



## Natural Resources Conservation Service

### CONSERVATION PRACTICE STANDARD

## COMPOSTING FACILITY

### CODE 317

(no)

#### DEFINITION

A structure or device to contain and facilitate an aerobic microbial ecosystem for the decomposition of manure, other organic material, or both, into a final product sufficiently stable for storage, onfarm use, and application to land as a soil amendment.

#### PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Reduce water pollution potential
- Conserve energy by reducing mass and improving handling characteristics of organic waste solids
- Reuse organic waste as animal bedding
- Transform organic waste into a soil amendment that improves soil health, provides slow-release plant-available nutrients, and suppresses plant disease

#### CONDITIONS WHERE PRACTICE APPLIES

This practice applies where at least one of the following conditions occurs:

- Organic solid wastes to be composted derive primarily from agricultural production or processing
- The compost can be reused in the operation, utilized for crop production, improve soil health, or marketed to the public

This practice applies to construction of a structure or device to contain and facilitate the composting process. Use NRCS Maryland Conservation Practice Standard (CPS) Nutrient Management (Code 590) for producer land application of finished compost to provide nutrients or as a soil amendment.

This practice does not apply to the routine handling of livestock and poultry carcasses. Use NRCS Maryland CPS Animal Mortality Facility (Code 316) for carcass composting facility design.

This practice does not apply to routine storage and handling of animal manure solids. Use NRCS Maryland CPS Waste Storage Facility (Code 313) for animal manure solids dry stack facilities.

#### CRITERIA

##### General Criteria Applicable to All Purposes

Plan, design, and construct the composting facility to comply with all Federal, State, and local laws and regulations. The landowner is required to obtain all necessary permits for project installation prior to construction. Review the Maryland Department of the Environment's (MDE's) *Permitting Guidance for Maryland Composting Facilities* dated September 2022 for additional guidance.

**Siting**

Locate and design the composting facility so it is outside the 100-year floodplain unless site restrictions require locating it within the floodplain. If located within 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) (Title 190), Part 410, Subpart B, Section 410.25, "Flood Plain Management," which may require providing additional protection for storage structures located within the floodplain. Construction activity within the 100-year floodplain requires permits or authorizations from MDE and/or the U.S. Army Corps of Engineers. Obtain all applicable permits and authorizations prior to the start of construction.

Locate facility a minimum of 50 feet from wells, streams, or other water features. Additional distances may be required by local or State laws. Redirect upslope surface runoff away from the composting site.

Locate the composting facility to ensure the floor is 2 feet or more above the site-identified seasonal high ground water table unless special design features are incorporated that will address the potential for leaching of contaminants to the water table. The water table may be lowered by use of drains to meet this requirement. Soils that have a rapid permeability (>0.6 inches/hour) in the upper 40 inches of the soil profile require a concrete pad, clay, or synthetic liner. The compost area and access must be kept free of standing water and rutting.

Contaminated runoff from any composting facility without a roof must be controlled. This may be accomplished with distribution over a Wastewater Treatment Strip (Code 635) or transfer to a storage facility or other approved treatment method.

Locate the composting facility where movement of odors toward neighbors will be minimized. Buffer areas, vegetative screens, and landscaping can help minimize negative effects of odors and visual resources. The location, layout, and design of the facility should be compatible with the surrounding landscape. Consideration should also be given to the location of neighboring dwellings and how they will be affected by prevailing winds.

The area surrounding the composting facility will be subject to a high traffic load during loading, mixing, and unloading. Ensure all-weather access to the composting facility. Use NRCS Maryland CPSs Access Road (Code 560) or Heavy Use Area (Code 561) if the site lacks appropriate existing access. Ingress and egress should not impact utilities or the flow of traffic.

**Capacity**

Size the composting facility in accordance with NRCS National Engineering Handbook (NEH) (Title 210), Part 637, Chapter 2, "Composting." Design the composting facility to accommodate the amount of organic waste feedstock generated for active composting and compost curing, along with the needed volume of additional bulking material or carbon source to achieve the composting action. Active composting includes both the primary and secondary stages of composting. Space for both the active composting and compost curing are required for making a stable finished compost product. Select facility dimensions to accommodate all stages of composting with space for turning, handling, and processing.

**Moisture**

Orient and design the facility to enable the management of the compost moisture content. A water source is needed for adding moisture in dry conditions. Apply moisture in layers, not just on top, when needed. If considerable precipitation is likely, design a cover. Minimize blown in precipitation on covered facilities by providing a roof overhang or orient the open side of the facility away from the prevailing wind direction.

Leachate should not occur from any composting facility. If leachate does occur, the mix is too wet. Adjust the composting mix by adding dry matter to eliminate the leachate. Address this issue in the operation and maintenance plan.

**Roofs and roof runoff**

If a roof is needed, design the roof using NRCS Maryland CPS Roofs and Covers (Code 367). Use NRCS Maryland CPS Roof Runoff Structure (Code 558) when designing the collection, control, and conveyance

of runoff from a roof that could pose a resource concern. Use NRCS Maryland CPS Underground Outlet (Code 620) when designing pipe outlets to prevent erosion or contamination of clean runoff water by composting materials.

### **Foundation and structure**

Design the facility to prevent the contamination of ground water resources. Evaluate site soils for depth to water table, permeability, texture, and bearing strength based on the design load and frequency of use.

For the design of a stable surface treatment, where appropriate, use criteria in NRCS Maryland CPS Heavy Use Area Protection (Code 561). Use the criteria in NRCS Maryland CPS Waste Storage Facility (Code 313) when designing composting facility slabs, walls, and floors. Prevent seepage of compost stack leachate in amounts that would pollute surface or ground water with collection and disposal of liquids in a safe manner, as necessary. Where seepage will be an issue, use NRCS Maryland CPSs Pond Sealing or Lining—Geomembrane or Geosynthetic Clay Liner (Code 521), Pond Sealing or Lining—Concrete (Code 522), or Pond Sealing or Lining—Compacted Soil Treatment (Code 520). Guidance on restricting seepage through foundation and subgrade material can be found in NRCS 210-NEH, Part 651, Chapter 10, Appendix 10D, “Design and Construction Guidelines for Impoundments Lined with Clay or Amendment-treated Soil.” Seepage control may not be necessary on sites that have a roof, waste material with little seepage potential, or in certain climates.

Composting facilities that will be used to process food waste must meet the requirements for concrete exposed to agrichemicals in NRCS Maryland CPS Agrichemical Handling Facility (Code 309).

### **Power supply**

Where needed for mechanically stirred composting systems, all power supply and electrical components, including wiring, boxes, and connectors, must meet the requirements of the National Electric Code. If the power supply is located in an area that is reasonably accessible by machinery, protect it with strategically placed bollards or other appropriate safety measures.

### **Wastewater**

If leachate or contaminated runoff is anticipated, use NRCS Maryland CPS Waste Transfer (Code 634) for collection and conveyance of any leachate or contaminated runoff from the composting facility to a wastewater storage or treatment facility for further management or reuse. Use NRCS Maryland CPS Waste Storage Facility (Code 313) or other applicable NRCS CPS for that purpose.

### **Safety**

Incorporate safety and personnel protection features and practices into the facility and its operation to ensure biosecurity and minimize the occurrence of equipment and fire hazards associated with the composting process as appropriate. These features may include warning signs, fences, ladders, ropes, bars, rails, and other safety devices to protect humans and livestock. For composting bins, limit the stack height to 6 feet unless a forced aeration system is provided. This will allow air to reach the center of the pile for proper composting and minimize the potential for spontaneous combustion.

## **CONSIDERATIONS**

Select the type of composting facility and composting method based on landowner’s goals, kind of organic waste solids, planned quality of finished compost, operator’s equipment, labor, time, and land available for the facility footprint, and resource concerns.

Develop an initial compost mix with a carbon to nitrogen ratio of at least 30:1 to reduce the most offensive odors. Poor odor is usually an indication of an anaerobic environment. Turning, mixing, or adding bulking agents or dry brown materials may improve the odor of the compost pile.

Consider the landscape elements when locating the facility. Landscape features can buffer prevailing winds which will minimize odors and protect visual resources.

Where appropriate, consider all-weather access roads for the composting facility site.

When locating the facility, consider a location away from crops typically consumed raw, food contact surfaces, water distribution systems, and other soil amendment sources where it could become a potential source of contamination.

If the site is located where fields have been artificially drained consider potential water quality issues. Locate or remove field tiles where seepage from the composting facility to ground or surface water is a resource concern.

Consider equipment access for the facility location and determine if a heavy use area apron is needed to properly manage the compost.

If the composting facility is in a higher precipitation area or the site will have heavy vehicle traffic, consider using a concrete base for the facility.

When designing for windrows, consider the compost site grade and pile alignment. Grade site to prevent ponding from occurring. Align windrows north to south to maximize solar warming.

Consider protecting the composting facilities from wind in cold or dry climates. Wind in cold climates can cause heat loss through convection, limiting microbial metabolism. In low humidity climates wind can cause drying, limiting water availability for microbial metabolism. Dry, pulverized compost is also susceptible to undesirable wind transport from the facility.

Consider the options for finished compost storage. Storage space may be included in the compost curing space or in a separate facility that also protects the resources.

Consider the impact of using treated lumber for the construction of composting facilities on the quality and acceptability of the compost. For production of certified organic compost have the producer consult with an organic certifier as to the use and acceptability of treated lumber that will meet the design life span for bins and compost storage structures.

## **PLANS AND SPECIFICATIONS**

Prepare plans and specifications that describe the requirements for applying the practice to achieve its intended use, including, but not limited to—

- Plan view showing layout and location of composting facility; if applicable, access road to facility; and setback distances from water bodies, streams, sensitive areas, property line, etc.
- Drainage and grading plan showing excavation, fill, and drainage containment, as appropriate.
- Pertinent elevations of the facility.
- Notification to the landowner and contractor of their responsibility to locate all buried utilities in the project area.
- Subgrade work (excavation, earthfill/drainfill, compaction requirements).
- Structural details of all components.
- Construction material quantities and specifications.
- Safety features (i.e., fire suppression).
- Certification statement by the contractor stating that they have constructed/assembled any non-NRCS designed structure in accordance with the requirements/specifications of the designer/manufacturer.

## **OPERATION AND MAINTENANCE**

Develop an operation and maintenance plan that is consistent with the purposes of this practice and the design life of the composting facility. Outline periodic inspections and maintenance of equipment and facilities. Include structural elements of the facility to be inspected or maintained, an inspection interval time frame, and recommendations for preventative maintenance.

Describe essential safety features of the facility to provide protection from or prevention of a compost fire. Closely monitor temperatures above 165°F. Take action immediately to cool piles that have reached temperatures above 185°F.

Provide procedures to monitor and maintain vibrant microbiological decomposition of the organic materials according to the design and site conditions and pertinent nuances of the organic materials to be composted. Guidance provided should be based on the needs and goals of the producer using literature provided by local university extension publication; NRCS 210-NEH, Part 637, Chapter 2, “Composting”; “NRAEAS 54: On-Farm Composting Handbook”; or other appropriate composting literature. Monitoring the temperature and moisture content of composting material reflects the phases of successive populations of microorganisms and their metabolism as they decompose the organic matter. The operation may need to undergo some trial and error in the startup of a new composting facility while the operator determines an efficient operating process. The operator must keep accurate records to aid in learning how to operate the facility efficiently.

Specify the types and volumes of animal waste and other sources of organic feedstock to be composted. Provide information on planned compost recipe ingredients and the sequence for mixing and building the compost piles. Direct the operator to land grant universities and other recognized entities that provide compost mixture calculators to balance feedstocks to meet a target carbon-to-nitrogen (C:N) ratio and moisture content. The NRCS Maryland CPS Waste Recycling (Code 633) may be used when nonagricultural byproducts are included in the composting feedstock.

Manage the compost for temperature, moisture, oxygen, and pH, as appropriate. Test the finished compost, as appropriate, to assure the product is stable and no longer heating from biological decomposition. Guidance for composting management, monitoring, and the testing of compost stability is in NRCS 210-NEH, Part 637, Chapter 2, Section 637.0209(h), “Determination of compost stability.”

The plan must include but is not limited to the following:

- Objective of the landowner or operator and the operation requirements;
- The mix proportions, moisture requirements, and materials used;
- The sizing requirements;
- The timing of the composting process including loading, unloading, and turning or aeration of the material;
- Temperature monitoring requirements, including a temperature log;
- What must be done to prevent leachate problems;
- Biosecurity requirements;
- Safety requirements;
- Frequently encountered mistakes and brief “fix it” scenarios, if available, or a reference to;
- References of sources of information or a reference to where they can be found.

### **Monitoring Documentation**

Provide a recordkeeping form for the operator to use listing at a minimum the date, amounts, and types of material added, compost temperature, weather conditions, and actions taken to manage the compost. Monitoring may include but is not limited to—

- **Compost Mix.**—Build a compost mix that encourages aerobic microbial decomposition and minimizes nuisance odors. Blend feedstock, build compost pile, and handle the compost mix to develop a porous structure for uniform aeration during composting.
- **C:N Ratio.**—Developing a composting recipe is a balancing act as both the C:N ratio and the moisture content of the individual materials need to be within acceptable ranges. The recommended initial C:N ratio of 20:1 to 40:1 for rapid composting is consistent with the nutrient needs of the bacteria and fungi in the compost pile. The composting process relies on the balance

of carbon- and nitrogen-containing materials. Compost with a greater C:N ratio can be used if nitrogen immobilization is not a concern. If carbon is present in excessive amounts relative to nitrogen so that the C:N ratio is above the optimal range, the composting process slows. For composting animal mortalities, C:N ratios as low as 14:1 may be effective and practical. Lower C:N ratios may lead to increased odor and ammonia loss.

- **Carbon.**—If needed, store a dependable source of carbonaceous material with a high C:N ratio for mixing with nitrogen-rich waste materials. Minimize odors and ammonia volatilization by blending sufficient carbonaceous material with the nitrogenous material (C:N ratio). Choose a carbon source that is compatible with the organic by-product being composted. A good carbon source will mix well with the organic matter, provide air space for aerobic decomposition, and enhance aeration. Therefore, a good carbon source also acts as a good bulking agent.
- **Bulking Materials.**—Bulking agents are ingredients used to improve the structure and porosity of a mix. Bulking agents are typically dry and vary in particle size (e.g., straw and sawdust), but could be old, finished compost. Add bulking materials to the mix as necessary to enhance aeration. The bulking material may be carbonaceous material used in the mix, slowly-degradable natural organic material, or nonbiodegradable or slowly biodegradable material salvaged from the compost mix at the end of the cycle. Make provisions for the salvage of any nonbiodegradable or slowly-decomposing material used in the composting process.
- **Moisture Level.**—Throughout the composting period, maintain moisture in the compost mix within the range of 40 to 60 percent (wet basis). Moisture contents above 60 percent invite fly production, anaerobic decomposition, and objectionable odors. Water may need to be added during the turning process if the compost is below 40% moisture. In general, the compost is too wet if water can be squeezed out and too dry if the mix doesn't feel moist to the touch. Prevent excess moisture from accumulating in the compost. This may require covering the pile.
- **Temperature of Compost Mix.**—Manage the compost to attain and then maintain the target internal temperature for the duration required to meet the desired compost product. To reduce pathogens, the compost temperature must be maintained above 130°F for a minimum of 5 cumulative days. It will be necessary for the compost to reach 145°F to adequately kill weed seeds. Closely monitor temperatures above 165°F as that will inhibit the composting process by destroying the thermophilic bacteria. Take action immediately, generally applying water and then mixing, to cool piles that have reached temperatures above 185°F to prevent combustion. A log of the temperature profiles should be maintained. Include the need to train workers regarding the recognition of the potential for spontaneous combustion for their safety and to prevent damages.
- **Turning/Aeration.**—Schedule the turning/aeration frequency to attain the desired amount of oxygen, moisture removal, and temperature control appropriate for the composting method used to optimize aerobic biodegradation. Turning and aeration are functions of the composting process chosen and should follow the requirements of that system.
- **Pile Configuration.**—Windrows and static piles should be parabolic in cross-section and rounded on top to shed rainfall. Align windrows and static piles to avoid accumulation of precipitation. Maintain positive drainage parallel to the windrows. Align windrows north to south to maximize solar warming.
- **Compost Period.**—Continue the composting process long enough for the compost mix to reach the stability level where it can be safely stored without undesirable odors. It must also possess the desired characteristics for its use, such as lack of noxious odor, desired moisture content, level of decomposition of original components, and texture. The compost period must involve primary and secondary composting as required to achieve these characteristics. Test the finished compost as appropriate to assure that the required stabilization has been reached.
- **Odors.**—If the initial compost mixing and compost pile structure do not accomplish adequate odor reduction, strategies may include altering the recipe to add more carbon, modifying the moisture content, modifying the pH by applying a material compatible with compost quality and with any specifications for its end use (e.g., certified organic), or using a biological inoculant.

**Composting**

Time, temperature, and turning the compost materials is critical, and if not carried out properly the composted materials may have limited uses.

Composted materials, to be used in the same way as manure solids, must store safely without undesirable odors. Typically, this requires a temperature phase to be maintained above 104°F for 5 days with at least 4 hours above 131°F during that time period.

Compost, for vegetable crops and off-farm use or sale, or compost used on any organic crops, must meet USDA National Organic Program requirements. For this, the compost must be stable when finished, be adequately dried, and contain limited quantities of pathogens. This includes compost used onfarm for crops subject to the Food Safety Modernization Act (FSMA) Standards for the Growing, Harvesting, Packing, and Holding of Produce for Human Consumption (Produce Safety Rule).

- For processing compost in either a static aerated pile or in-vessel compost system, the temperature of the compost is required to be maintained between 131°F and 170°F for 3 days.
- For a windrow system the temperature of the compost is required to be between 131°F and 170°F for 15 days with a minimum of five turnings of the compost to ensure the windrow is mixed and evenly composted.

For crops subject to the FSMA Produce Safety Rule, direct growers to the rule for additional criteria that may be applicable. See <https://www.fda.gov/food/food-safety-modernization-act-fsma/fsma-final-rule-produce-safety>.

Local compost certification regulations may vary.

**Use of Finished Compost**

Compost can be reused in the operation and utilized for crop production or bedding. It also serves to improve soil quality and can be marketed to the public.

Use NRCS Maryland CPS Nutrient Management (Code 590) for producer land application of finished compost to provide nutrients, as a soil amendment, or both where the finished compost is stable decomposed material that will not reheat, is reduced in pathogenic organisms, and most weed seed are no longer viable.

When applying a general compost material that is not a stable pathogen-reduced product, follow NRCS Maryland CPS Nutrient Management (Code 590) criteria for manure solids application. For this, abide by any State or local rules that may detail crop type, location, and timing restrictions for manure application.

**SUPPORTING DATA AND DOCUMENTATION****Field Data and Survey Notes**

The following is a list of the minimum data needed:

1. System plan sketch;
2. Topographic survey of the site showing building locations, elevations at structure location and location of dwellings, wells, floodplains, etc.;
3. Soils exploration showing seasonal high water table;
4. Operator data used to size the facility and documentation of the landowners decisions.

**Design Data**

Record on appropriate engineering paper. For guidance on the preparation of engineering plans, see chapter 5 of the Engineering Field Handbook (EFH), Part 650. The following is a list of the minimum required design data:

1. Project narrative;
2. Location map with index page;
3. Comprehensive Nutrient Management Plan or Waste Management Plan including the Operation and Maintenance Plan;
4. Plan view including, location map, all system components, material and construction specifications;
5. Construction drawings, and component details;
6. Structure sizing computations;
7. Structure and component design and details;
8. Area grading plan;
9. Quantities estimate;
10. Engineering job class on plan;
11. Details of foundation drainage, when required;
12. Planting plan. This must meet the criteria, specifications, and documentation requirements of the Maryland conservation practice standard, Critical Area Planting, Code 342.
13. Written operation and maintenance plan.

### **Construction Check Data/As-built**

Record on survey notepaper, SCS-ENG-28, or other appropriate engineering paper. Survey data will be plotted on plans in red. Installation and construction check notes are to be recorded in sufficient detail to show that the practice meets this standard and applicable specifications. The following is a list of minimum data needed for as-builts:

1. Documentation of site visits on CPA-6. Include the date, who performed the inspection, specifics as to what was inspected, all alternatives discussed, and decisions made and by whom;
2. Actual dimensions of installed structure;
3. Verification of adequate foundation preparation;
4. Documentation of installation of foundation drainage;
5. Documentation of reinforcing steel and proper concrete installation, if applicable;
6. Condition of precast panels, if applicable;
7. Certification statement from the contractor(s) that they have constructed/assembled the structure in accordance with the plans and specifications;
8. Statement on seeding and fencing;
9. Final quantities and documentation for quantity changes, and materials certification;
10. Sign and date checknotes and plans by someone with appropriate approval authority. Include statement that practice meets or exceeds plans and NRCS practice standards.

### **REFERENCES**

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