step 2. Place the carcass on the bed of compost material. The carcass should be laid on its side to reduce the chance that the legs will be exposed as the pile settles. For a single animal, the carcass should be oriented so that the length of the body is going lengthwise of the pile.

If multiple carcasses are to be composted at the same time, a windrow can be formed. It is recommended that carcasses be laid at right angles to the orientation of the windrow and placed so the body of one overlaps the legs of the adjacent carcass. This helps reduce the overall length of the windrow needed and the amount of compost material needed. See Diagram 1.

Step 3. Prepare carcass, if desired. This is the most convenient point in the process to vent the carcass, open it up or to insert a thermometer, if any of those steps are to be taken.

Step 4. Cover carcass(es) with at least two feet of compost material. To be sure that at least two feet of cover is present over all parts of the carcass, the equipment operator or preferably someone working on the ground should probe all parts of the pile to determine how deep the carcass is buried. A three foot long compost thermometer makes a good probe, as does a length of sharpened steel rebar. Any type of rod that is at least three feet long and has a tapered end will work.

When composting carcasses in the winter, additional cover material will be needed to maintain pile temperatures. An additional six to twelve inches of cover material will insulate the pile and allow the core of the pile to stay warm and active for much of the winter.

Step 5. Monitor the pile regularly, especially for the first 4 or 5 days. An active carcass compost pile will change dramatically over the first week of composting. Piles often settle a foot or more and sometimes develop cracks that can lead to odors and attract animals and insects to the pile.

Step 6. Maintain the pile as needed. If a crack appears in the pile or if any of the carcass becomes exposed, or if there is any animal activity, the pile will need to be repaired. This usually consists of either raking material into the cracks or adding more material to cover exposed parts and to discourage scavengers. Any of these conditions should be corrected as soon as possible since they can lead to greater problems if left uncorrected.

Step 7. Pre-condition the carcass(es). To do this, allow the pile to compost undisturbed for several days to several weeks depending on size and type of carcass or offal. See the table below for suggested lengths of time for different carcass types. The pile may be left for up to six months if turning is impractical at the end of the pre-condition period. Some piles may be ready to turn in shorter time. This can be determined by digging into the pile to determine the level of decomposition. The length of the pre-condition period can vary considerably based on the level of energy in the compost medium, the size of the carcass and the time of year.

TABLE 1 SUGGESTED LENGTH OF PRE-CONDITION PERIOD FOR CARCASSES AND OFFAL

Type of Material	Length of Pre-condition Period (Days)
Poultry offal	7 to 10
Large animal offal	20 to 25
Large animal offal with bones	25 to 40
Poultry and other small carcasses	25 to 35
Deer, goats, sheep and mid size carcasses	35 to 45
Cows, horses and other large carcasses	40 to 90

Note that these suggested pre-conditioning time periods are based on the use of an active, hot compost medium. Pre-conditioning times may increase dramatically if the medium is old, wet, extremely dense or otherwise inhibited in activity.

Step 8. Turn the pile or windrow. The pile or windrow may be turned with a bucket loader, excavator or any other piece of equipment that will lift, fluff and mix the material. A compost turning machine would be ideal for this purpose. Turning should be done about once a week for as long as the average pile temperature is above 110° F. At least two turnings are recommended even if the temperatures are below 110° F when it is time to turn the pile or windrow for the first time. For more detail on determining turning schedules, see the section on Aeration for Turned Windrows.

Step 9. Cure the compost. Once the pile has cooled to less than 110° F (43°C), it may be placed in a larger stockpile to cure. Curing normally takes from 3 to 6 months after the active compost stage is done. Compost that is to be field applied may be cured for a shorter time or applied immediately after the active composting stage.

Turned Windrow.

In general, a turned windrow system is not recommended for fresh whole large or medium size carcasses for a number of reasons. A turned windrow may be used, however, if grinding equipment with sufficient capacity to handle a whole carcass is available. A turned windrow may be used for smaller animals such as chickens since it may be possible to mix them with the compost media and then be turned on a regular basis. In order to avoid nuisance and vector problems, it would be necessary to pick up any carcasses that fall out of the windrow during turning and then re-bury them in the compost media. The windrows may have to be re-covered with compost following the first few turns to make sure that all carcasses are buried deeply enough in the pile. This extra work of repeated burying and covering makes the turned windrow system an unattractive option for most farms. (See the On-Farm Composting Handbook for details on managing a turned windrow compost system.)

Mixing for Turned Windrows. The mixing of ingredients in a turned windrow may be done in two ways. If a mixing device such as a feed mix wagon is available, the compost materials may be premixed prior to forming them into a windrow. This approach is preferred for carcass composting since the carcass(es) can be buried in a fully mixed medium at the start. If no mixing device is available, the ingredients can be laid out as in Diagram 7 and then mixed with a bucket loader or windrow turner.

Pile Construction for Turned Windrows. Windrows that will be turned may be laid out the same as those that will be managed using the pre-condition and turn system. See Diagrams 2 through 6 for windrows built using a pre-mixed compost medium. Or they may be laid out as in Diagram 7 if the ingredients in the medium are not going to be pre-mixed.

Aeration for Turned Windrows. Aeration in a windrow system in general occurs as a result of the natural intake of air along the sides of the windrow as the pile heats and vents the hot air out the top of the windrow. The ease with which this happens depends on the porosity of the compost medium. As the windrow or pile composts, it settles, thus increasing compaction and reducing porosity. Periodically, it necessary to fluff up the compost material to re-introduce the air space into the pile to allow it to continue to 'breathe'. This can be done by lifting and fluffing the material with a loader of some type or by turning it with a compost turner.

The frequency of turning in a turned windrow system can be determined based on time or on temperature. The initial turning schedule, however, may be determined by the need to meet certain regulatory requirements. In Maine, the Chapter 211 rules require that carcass compost being managed by the turned windrow method must achieve a temperature of 131° F (55°C).for a minimum of 15 days and that it will be turned at least five times while the temperature is at or above 131° F (55°C).

After this regulatory requirement has been met, the windrow or pile will still need to be turned periodically in order to facilitate the aeration process and maintain pile temperatures. Generally, if a windrow is turned once a week as long as temperatures remain at or above 110° F, the aeration needs will be met.

Those who want to base turning on temperatures may use the following rules of thumb to guide turning decisions:

- Turn whenever there is a significant drop in pile temperature from one day to the next and no external cause is apparent.

- Turn whenever the pile temperature exceeds some temperature threshold. An example might be to turn any time the temperature exceeds 160°F.
- Turn if the temperature reading at the one foot depth in the pile is more than twenty degrees F hotter than the three foot temperature.

For additional details on how to construct and manage a Turned Windrow System refer to the 'On-farm Composting Handbook'.

Curing. Curing in a turned windrow system is similar to curing in the pre-condition and turn system. Once the pile has cooled to less than 110° F (43°C), it may be placed in a larger stockpile to cure. Curing normally takes from 3 to 6 months after the active compost stage is done. Compost that is to be field applied may be cured for a shorter time or applied immediately after the active composting stage.

Static Pile and Aerated Static Pile

Mixing for Static Piles
Thorough up-front mixing of the compost ingredients is essential for success in static compost systems since the material remains undisturbed throughout the active composting phase of the process. This means that the ingredients must either be placed in a mixing device in the right proportions (see section on compost media) or layered in the right proportions and mixed with a loader. For static pile systems, a mixing device such as a feed mix wagon is highly recommended since a much more uniform mixture can be created than with a bucket loader.

Pile Construction for Static Piles
Once a thorough mix of ingredients, including the carcasses or parts, has been achieved, they should be laid out as shown in the Diagram 8. It is important that once the pile has been formed, a layer of compost, compost media or other dry bulky material be placed over the mixture. This layer not only insulates the pile allowing it to heat throughout, but acts as odor control. If sufficient cover material is not used, animals are likely to be attracted to the piles.

Aeration for Static Piles
Aeration for static piles may be either passive or active. The difference is that in active aeration, a blower would be used to blow or draw air through the compost mixture, while passive aeration depends on the natural flow of air in the pile caused by the heating of the material.

Passively Aerated
Passive aeration depends on the pile maintaining sufficient porosity throughout the compost process to allow the pile to naturally draw air in through the pile sides. In order for this to happen, the original mix must be made up of materials

that will resist compacting as the pile settles and reduces in size. Generally, this means that there are components such as wood chips or coarse wood shavings that will continue to provide air spaces as the process progresses. A relatively low starting bulk density (about 800 lbs per cubic yard) for the mix will also be a benefit. Passively aerated piles may include aeration pipes under the piles to try to improve the amount of air flow in the pile. Results using aeration pipes under passively aerated carcass compost piles has had mixed results. Although early pile temperatures may be higher when using the aeration pipes, they have also led to more odor and vector issues since the pipes can act as conduits for liquids to leave the pile.

Actively Aerated

Actively aerated carcass compost piles would rely on using a similar mixture of ingredients as described in the passively aerated compost pile section above. These systems, however, all have either aeration pipes underneath the pile or an air plenum built into the floor of the compost area. These structures allow air to be blown into the pile mechanically. A key to using an actively aerated static pile is determining the number, size and scheduling for blowers. A common rule of thumb is to design a blower system to deliver approximately 10 cfm (cubic feet per minute) of air per dry ton of composting material based on continuous airflow. (Delivery rate would need to be higher for intermittent aeration schemes.) Blowers for this type of system generally are in the 1/3 to 1/2 hp size range. The 'On-farm Composting Handbook' has details on how to construct and manage an aerated static pile

Length of Time in Pile

Most regulations, including Maine's Chapter 211, that determine the minimum standards for carcass composting require that static piles remain undisturbed for 21 days or more. The rules then allow the compost to be moved to curing piles. Experience has shown that meeting this standard will result in pathogen and weed seed kill and will significantly reduce the vector attraction but the composting process is far from finished. Generally, temperatures in the static pile will still be well over 130°F (55°C) at the end of the 21 day period. Longer compost periods are recommended if a stable final product is the goal.

Curing

Curing is especially important for compost produced using either of the static pile systems since experience has shown that the material is not uniformly composted at the end of the nominal active composting period and may contain very immature active material in some locations. Allowing it to cure for three to six months will allow harmful constituents in the immature compost such as ammonia or volatile organic acids to further break down prior to use. For the curing to be effective, however, the compost needs to be moved from the original location and actively mixed and re-piled to allow the various parts of the pile to be homogenized.

Bin Systems.

A permanent bin system may be set up to accommodate routine mortalities on a farm. Generally, bins are sized and used for carcasses that are 300 lbs or less. Some mid-western farm operations, however, have successfully composted cow carcasses using large concrete bins with built in air ducts or temporary bins made from large round bales of hay. The dimensions of the bins should be determined based on the size of the carcasses to be composted and the equipment that would be used to unload the bins. (See reference section for publications about designing, building and managing bin compost systems.) One of the most commonly used bin systems was developed for the broiler industry by the University of Maryland. That system is used throughout the Southeastern United States for the disposal of poultry. Some of the basics are given below. More information on bin design, construction and management may be found in several references in the Bibliography.

Maryland Bin System

The University of Maryland Bin Composting System uses wooden (or sometimes concrete block) bins to compost poultry carcasses. The composting is done in two active stages plus a curing stage. Stage I begins by placing a 6" layer of dry poultry manure in the bottom of a bin then placing a 6" layer of straw, chopped hay or other loose bulking material, then poultry carcasses and a layer of manure. The straw, carcass, manure sequence is repeated until the bin is full. (See Diagram 9.) It is then allowed to compost for 7-10 days.

Stage II begins when the material that has been composting 7-10 days is moved into a second bin. The moving should be done so as to mix and loosen the material as much as possible.

After the material has been in the second bin for approximately 10 days, the highly active composting period is complete. The material may then be moved to a curing pile for 30 days.

1. Bin Construction - The compost bins must be built of decay-resistant wood or other durable materials. They are built on an impervious base and most have a roof to keep out excess moisture. Plans for bin construction are available from several sources (See Bibliography.)

Bins are typically 5' high, 5' deep and 8'+/- wide, with the width of the bin planned to accommodate the size of the equipment used to load and unload each bin. The second stage, or secondary composter, may consist of individual bins or one bin of the size equivalent to the sum of the individual bins.

2. Bin Volume - For each stage of the composting process, storage volume is calculated as follows:

a. Volume (cf) = Number of birds in flock x Design Factor (See Table 2)

b. Number of bins per stage = volume (from above) (cf)/volume of one bin (cf)

TABLE 2. DESIGN FACTORS FOR SIZING COMPOSTING BINS*

Poultry Type	Design Factor cu. ft./bird
Broiler	0.0105
Roaster	
• females	0.0071
• males	0.0214
Laying Hens	0.0035
Breeding Hens	0.0048
Breeders - Male	0.0238
Turkey	
• female	0.0196
• tom	0.0468
• feather production	0.0741

*From SNTC Bulletin S210-0-05

3. Operation of Maryland Bin systems

a. Temperature should be monitored on a daily basis. Temperature should peak at 130° to 140° F in each stage of the composting process.

b. At the end of each day that carcasses are placed in the bin, they should be covered with manure and bulking agent to reduce odor, fly and vermin problems.

c. The Compost mixture normally remains in primary (Stage I) bin for a minimum of seven (7) days after bin is filled and a minimum of seven (7) days in the secondary (Stage II) bin. After leaving the secondary (Stage II) bin, the compost should remain in a curing pile for at least 30 days before use or distribution. The material will still be active at this point.

d. To avoid fly and odor problems, carcasses should be placed at least 6" from the sides of composting bins.

e. The compost medium ingredients that are recommended by the University of Maryland age given in the table below. See the section on compost materials for additional ideas for materials that may be used.

f. Moisture in the composting material should be checked periodically and water added if it is not moist to the touch.

Composting Mix Ratio Recommendations for the Maryland Bin System

The mix ratio recommended by the University of Maryland and the Natural Resources Conservation Service is given below in Table 3.

TABLE 3. MIX RATIO RECOMMENDATIONS FOR MARYLAND BIN SYSTEM*

Component	Parts by Volume	Parts by Weight	C:N Ratio
Chicken Manure	1.5	1.2	15:1
Dead Birds	1.0	1.0	5:1
Straw (Bulking Agent)	1.0	0.1	50:1 to 300:1
Water *			

*A mixture that has enough moisture (50-65 percent) to feel moist to the touch but not so moist that water can be wrung out should be about right, i.e. it should feel like a "damp sponge" to the touch.

Final Disposition of Compost

Compost produced from animal carcasses or animal body parts may only be distributed to the public if the operation has temperature records to show that the batch under consideration has met the time/temperature standards for the specific composting system being used .(See section ‘Meeting Time/Temperature Standards’ for a list of these standards.)

Compost that has not met the appropriate time/temperature standard or for which there is no record indicating that it has met the standard may be spread on the owner’s own fields. It may also be incorporated into other batches of compost and re-composted in order to meet the time/temperature standard.

Compost that has met the standards may be used for any purpose for which it is suitable based on its agronomic characteristics.

Management of Bones

In most compost piles, the soft tissue from the carcass will disappear much more quickly than the larger bones. This means that the operator must be prepared to manage the bones in the finished product. This can be done by one of the following methods:

1. Grinding the bones/compost mix so that the bone particles become a part of the final product.

2. Screening out the bones from the final product. The separated bones may be buried, added to another active compost pile and re-composted, ground up for use as a calcium-rich soil amendment or even burned.

3. Spread compost including bones on land. The compost product with bones may be spread on forest land or agricultural fields. Consideration should be given to possible impact of large bones on equipment that may be operated on the field in the near future. Experience has shown that if compost with bones is spread on tilled ground, the tillage equipment will break up the bones and incorporate them into the soil. Spreading bones on hay ground, on the other hand, may be undesirable since they can be picked up by the haying equipment.

Monitoring

Visual Inspection. Carcass compost piles should be visually inspected daily for the first week after construction and then at least once a week for the next 10 to 12 weeks. It is important to make sure that any maintenance needed is recognized quickly and taken care of promptly.

Temperatures. If distribution of the final product to the public is being contemplated, then temperatures must be taken and recorded daily (at least 5 days per week) until the time/temperature standard has been met. (The procedures for taking temperatures are given in the section on taking temperatures on page 10.) To be meaningful, temperatures should be taken in the same locations each time. Marking the locations for temperatures with a stake, flag or other marker helps make temperature taking more consistent. Graphing pile temperatures is a good way to visualize how the pile is performing over time and may help in making management decisions in the future.
If carcasses are being added to the end of an existing windrow and the time is more than 2 weeks between successive additions, there should be a gap left and treat the continuation as a new windrow for the purpose of taking temperatures and management activities.

Moisture. Moisture can be checked using a squeeze test. The compost medium should be damp to the touch when a small amount is squeezed by hand but not so wet that water drips out

Record Keeping

Record keeping is important in composting as in all other farm activities. Here are some records that should be maintained:

Location and Date piles built. It is important, especially if the compost is to be distributed to the public, that each batch be identified uniquely. This unique identification should include the pile location on the site and the start date. The date when the last addition of raw ingredient is made is usually recorded as the start date. It is from that date, that the time/temperature requirements are tracked.

Temperatures. (See sample temperature chart in Appendix.) Temperature records must be maintained if the compost product is to be distributed to the public. Even if the product is to be used on the farm fields, the temperature records are a useful tool in evaluating the compost process.

Disposition of Compost. If the farm operation is required to have a nutrient management plan under Maine law (7 MRSA §4201 – §4209), the farm must maintain a record of the disposition of all nutrients, including compost, that were generated on the farm or brought on to the farm. Even if a nutrient management plan is not required, there should be a record of the final disposition of each batch, whether it is distributed to the public or used on the farm's own fields.

Emergency Disposal Situations. Chapter 211 requires that for emergency carcass disposal situations, the following records shall be kept for **at least one year after the compost product has been distributed**: Location and date piles built, Temperatures measured in the compost piles, record of the disposition of the compost.

Biosecurity

For Livestock operations, biosecurity has become an important consideration. The threat of the spread of highly contagious diseases is ever present. A compost operation on a farm should adhere to biosecurity measures just as other farm operations do. (See the references for useful publications on farm biosecurity measures.) Here are some biosecurity considerations:

Good pile construction and maintenance. For routine mortality, one of the most important biosecurity measures is taking care to build the compost pile correctly to discourage disease vectors (scavengers) from disturbing the pile. Likewise, prompt maintenance when cracks appear or part of a carcass is exposed is a must. Take care not to use the same equipment for the raw inputs and finished product unless it has been cleaned after handling raw materials.

Large scale disaster. In cases of where a large number of carcasses must be managed quickly, it may be necessary to bring additional equipment, personnel or materials onto the farm to handle the larger volume. Biosecurity protocols should be established to minimize the amount of traffic on and off the farm, to ensure proper disinfection procedures are used and to limit exposure of livestock to off-farm traffic.

Disease outbreak. In the case of a disease outbreak, the farm operation should contact their veterinarian as soon as possible to assess the disease. If the veterinarian suspects that it is a reportable disease, he or she will then notify the appropriate state and federal animal health authorities for direction on implementing biosecurity measures.

Small Backyard Poultry Flocks

Most of the systems or approaches described in this document are intended for use by commercial agricultural operations. Small flock owners should refer to University of Maine Cooperative Extension bulletin: “Safe Disposal of Backyard Poultry Mortalities”. (2006) for guidance in disposing of a small number of birds in an emergency.

DIAGRAM 1.

DIMENSIONS OF COMPOST WINDROWS FOR DAIRY COWS.

Assumptions:

1. There will be **two feet of cover material beyond the carcass** on the ends and sides of the windrow.

2. There will be **18 inches of material below and two feet +/- of material over** the carcass. (more in winter)

3. The back of one carcass may rest on the legs of the adjacent carcass.

4. Volume of base material needed is determined by the formula:

   Vol. = 1.75X + 1.75 where X is the number of cows being composted.

   Example: for **four cows**,
   Vol. = 1.75 x 4 + 1.75 = **8.75 cu. yds**.

5. Volume of cover material needed will be determined by formula:

   Vol. = 6X + 6. where X is the number of cows being composted.

   Example: for **four cows**,
   Vol. = 6 x 4 + 6 = **30 cu. yds**.

6. Windrow length may be determined by formula:
   Length = 4 x X + 4. where X is the number of cows being composted.

   Example: for **four cows**
   Length = 4 x 4 + 4 = **20 ft.**

7. Use pairs of windrows to save space on pad.

8. Windrows run up/down slope with slope about 2-4%

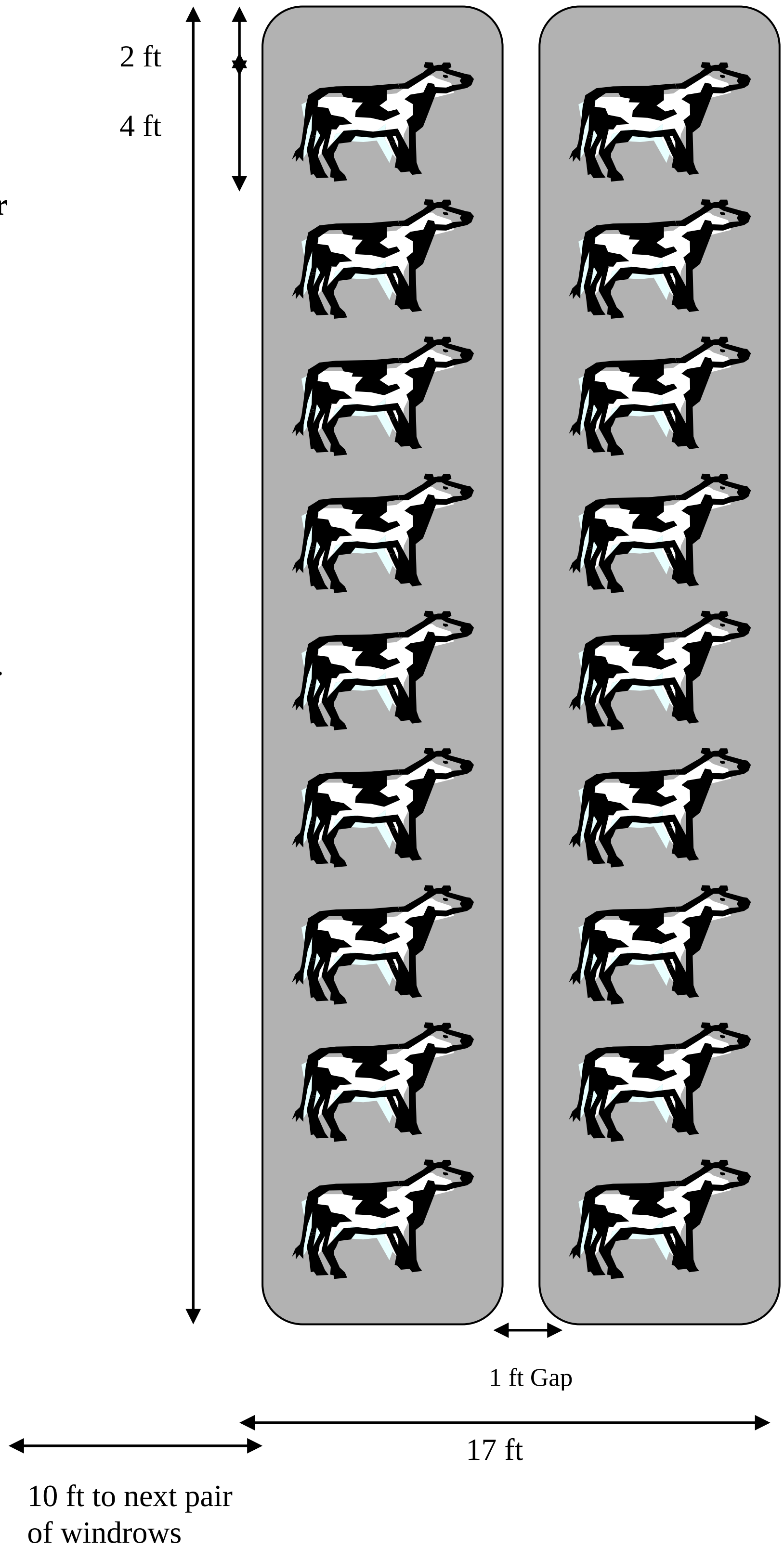


DIAGRAM 2.

COMPOST WINDROW LAYOUT FOR LARGE ANIMAL CARCASSES

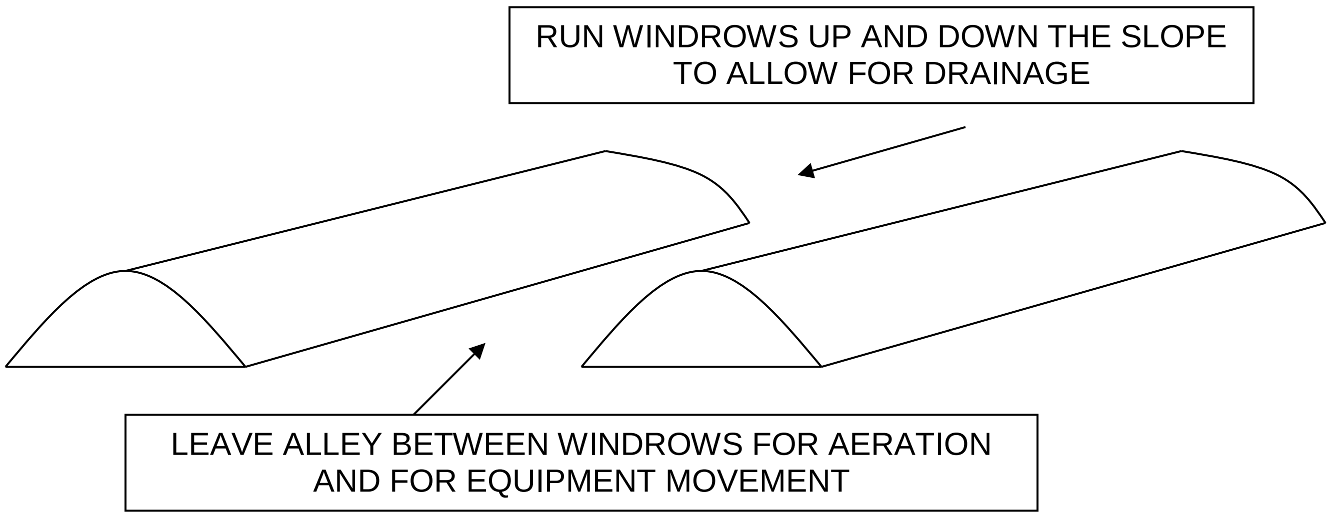


DIAGRAM 3.

WINDROW CROSS SECTION FOR LARGE CARCASSES

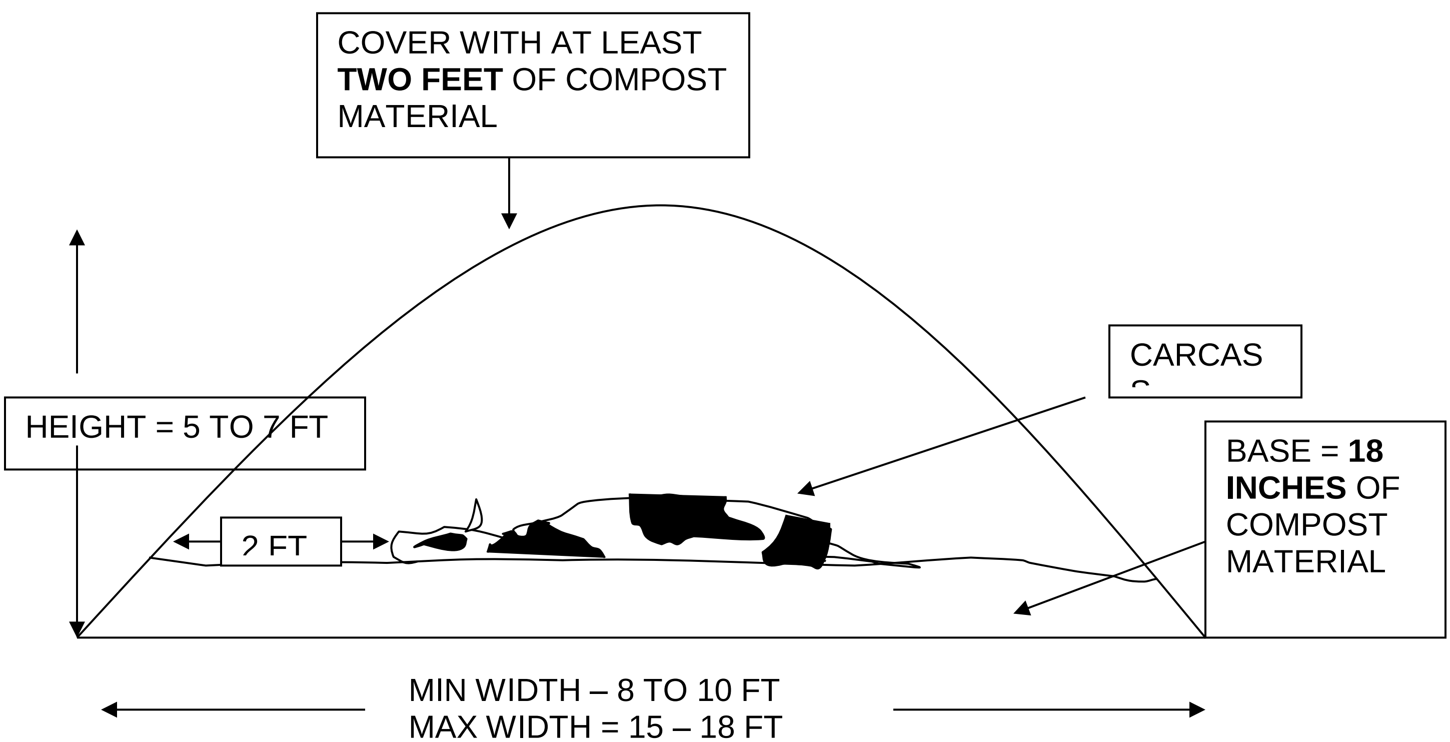
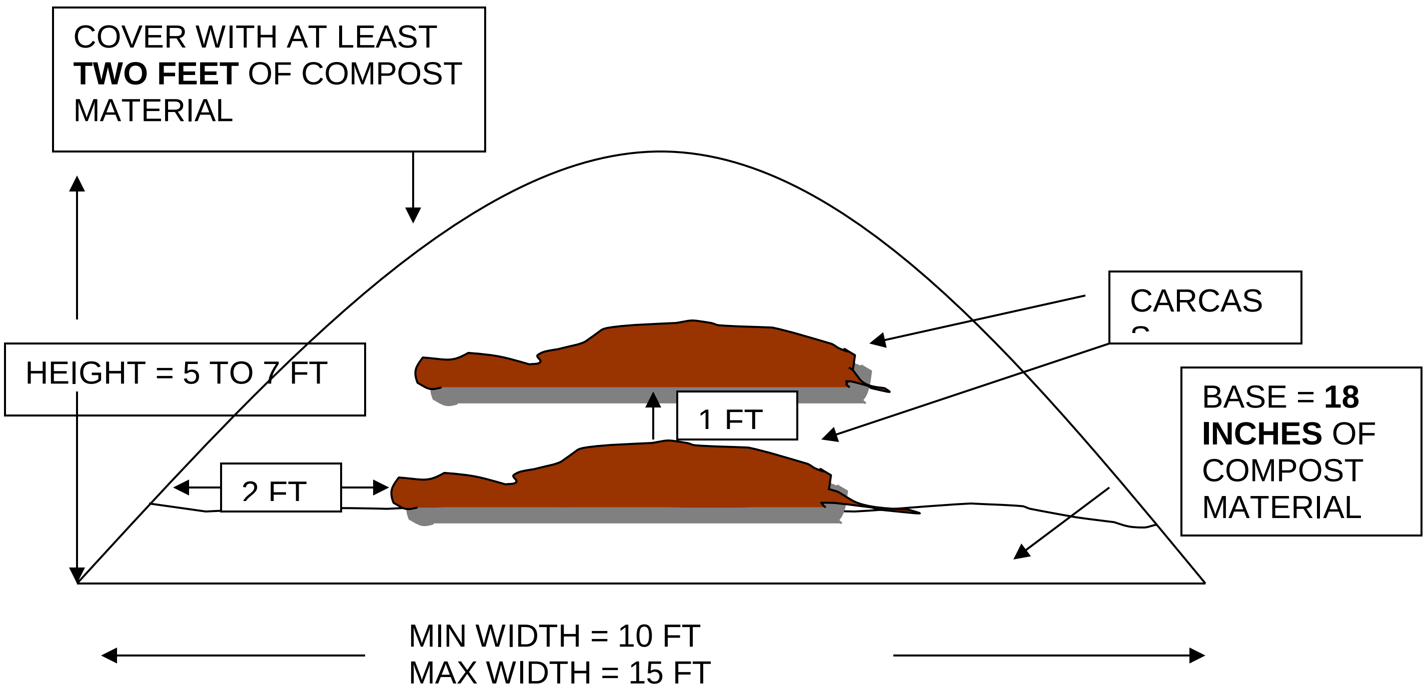
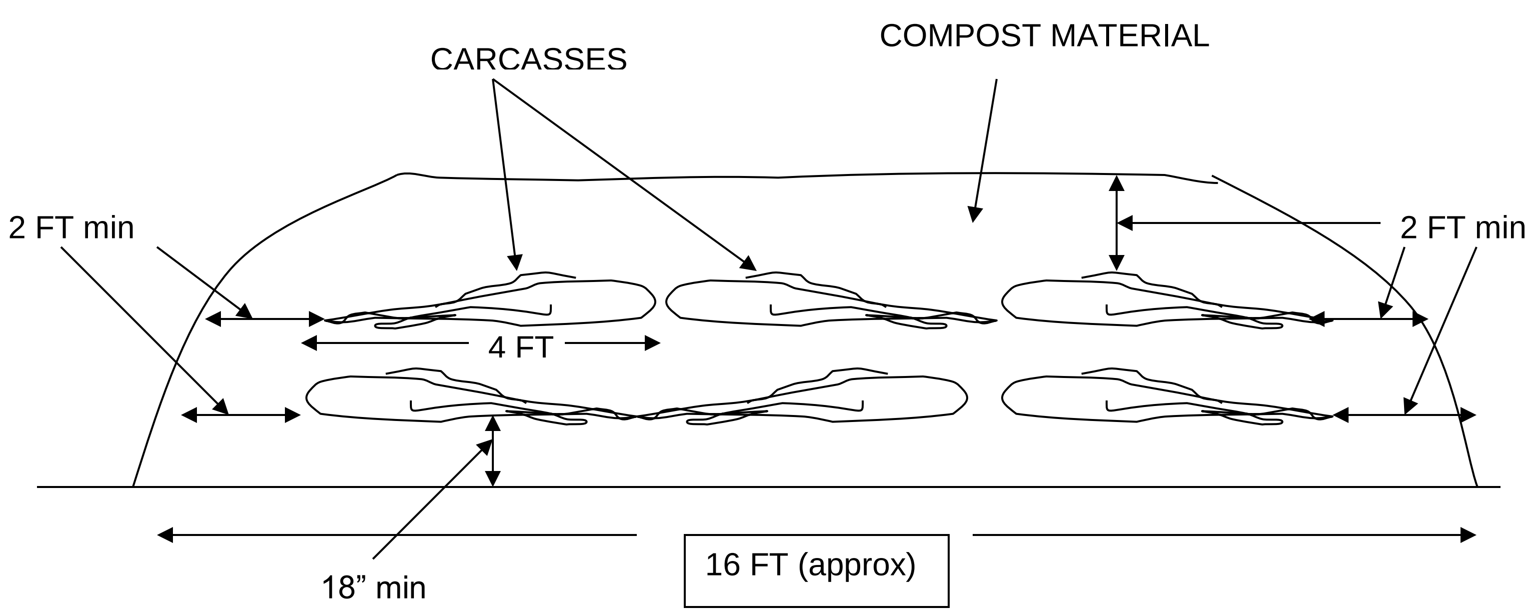


DIAGRAM 4

WINDROW CONSTRUCTION for MEDIUM SIZE CARCASSES



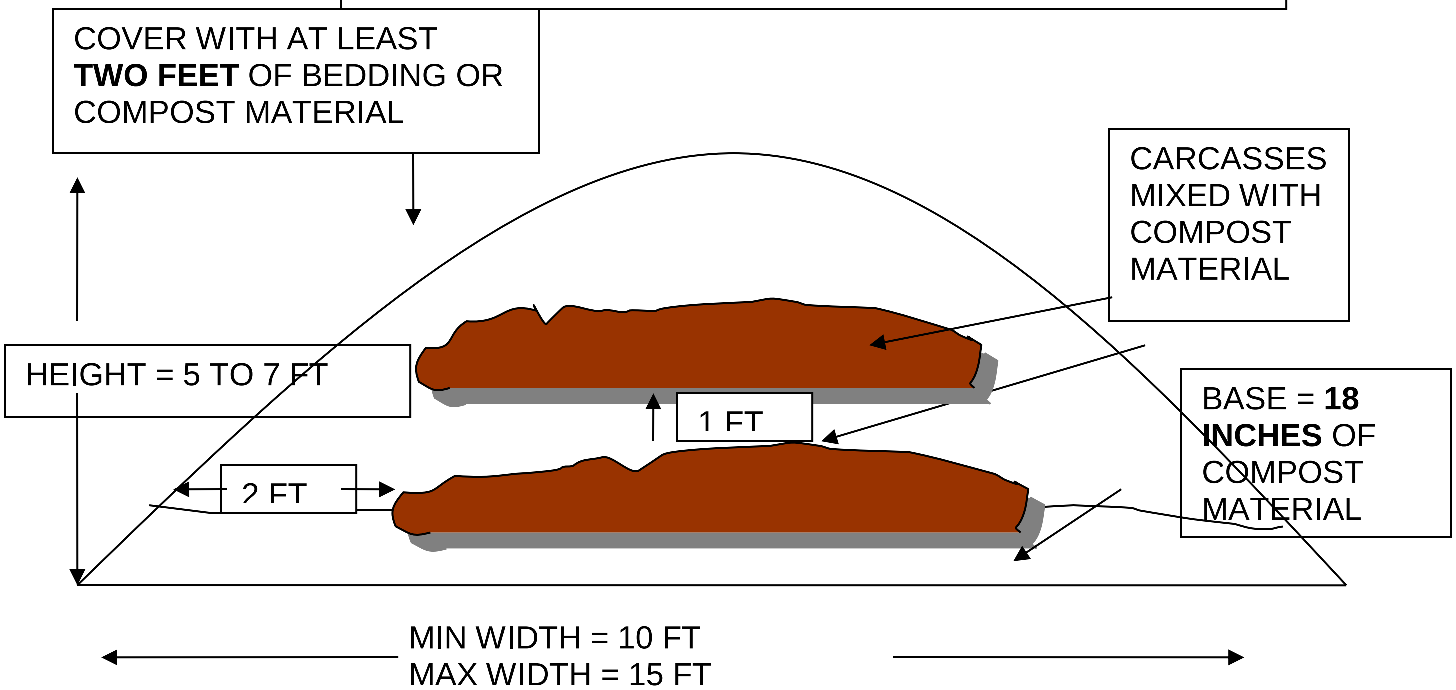
WINDROW CROSS SECTION: END VIEW



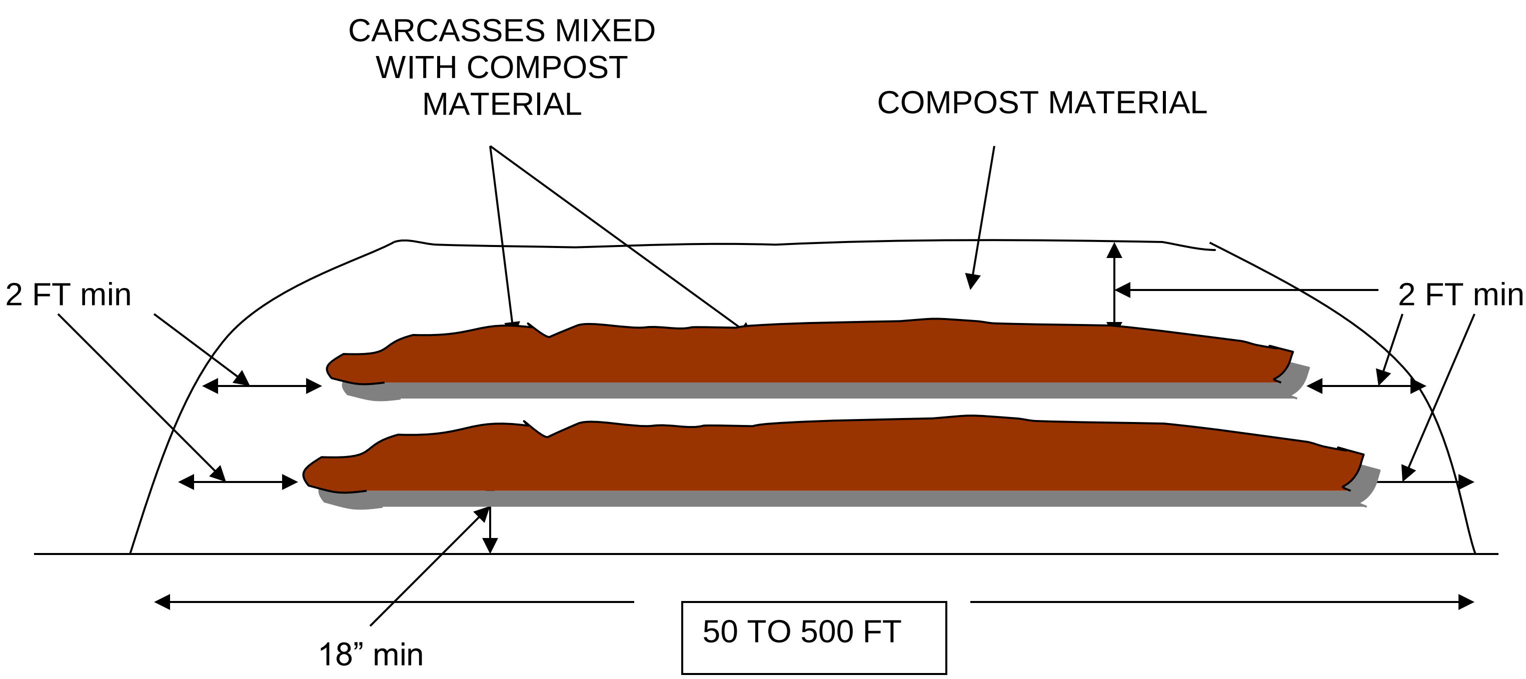
WINDROW CROSS SECTION: SIDE VIEW

DIAGRAM 5

WINDROW CONSTRUCTION for POULTRY AND OTHER SMALL CARCASSES



WINDROW CROSS SECTION: END VIEW



WINDROW CROSS SECTION: SIDE VIEW

DIAGRAM 6	WINDROW CONSTRUCTION for OFFAL

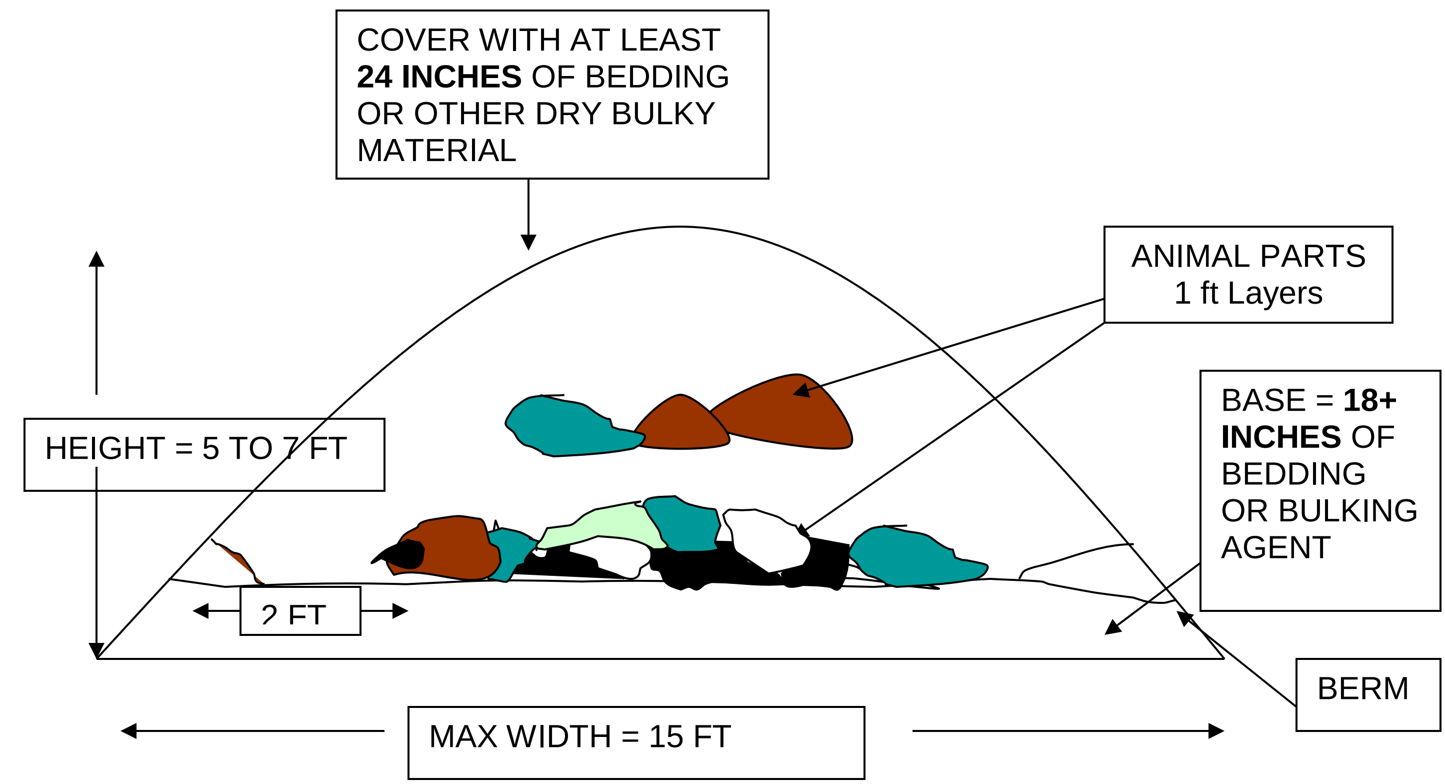


DIAGRAM 7. LAYERING FOR A TURNED WINDROW PRIOR TO TURNING

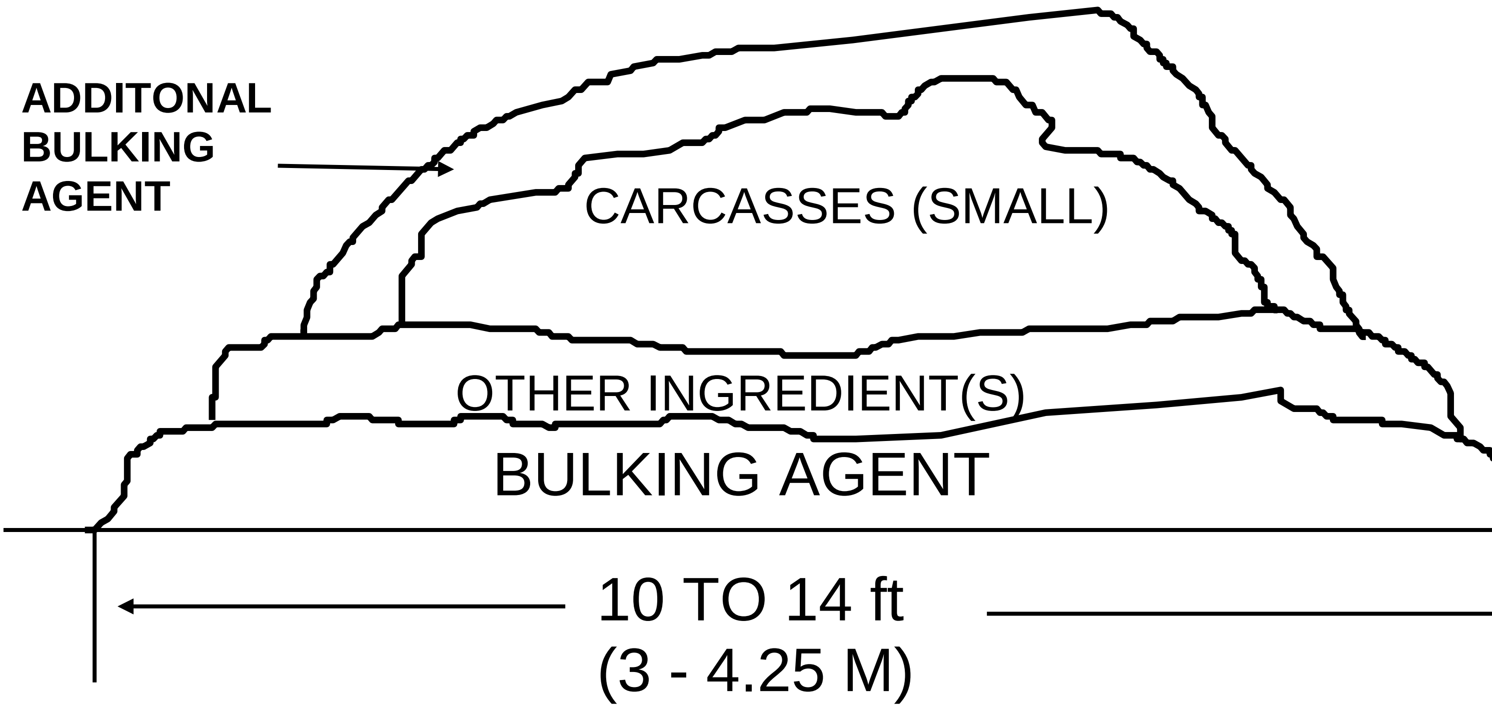


DIAGRAM 8 LAYOUT FOR AN AERATED STATIC PILE

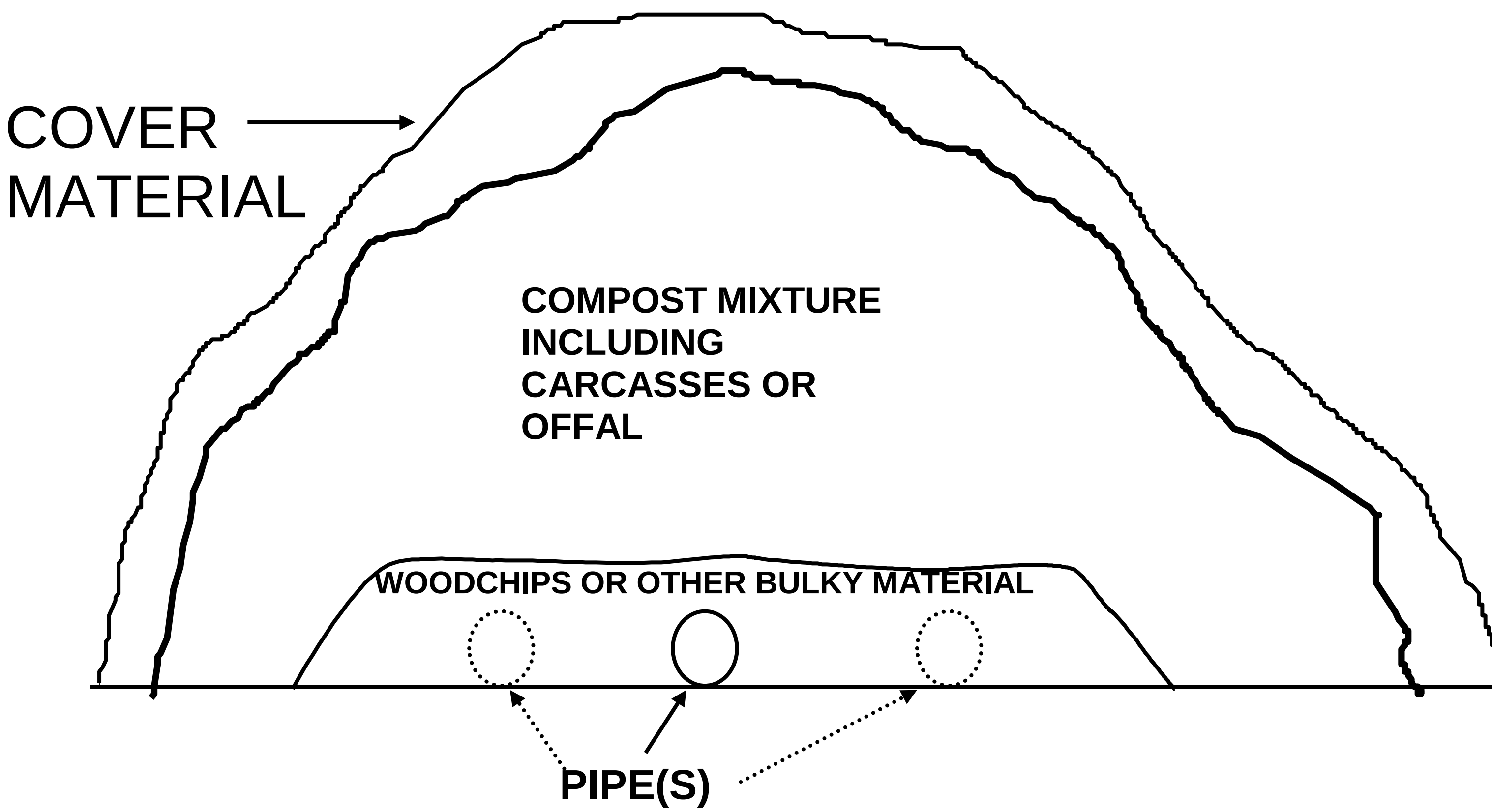
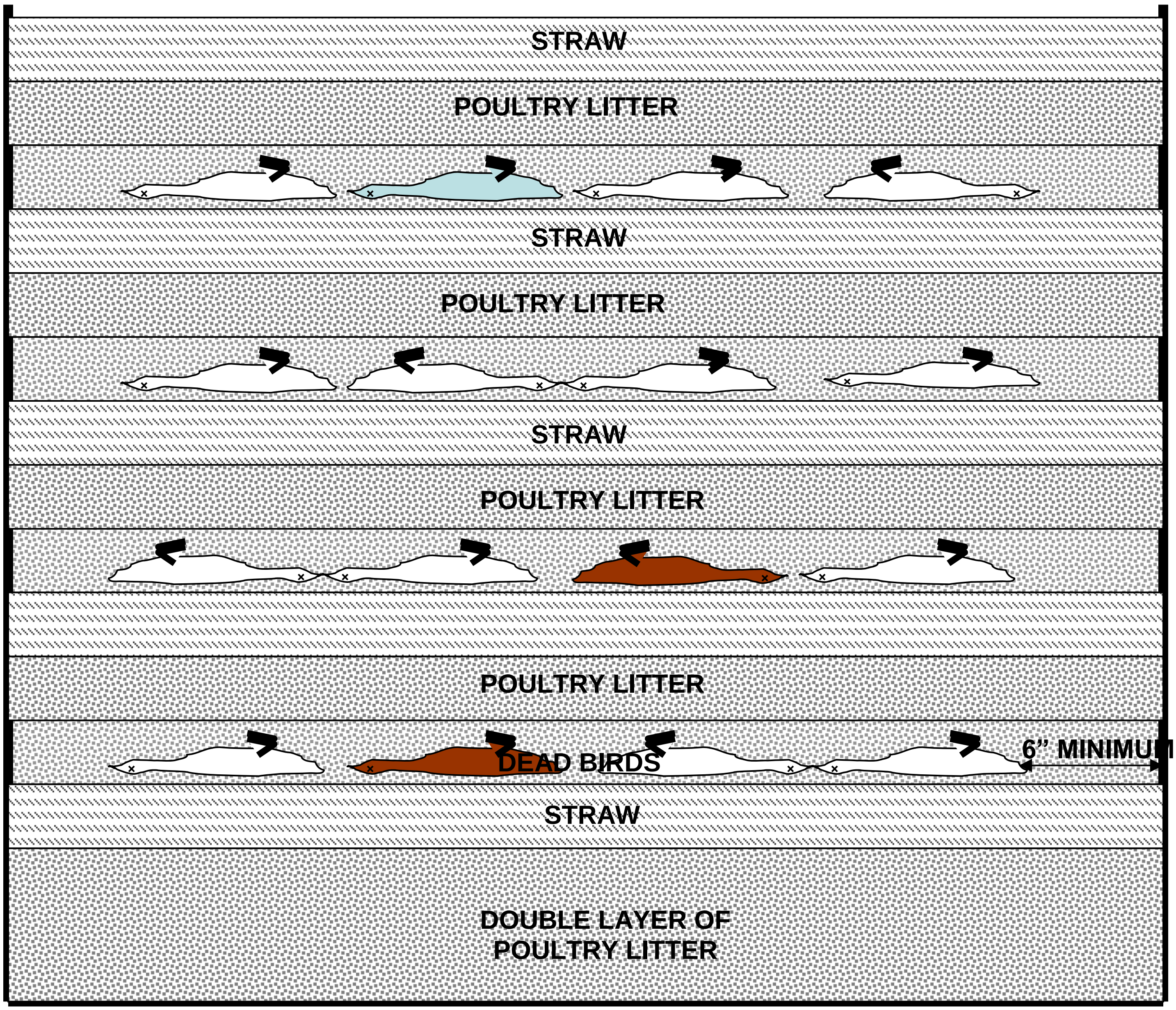


DIAGRAM 9 .LAYERING IN THE MARYLAND BIN COMPOST SYSTEM



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LOCATION ____________ PILE CONTENTS ___________________________ STARTING DATE____________

DATE	TIME	One Foot	Three Feet	Internal	Animal Activity Signs	AIR TEMP	WEATHER	PILE MGT./Comments