THE UNIVERSITY OF TENNESSEE
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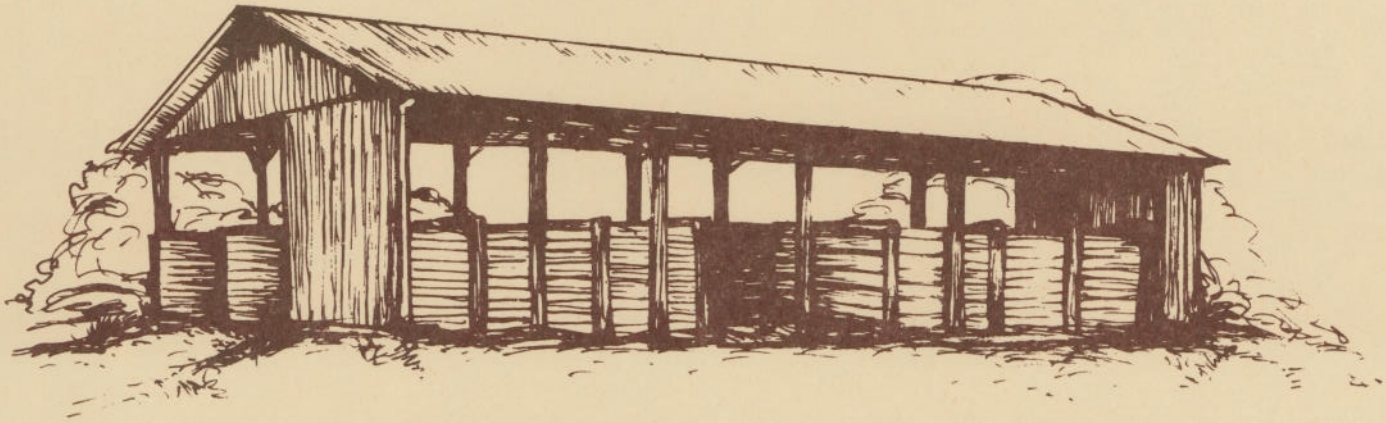
Dead Poultry Composting



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This publication was adapted for use in Tennessee by
H. Charles Goan, Professor and Leader, Animal Science-Poultry;
George Grandle, Associate Professor, Agricultural Engineering;
and John Jared, Professor, Plant and Soil Science

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Composting Poultry Carcasses

Tennessee poultry producers are facing increasingly difficult problems disposing of dead poultry on their farms. Current practices include incineration, burying the carcasses in approved pits and rendering. However, these disposal methods may not be environmentally sound or cost effective.

Composting

Research by Dennis Murphy at the University of Maryland has sparked new interest in the old organic gardening practice of composting. In this case, the composting is of dead chickens. Composting is a controlled, natural process in which beneficial microorganisms, bacteria and fungi reduce and transform or change organic wastes into a useful end product. In dead bird composting operations, a prescribed mixture of dead chickens, poultry litter, straw (or similar substance) and water provide the necessary ingredients for changing the mixture to compost. Ideally, this mixture should have a carbon:nitrogen ratio (C:N) of about 23:1 and a moisture content of about 55 percent. Acceptable C:N ratios are between 15:1 and 35:1. Acceptable moisture content ranges are between 40 and 60 percent.

Composter Size

Composting is carried out in two stages. The compost mixture remains in a primary bin for seven to 10 days, and is then moved to a secondary bin for 10 - 14 days to complete the process. Composter size is based on broiler farm capacity, overall bird size at the end of the production cycle and mortality. Studies show that the composter should be designed using the following formula:

capacity of the first stage composter bins in cubic feet = 0.0025 x final bird weight x number of birds raised per cycle.

A composter on a 75,000 -bird capacity broiler farm.

Table 1. Number of First Stage Composter Bins Required Based on Number of Broilers on Hand (Based on 4.2 lb. bird).

Farm Capacity	Required Cubic Feet for 1st Stage Bins	No. of 1st Stage Bins (5'x 5'x 8')	Required Cubic Feet for 2nd Stage Bins
20,000	210	1	210
40,000	420	2	420
60,000	630	3	630
80,000	840	4	840
100,000	1,050	5	1,050
120,000	1,260	6	1,260

Example: What capacity of first-stage composter bins in cubic feet is required for a poultry grower with a 100,000-head capacity farm with a final bird weight of 4.2 pounds?
First-stage capacity in cubic feet = 0.0025 x 100,000 x 4.2 = 1,050 cubic feet.

Field studies have shown that at least 1 cubic foot of secondary composting bin is necessary for each cubic foot of first-stage or primary bin capacity.

Table 2. Formula for Dead Poultry Composting

Materials	Parts by Weight
Dead Chickens	1
Chicken Litter	2 to 3
Straw (wheat)	1/10
Water (add sparingly)	0 to 1/2

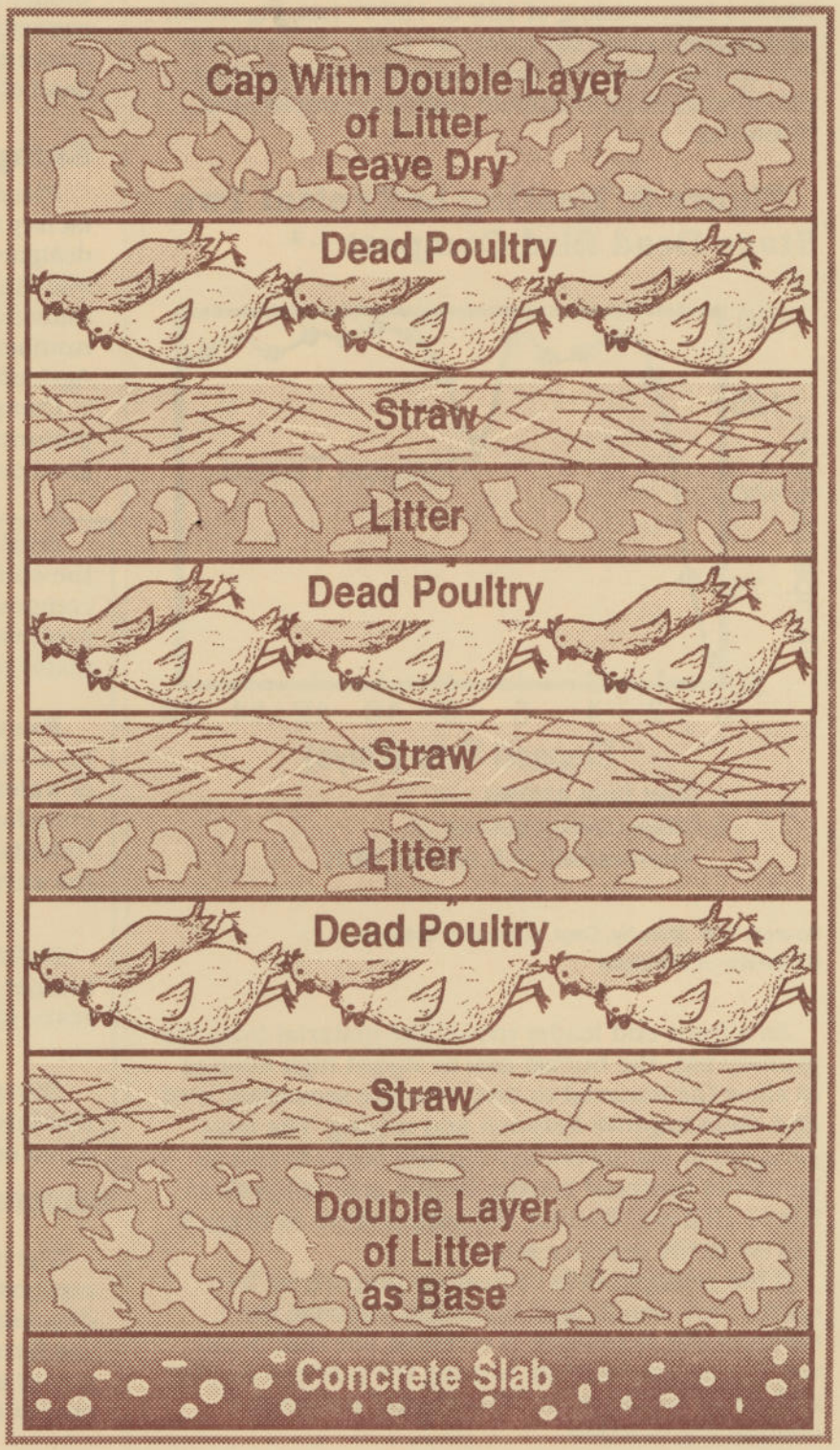
Composter Operation

A simple mixture of straw or similar substance combined with dead chickens, poultry litter, water and oxygen will produce the readily available beneficial bacteria and fungi needed to convert these materials into an inoffensive and useful compost.

Once the weight and volume relationships of one day's dead poultry are determined, the other elements can be weighed out according to the formula in Table 2. Weigh the elements in buckets on scales the first day. On subsequent days, a loader can be used once the weight of a full loader/bucket is determined for each element except water. One gallon of water weighs about eight pounds. Or, use a hose to deliver the correct amount of water based on a percolation test (the time necessary to deliver the required gallons through the hose).

Place at least 12 inches of poultry litter on the concrete floor of the first-stage composter bin. A layer of straw is placed on top of this first layer of litter to allow oxygen under the chickens. Add a layer of dead chickens; apply water; cover the chickens with another layer of litter, followed by another layer of straw. Water may then be added to satisfy the formula. The final cover or cap will be two layers of litter placed over the chickens. Do not add water to this final cap. See Figure 1 for details of layering the ingredients.

Figure 1. Dead poultry composter bin layering.



Note: 400 pounds of dead poultry will require the following:

- 800 pounds litter.
- 40 pounds straw (one bale).
- 25 gallons water. Water should be applied to each solid element during the layering process. This will allow the solid elements to soak up the required amount of water. Use water sparingly.

During the composting process, the volume of the mass will reduce 25 to 30 percent. This will enable the operator to add more material to top off the bin.

Ideally, the composter will be sized so the average day's mortality will equal one layer of dead chickens in the primary bin. Each subsequent day, layer the dead chickens and the other elements in the bin (litter, chickens, straw; litter, chickens, straw).

As the birds near market age and weight, filling a bin in two or three days may occur. At this loading rate, the bottom third of the bin will heat up normally, but the temperature may then decline rapidly due to compaction and exclusion of oxygen. This problem can be corrected by loading two bins, switching from one to the other on alternate days. This helps to prevent compaction, and normal temperatures can be maintained.

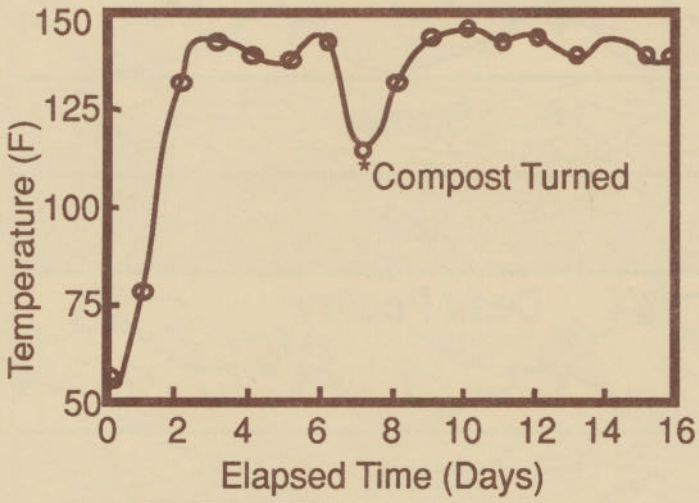
In field studies, odors and insects have not been a problem. Tests on certain pathogens (such as *E. Coli)* and on Gumboro and New Castle disease viruses show they do not survive the pasteurizing effects of composting.

Fly larvae, bacteria and viruses are destroyed through the combined effects of time and temperature in composting. Temperatures in the outer edges of the primary bins may not reach high enough to destroy them. Therefore, the dead birds should not be placed within 6 inches of the sidewalls. Pathogenic microorganisms and insect larvae may survive unless primary compost is turned and mixed at least once. Also, if carcasses are carelessly loaded against the sidewalls, the result is putrefaction, not reduction, of compost material. To prevent putrefaction, avoid placing birds within 6 inches of the sidewalls.

Monitoring The Composter

Once the primary bin is full, monitor the temperature in the compost pile with a 36-inch probe-type thermometer. After seven to 10 days, the pile should reach a high reading of 130 to 150 F. (see Figure 2), which pasteurizes the compost. Once the temperature peaks, move the material to the second-stage bin or secondary treatment alley for aeration and reheating.

Figure 2. Heating in Typical Two Stage Dead Bird Compost [1, 2]



1 Start Date 4/20/89
2 Straw carbon source
Intermediate C:N ratio (= 18:1)

Source: D.W. Murphy, Dept. of Poultry Science, University of Maryland

As a front-end loader moves the material from the primary bin, the bucket can be raised high enough to allow the material to drop into the secondary unit and, thus improve aeration and mixing. The temperature in the secondary bin will begin to rise as beneficial bacterial activity begins and will peak in five to 10 days. Monitor the temperature in Stage 2 just as in the primary stage.

If the compost fails to heat up properly or becomes foul- smelling, it is usually because the compost pile is too wet. A compost pile that is too wet can be amended by turning the pile and adding additional broiler litter. This should restart the composting reaction.

The final step is to store the pasteurized compost in a manure storage shed or pile it outside, covered with plastic. During the planting season, apply compost directly to the land and work it into the soil, using the same guidelines as applied to poultry manure.

Loading and managing a composter sized for a broiler farm having a 100,000 to 120,000-bird capacity takes about 20 minutes a day. This average does not include the time necessary to pick up the dead chickens.

Sample Design

Plans for a typical dead poultry composting facility are shown in figures 3 and 4. This facility is designed for growers with 120,000 bird capacity, but the size can be increased or decreased to meet individual farm needs. Additional copies of plan number T4140 are available from your county Agricultural Extension Service office.

Composters can vary considerably and still perform well. However, experience teaches that all good composters have certain common features.

Roof: While some materials may be composted in the open, this does not work well with dead bird composts. A roof ensures year-round operation and controls rain water and percolation, which can be major problems.

Foundation: A concrete foundation is critical for an all-weather operation. It will stop the movement of water and bear the weight of equipment. A concrete foundation secures the composter against rodents, dogs, etc., and prevents contamination of the surrounding area.

Building Materials: Specify pressure-treated lumber or other rot-resistant materials as they resist the biological activity of composting.

Storage Space: It's strongly recommended that raw litter storage space and storage space for finished compost be built into the composter.

The cost of materials for construction of the composter, including the concrete pad, will vary depending on the design and size needed to adapt to the farm situation. Total cost will depend on composter size, which is based on flock size, and the cost of labor to construct the unit.

Land Application of Compost

Once the composting process is completed, protect the product from rainfall to prevent the leaching of soluble nutrients such as nitrate and potassium from the pile.

The nutrient content of the compost will vary depending upon the amount and nutrient content of the manure and straw, the age of the compost and the method of storage. Compost samples analyzed by the University of Maryland had the following average analysis on an "as sampled basis":

Moisture	46%
Nitrogen (total)	2.2%
P_2O_5	3.3%
K_2O	2.4%

A ton of compost provides approximately 44 pounds of total nitrogen (N), 66 pounds of phosphate (P_2O_5) and 48 pounds of potash (K_2O). Because of variation in nutrient composition of composts, regular analyses for nitrogen, phosphorus and potassium are desirable.

Land application of compost or poultry waste, like application of fertilizer, should balance nutrient content of the material with the crop nutrient needs based on regular soil tests and realistic yield goals. The greatest problem in land application of organic wastes is over-application. This is not only wasteful of potential plant nutrients, but it can also result in excessive levels of nitrogen and phosphorus in soils. Nitrogen not taken up by plants can be lost to groundwater by leaching. Both nitrogen and phosphorus can be lost to surface water through runoff.

To avoid excessive nutrient application, maximum rates of compost should be based on the nitrogen need of the crop. However, when the higher rates of compost are used, good soil conservation practices should be followed to prevent any runoff of phosphorus into streams and other surface waters. If the crop requires only small amounts of additional phosphorus and nitrogen needs are high, it may be necessary to base compost rates on phosphorus needs and supplement with commercial fertilizer to meet nitrogen requirements.

In general, 50 to 65 percent of the total nitrogen will be available during the growing season in which it is applied. Assume 80 percent of the phosphate and potash will be available.

Apply compost as close to planting as possible for annual and row crops and incorporate with normal soil tillage operations.For cool-season perennial grass pastures and hayfields (fescue and orchardgrass), make early fall and late winter or early spring applications. Based upon the average analysis indicated previously and assuming 65 percent of the nitrogen will be available during the season, the following maximum application rates are suggested in Table 3.

Table 3. Suggested Application Rates of Dead Bird Compost

Crop	Time of Application	Tons of Compost Per Acre
Corn		
100-125 bu.	prior to planting	4
125-150 bu.		5
Cool season pasture (fescue, orchardgrass)	early fall	2
	late winter	2 *
Cotton	prior to planting	2-3
upland		1-2
bottomland		
Small grains (grain)	prior to fall seeding	1
	topdress late winter	2
Small grains (forage)	prior to fall seeding	3
winter grazing	topdress late winter	2
Summer Annuals	prior to seeding	3
Tobacco	late winter early spring	5-7

* Add two extra tons following each hay cutting.

Frequently Asked Questions About On-Farm Poultry Carcass Composting

What is essential during the poultry carcass composting cycle?

For the cycle to work properly, temperatures in excess of 130 F must be achieved and maintained for approximately 16 to 20 days. The 130 F temperature must be reached in the primary and secondary bins.

Are special ingredients required for composting?

The process described does not employ inoculants, chemicals or other commercial additives. These may (or may not) improve the operation of a composter. The simple process and materials discussed will produce the required decomposition of carcasses.

Do composters produce an odor?

Except when moving compost, there should be no objectionable odor from the composter. Movement of compost from the primary to the secondary bin releases some odor. The odor is not that of decomposing carcasses, and it abates quickly after moving is completed. Except when moving primary compost, there should be no objectionable odor in or around poultry carcass composters.

Are flies a problem?

Fly breeding has not been a problem with composters. If the composter is operating properly, temperatures in excess of 130 F generated throughout primary and secondary masses are sufficient to kill maggots already in carcasses when they are placed into the composter. Covering the birds in primary bins with dry litter discourages flies.

However, during the cool months in late fall or early winter, flies from other areas on the farm may be attracted to the composting facility. This is due to the warm areas around the composting bins.

Do composters fail, and why?

Occasionally, composters fail to reach an adequate temperature, or they may produce odors and seepage. Composting is a biological process that depends on providing nutrients in an environment favorable for microbiological decomposition. Common mistakes are failure to provide all the materials needed for food and aeration, or sloppy loading of primary bins so materials are not "sandwiched." Too little straw (or alternate carbon source) results in a dense, anaerobic mass which will not compost.

Too much water is also a common problem. Saturated compost piles are anaerobic and will not support the desired aerobic, thermophilic bacterial growth required for rapid, odorless decomposition of carcasses.

Compost materials can be amended. When primary compost is turned, dry manure or straw can be added to compost that is "too wet," water can be added to compost that is "too dry" and improperly mixed materials can be remixed. A little experience and perseverance usually give good results in a short time.

Are composters biologically safe?

A. *Mode of operation*: Composters are intended to deal with normal mortality on the farm. It is not recommended that carcasses be transported from the farm where they originate, either to another poultry farm or to a central processing facility.

B. *Managing the process*: Sloppy loading (piling carcasses against sidewalls), careless layering of materials and taking "shortcuts," such as skipping the second stage of composting, will defeat the effectiveness as well as the safety of the method and should be avoided.

C. *Structural design*: Pressure-treated lumber, concrete and a roof are all important biosecurity features of the composter, and should not be compromised for the sake of economy. These combined features contain and maintain the compost mixture, and they minimize area contamination with manure, tissues, etc. Finally, they absolutely exclude vermin and scavengers.

D. *Research* conducted in the Department of Poultry Science at Auburn University shows that conditions produced within a typical two-stage composter result in a decline of coliform bacteria to undetectable levels during the compost cycle. Findings indicate that composting results in effective inactivation of bacteria.

Do large carcasses decompose?

Whole birds compost well, but long bones, keels, etc., can survive the process. Large turkeys compost just as well as broilers.

Are the roof and concrete floors necessary?

A roof is necessary to ensure all-weather operation and to control moisture content of the compost. Concrete prevents soil contamination, excludes vermin, and most importantly, provides a good working surface for manure-handling equipment.

What should be used as compost media if broiler litter is unavailable?

Several alternative carbon (bulking) ingredients

can be used successfully, singly or in combination. These may include, but are not limited to, corn stover, soybean pods and trash, poor quality hay, sawdust, grass clippings, leaves, "cake" (the wet compact crust that forms around feeders and waterers) or manure without litter that is found in layer operations and slatted-floor breeder houses. Substitution of carbon and nitrogen sources does require some analysis, recalculation of mix proportions and on-site experimentation to ensure that mixtures provide C:N ratios between 20 and 35, and that sufficient moisture and bulking are provided to support vigorous aerobic fermentation.

Can poultry compost be recycled back into the primary compost bins?

Up to one-half of the manure and one-half of the straw used in primary composting can be substituted with recycled compost. Recycled compost produces a rapid start-up in primary boxes, and increased recycling produces a stable end product. Recycling also reduces material costs.

What are the costs of composting?

Costs fall into three major categories - initial investment, labor and composting materials. The composter size, building materials and construction methods determine the initial investment. For poultry farms that have been in operation for five years, the composter qualifies for USDA Agricultural Stabilization and Conservation Service cost-sharing funds. Labor required is approximately one-half hour per day, at whatever the prevailing rate may be. Material costs (straw, etc.) vary from none, where materials are available on the farm or are provided by a second party, to an undetermined amount when materials must be purchased.

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Blake, J.P., and J.O. Donald, 1990. *Frequently asked questions about on-farm poultry carcass composting.* DTP Circular 10-90-005. Alabama Cooperative Extension Service. Auburn University.

Donald, J.O., C. Mitchell, and V. Payne, 1990. *Dead poultry composting.* Circular ANR-558. Alabama Cooperative Extension Service. Auburn University.

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Figure 3. Dead Poultry Composting Facility Details.

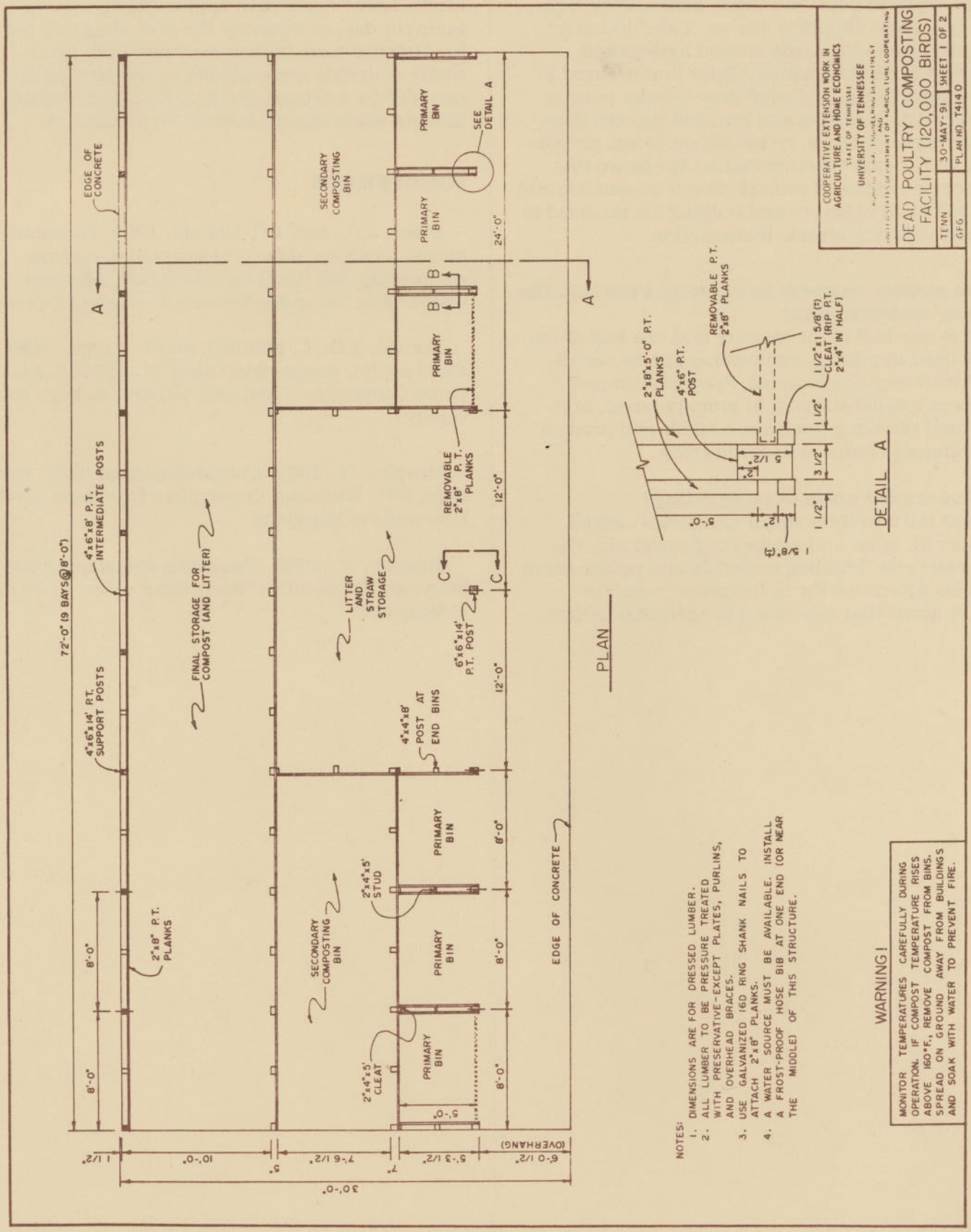
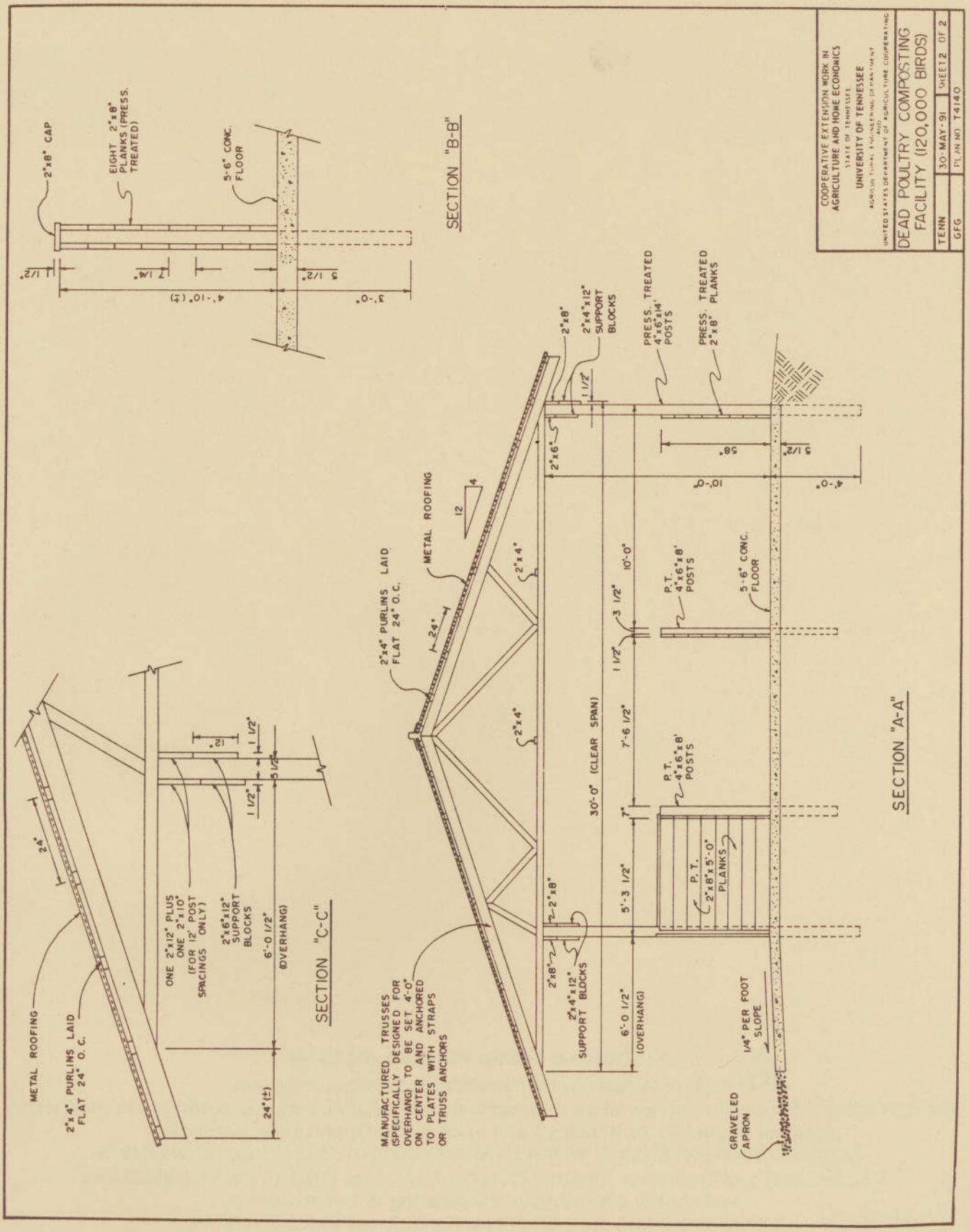


Figure 4. Dead Poultry Composting Facility Details.



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The University of Tennessee Institute of Agriculture, U.S. Department of Agriculture, and county governments cooperating in furtherance of Acts of May 8 and June 30, 1914. Agricultural Extension Service

Billy G. Hicks, Dean