



Recycling Technical Assistance Project #505

**North Lebanon Township,
Lebanon County**

**Configuring Recycling and Yard Waste Composting
Areas for Efficiency and Safety**

*Sponsored by the Pennsylvania Department of Environmental Protection
through the Pennsylvania State Association of Township Supervisors*

FINAL REPORT

November 2012

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TABLE OF CONTENTS

1. STATEMENT OF THE PROBLEM	1
2. SUMMARY OF WORK COMPLETED	1
3. POSSIBLE SOLUTIONS	1
4. RECOMMENDATION	2
4.1 North Lebanon Township – Recycling Background.....	2
4.2 North Lebanon Township Drop-Off Facility	2
4.3 Drop-Off Facility Configuration	4
4.4 Proposed Composting Facility Configuration	5
4.5 Conclusion	6

List of Appendices

Appendix A – Proposed Composting and Recycling Site Plan Macro View

Appendix B – Close-up: Drop-off Area Site Plan

Appendix C – Close-up: Composting Area Site Plan

Appendix D – PA DEP Guidelines for Yard Waste Composting Facilities

Appendix E – Cumberland County SWA Compost Operators Guide

TABLE OF CONTENTS

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Recycling Technical Assistance Project #505 North Lebanon Township, Lebanon County, PA

Configuring recycling and composting areas for efficiency and safety

1. Statement of the Problem

North Lebanon Township in Lebanon County, Pennsylvania, intends to move its existing yard waste composting operation into a new expansion area and dedicate the present composting area to a residential drop-off center for various paper grades and yard waste, and for pick up of compost products. The new compost area will provide needed space for improved windrow composting, grinding, and curing of compost and wood mulch in conformance with Pennsylvania Department of Environmental Protection (PADEP) Guidelines for Yard Waste Composting Facilities. A conceptual layout of the facilities will be proposed and rendered into a recommended site drawing.

2. Summary of Work Completed

The North Lebanon Township Recycling and Yard Waste Drop-Off Area and its features were observed and evaluated in concert with the Township's desire to move its yard waste composting operation into an adjacent area. During this project, MSW Consultants performed an on-site review of the current property and obtained existing site drawings, which were converted to a Computer-Aided Design (CAD) format. MSW Consultants used the CAD drawings to render a reconfigured drop-off area to improve traffic flow and provide adequate space for delivery of materials and pickup of compost products. The design for the proposed yard waste composting area was developed to include space dedicated to windrow composting, grinding and curing in conformance with PADEP Guidelines for Yard Waste Composting Facilities. The final site plan was presented to the Township in a final project meeting. Site Plan drawings are presented as Appendices A, B and C to this report.

3. Possible Solutions

North Lebanon Township intends to improve its recycling drop-off site features by adding two recycling roll-off containers for collection of corrugated cardboard (OCC). Because the need for a reconfigured site is well defined and constrained by current parcel boundaries and physical attributes, this project did not explore multiple potential solutions. Rather, the effort focused on helping the Township optimize the use of its existing space and address its stated objectives. The remainder of this section briefly describes the solution pursued for this project.

When the OCC roll-offs are acquired, an existing compartmentalized recycling trailer will be dedicated to the collection of mixed paper grades. A roofed roll-off container utilized to house dropped off newspapers sits outside of the gated drop-off area to encourage its use. A second paper recycling trailer is located within the gated area. The bulk of the gated area is used primarily for the drop-off and processing of yard waste.

The Township intends to move its yard waste processing operation from within the gated area to a field immediately north of the drop-off site. This new area has sufficient space to accommodate the

Township’s practice of double-grinding woody waste and to incorporate windrow composting of Township leaf waste.

By moving yard waste processing functions from the drop-off area, space will become available to contain all recycling and yard waste drop-off activities within the gated area. Access to the gated area is controlled by key cards issued by the Township to its residents and their contractors for an annual fee. Locating some or all of the recycling collection containers within the gated area, however, will limit access to those residents without key cards.

4. Recommendation

The Site Plan drawings in Appendices A-C represent the recommendations for the configuration of the North Lebanon Township recycling and composting facilities. The rationale behind the recommendations is discussed in the following sections.

4.1 North Lebanon Township – Recycling Background

North Lebanon Township (2010 population 11,429) was mandated by Pennsylvania’s Municipal Waste Planning, Recycling and Waste Reduction, Act 101 of 1988, to provide curbside recycling and leaf waste collection for its residents. In addition to the curbside services to 4,171 housing units, the Township created a drop-off site for various grades of paper in 2004 when it relocated its yard waste drop-off site. The bulk of the drop-off area is dedicated to the collection and processing of yard waste.



4.2 North Lebanon Township Drop-Off Facility

The North Lebanon Township Drop-Off Facility replaced a yard waste drop-off site that was subject to illegal dumping problems. The site was located next to the Township’s salt shed; it was accessible from a major road and was not visible from the Township building. The Township took several steps to control the problem. The drop-off site was relocated to an area directly adjacent to the Township office. Next, the Township applied for and received a PADEP Act 101 recycling grant for a key card access control system, site fencing and site paving, which cost \$18,185.50 in 2004 dollars. Two surveillance cameras were added to the facility in 2006 at a cost of \$3,963.90. With the new location, key card access and surveillance cameras, the Township was able to control who and what was entering the facility, and identify persons abusing the site.



North Lebanon Twp. access gate key card swiping mechanism

Project #505
North Lebanon Township, Lebanon County, PA
Configuring Recycling and Composting Areas for Efficiency and Safety

Residents pay \$30/year to utilize the gated drop-off facility. Contractors serving North Lebanon Township residential properties are permitted to use the Township's compost facility for a \$250 annual fee. The fees have been adjusted once since 2004, when they were \$20 for residents and \$200 for contractors. The Township initially issued 400 access cards at a cost of \$1,056. Beginning in January each year, patrons buy a new card to access the site. 1,100 key cards were in use in 2012.

Although the bulk of the yard waste brought to the facility is in the form of brush and branches, a Jersey barrier bunker is provided for the drop-off of lawn clippings and leaves.

North Lebanon Township uses three leaf vacuums to collect leaves in the fall. In 2011, 3,633 tons of the Township's leaves were hauled by Natural Soil Products to its compost facility in Tremont, Schuylkill County, Pennsylvania. The Township performs a spring clean-up collection for assorted yard waste with a grapple-mounted front-end loader and dump trucks.



Lawn clippings and leaves drop-off bunker

Materials collected in the spring of 2011, including 86 truckloads between 10 and 20 cu. yds. each, were delivered to the yard waste drop-off facility for processing into wood chips through the Township's Bandit Beast Model 2680 horizontal grinder.

After an initial grind, leaves and grass clippings are added to the wood chips for a second grind that produces a mulch product. The mulch is free to any resident who has an access card. The Township charges a loading fee of \$10/scoop for residents who don't or can't load mulch themselves. The Township also delivers mulch for a fee of \$30 for three loader scoops or \$70 for a six scoop truckload.

The Township designates an area outside of the facility gate for the drop-off of Christmas trees by any resident, with or without a gate access card.

A roofed roll-off container is also located outside of the gated drop-off area. This allows all Township residents to drop-off bundled or Kraft-bagged newspapers (ONP) within the roll-off container. The Township provides twine and scissors to encourage bundling of loose newspapers. The newspapers are provided to local farmers for use as animal bedding.

Within the gated area is a compartmentalized Dempster Alleycat RSWT-3000 recycling trailer with separate bins for broken-down corrugated cardboard (OCC), glossy paper, magazines, and office paper. The Township moves the trailer outside of the gated area on the 2nd weekend each month so it can be accessed by all residents. North Lebanon Township uses a down stroke baler, located in its maintenance building, to process OCC. Consolidated Scrap Resources, Inc. (CSR-Brandywine) is the current market for the Township's OCC, magazines, glossy paper, junk mail and office paper collected at the drop-off facility.



Newspaper (ONP) Roofed Roll-off Container



Compartmentalized Alleycat Recycling Trailer

4.3 Drop-Off Facility Proposed Reconfiguration

The site plan for the reconfiguration of the drop-off facility can be found in Appendix B. The location of the newspaper roll-off container is recommended to remain the same to allow access by patrons without key card access to the gated facility. The area designated for drop-off of Christmas trees can also serve as the temporary location for the compartmentalized recycling trailer on the second weekend of each month.

Residents and contractors with key cards entering through the access gate should traverse the site in a counter-clockwise fashion. They will initially encounter the recycling area to their right. The compartmentalized recycling trailer and the two proposed corrugated cardboard roll-offs are recommended to be parked diagonally along the facility's south fence. This arrangement will ease the parking and removal of the trailer and roll-offs and will expose both sides of the containers for deposit of materials. The trailer will be configured to accept magazines, glossy paper, junk mail and office paper in its compartments when the OCC roll-offs become available. There is ample room in the design for vehicles with yard waste materials, or those patrons desiring to pick up compost products, to pass safely to the left of the recycling area.

Proceeding from the recycling area, patrons will encounter an expanded drop-off area for brush and branches parallel to the east fence. The 8,000 sq. ft. dimension of the Brush Drop-off Area, and the use of traffic cones, will allow the Township to direct vehicles to an ever-changing brush pile working face. As the working face grows, or diminishes as materials are processed in the composting area, placement of the traffic cones will be adjusted to designate the preferred dumping area.

Four bunkers are recommended to be created along the west retaining wall utilizing the Jersey barriers presently on the site. The Jersey barriers are 20' deep and can be placed at intervals of approximately 40 feet perpendicular to the retaining wall. The drawing depicts the first bunker located against the north fence as unassigned to any particular use. It could be used as a storage area for site equipment such as traffic cones or fulfill a future site need. A second bunker is recommended for the current practice of drop-off of lawn clippings and leaves. This would require that the Township relocate the "Lawn Clippings and Leaves Only" sign from its present location to above the west end of the second bunker. The logic behind this recommendation is to have patrons

complete their drop-off of recyclables, brush and branches, or lawn clippings and leaves, before proceeding to the third and fourth bunkers for pick up of compost products. These two final bunkers are recommended specifically for storage and pick up of compost and mulch produced in the composting area. As with the recycling container area, there should be ample vehicular room for safe passage past the storage bunkers toward the access gate exit at the south end of the bunkers.

4.4 Proposed Composting Facility Configuration

PADEP utilizes a “permit-by-rule” provision in the Municipal Waste Regulations to regulate leaf and yard waste composting facilities. All persons, municipalities and counties may obtain the permit-by-rule by notifying PADEP and observing the Department’s Guidelines for Yard Waste Composting Facilities (Appendix D).

The guidelines specify isolation distances from neighboring properties, water features, etc. For North Lebanon Township, a critical distance is that from the adjacent private Tree Farm immediately east of the proposed composting area. Composting may not be conducted within 50’ of the property line. The design presented in Appendix C preserves this isolation distance through the existing property boundary and the establishment of 20’ buffers surrounding the recommended compost windrow locations. In addition, Paragraph f., Page 4, of the Compost Guidelines’ siting restrictions waives the 50’ property line isolation distance for compost curing piles. For this reason, the 4,000 sq. ft. Curing Area is recommended to be located within the southeast corner of the proposed composting area, the portion of the site that is closest to the Tree Farm.

The Township presently grinds woody wastes utilizing a Bandit Beast Model 2680 horizontal grinder within the drop-off area. Public access to the drop-off area is routinely restricted during processing activities. Creating the 3,200 sq. ft. Grinding Area within the proposed Compost Area should obviate the need to close the drop-off site during processing since the site will be kept off-limits to the public. The Grinding Area is to be located adjacent to the Curing Area as well as the proposed 20’ gate at the south fence separating the Drop-off Area from the Composting Area. Diagonally opposed to the Grinding Area on the south side of the gate and fence is the Brush Drop-off Area. These locations will minimize the distance that woody waste will need to be moved between the Brush Drop-off, the Grinding, and Curing Areas.



Single-ground wood mulch curing pile located within the drop-off area

The remainder of the proposed composting facility is to be dedicated to windrow composting. Although North Lebanon Township has relied on Natural Soil Products in Tremont, Pennsylvania

to manage the Township’s leaves each fall, the proposed compost area will present the opportunity to windrow compost the leaves on site, negating the need to transport the material 36 miles into Schuylkill County. Once North Lebanon Township gains experience with windrow composting it will be able to judge whether the site will have capacity to accept additional quantities. Neighboring Jackson Township, Lebanon County, has expressed interest in bringing its leaves to North Lebanon Township for composting. A Compost Operators Guide produced under the Recycling Technical Assistance Program for Cumberland County is included in this report as Appendix E.

The design of the proposed composting area would permit three pairs of 14’ x 140’ windrows to be constructed and managed on the site. The proposed windrows are to be oriented west to east and perpendicular to the slope of the site, which is estimated to be two (2) percent running west to east. This configuration will allow ease of access to any of the windrows from a proposed 20’ gate along the facility’s western fence. The Township owns a tow-along Wildcat compost turner that attaches to the Township’s front-end loader. The 8’ x 5’ height of the windrow tuner’s throat will allow the Township to turn the 14’ windrows in two passes by traveling the 20’ buffer lane between each pair of windrows and the 8’ aisle between the two windrows in each pair. As the leaves decompose, the two windrows within each windrow pair can be combined, reducing the overall footprint of the windrows and creating space for additional leaf or yard waste to be brought into the site.



Site of the proposed North Lebanon Twp. Composting Facility

4.5 Conclusion

North Lebanon Township is in position to improve its composting operations and expand its drop-off facility for recyclables and yard waste. The Township has applied to PADEP for funding to reimburse the cost of acquiring two roll-off containers to be dedicated to collection of corrugated cardboard (OCC). The Township must notify PADEP of its intention to move its composting operation into a new area north and adjacent to the drop-off area. The proposed compost site drawing provided as Appendix C of this report should assist the Township with the Permit-by-Rule notification. Once the composting operation is moved to the new area, the drop-off facility can be reconfigured to improve access to the Township’s OCC and mixed paper recycling containers, the brush drop-off area, the lawn clippings and leaves bunker, and the storage bunkers for the compost products produced by the Township.

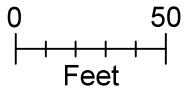
APPENDIX A

**NORTH LEBANON TOWNSHIP COMPOSTING
AND RECYCLING SITE PLAN**

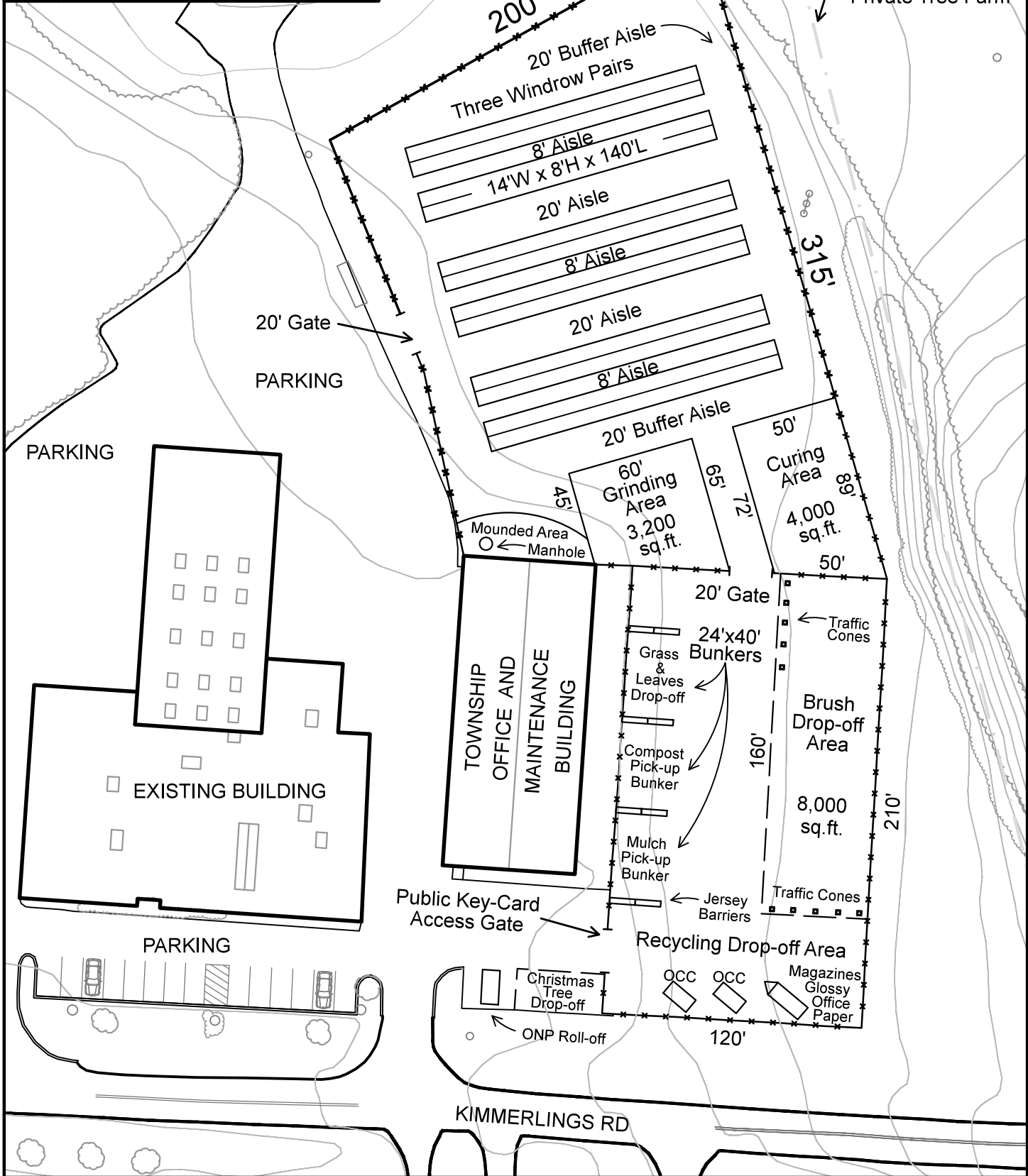
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Yard Waste Processing Facility Schematic Design

North Lebanon Township, PA



November 2012



Property Line for the Adjacent Private Tree Farm

20' Gate

PARKING

PARKING

EXISTING BUILDING

PARKING

TOWNSHIP OFFICE AND MAINTENANCE BUILDING

Public Key-Card Access Gate

KIMMERLINGS RD

200'

20' Buffer Aisle

Three Windrow Pairs

8' Aisle

14'W x 8'H x 140'L

20' Aisle

8' Aisle

20' Aisle

8' Aisle

20' Buffer Aisle

60' Grinding Area
3,200 sq.ft.

50' Curing Area
4,000 sq.ft.

Mounded Area
Manhole

24'x40' Bunkers

Grass & Leaves Drop-off

Compost Pick-up Bunker

Mulch Pick-up Bunker

Brush Drop-off Area

8,000 sq.ft.

Jersey Barriers

Recycling Drop-off Area

Christmas Tree Drop-off

OCC

OCC

Magazines
Glossy Office Paper

ONP Roll-off

120'

160'

50'

65'

72'

50'

20' Gate

Traffic Cones

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315'

50'

89'

50'

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210'

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APPENDIX B

**NORTH LEBANON TOWNSHIP RECONFIGURED
DROP-OFF AREA SITE PLAN**

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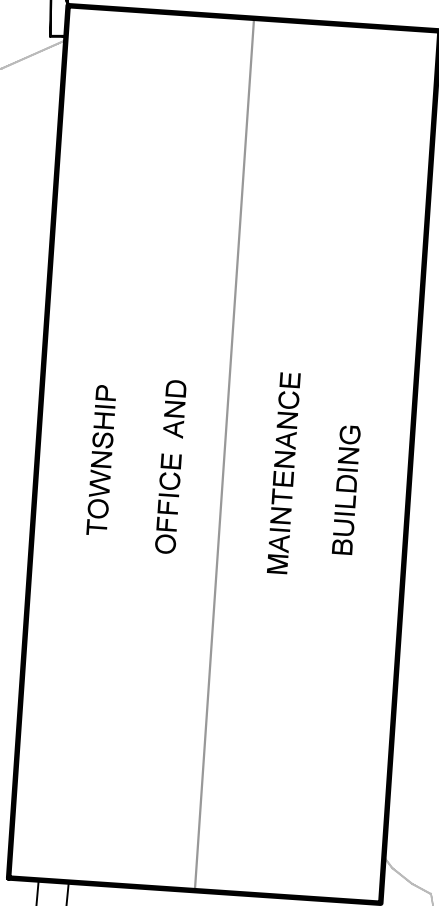
Yard Waste Processing Facility Schematic Design

North Lebanon Township, PA



November 2012

COMPOSTING AREA



20' Gate

Traffic Cones

24'x40' Bunkers

Grass & Leaves Drop-off

Brush Drop-off Area

Compost Pick-up Bunker

160'

8,000 sq.ft.

Mulch Pick-up Bunker

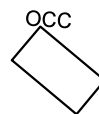
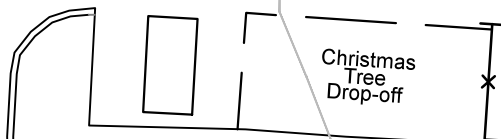
210'

Public Key-Card Access Gate

Jersey Barriers

Traffic Cones

Recycling Drop-off Area



Magazines Glossy Office Paper

ONP Roll-off

120'

DROP-OFF AREA

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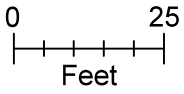
APPENDIX C

**NORTH LEBANON TOWNSHIP PROPOSED
COMPOSTING AREA SITE PLAN**

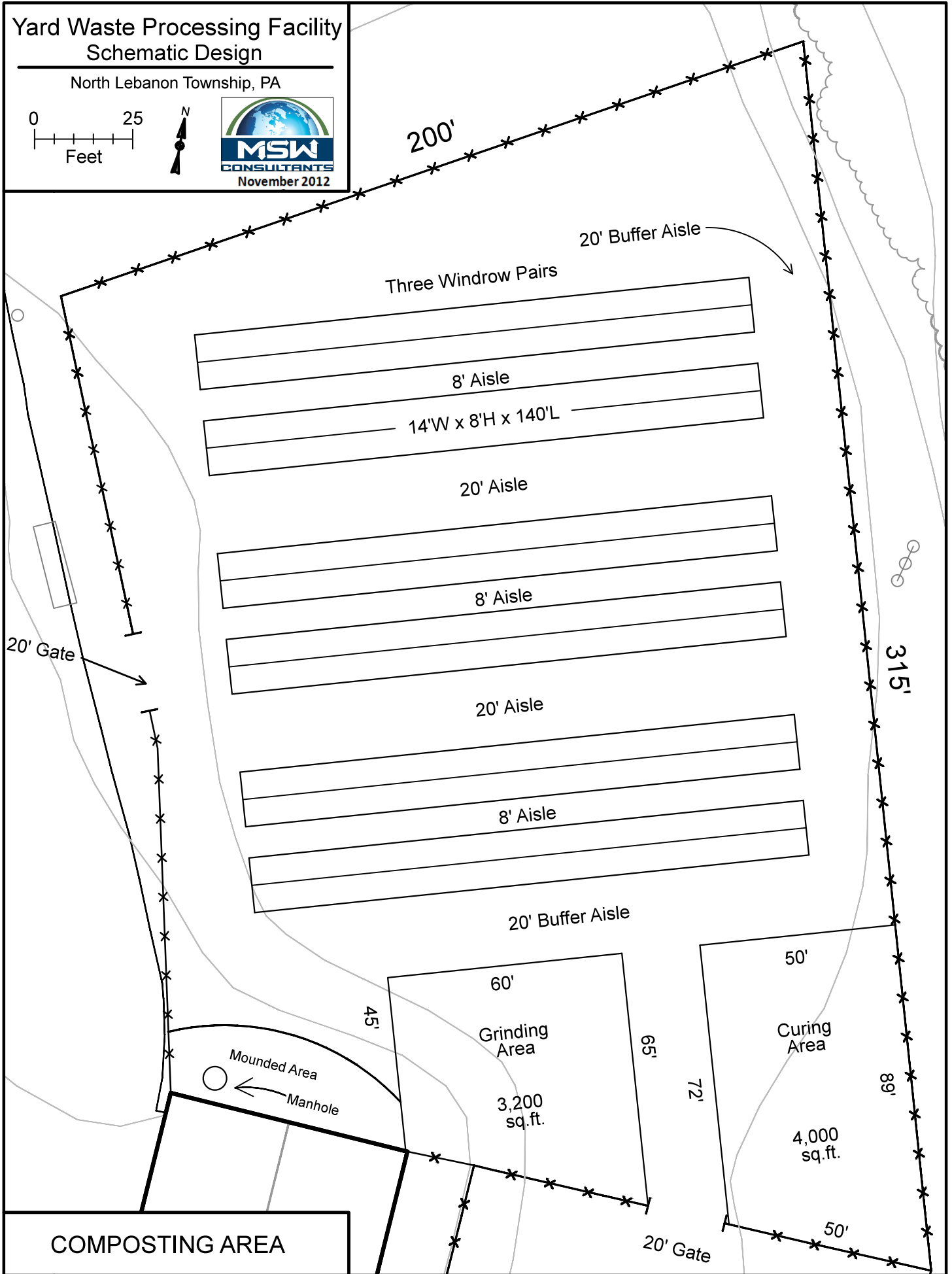
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Yard Waste Processing Facility Schematic Design

North Lebanon Township, PA



November 2012



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APPENDIX D

**PA DEP GUIDELINES FOR YARD WASTE
COMPOSTING FACILITIES**

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DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Waste Management

DOCUMENT NUMBER: 254-5403-100

TITLE: Guidelines for Yard Waste Composting Facilities

EFFECTIVE DATE: September 1, 1997
Minor changes made January 6, 2009

AUTHORITY: Solid Waste Management Act (35 P.S. §§ 6018.101 et seq.) and regulations at 25 Pa. Code Chapters 271, 281, and 285 (the “municipal waste regulations”).

POLICY: It is the Department’s policy to provide a person, municipality, or county with the information necessary to operate a yard waste compost facility.

PURPOSE: The purpose of this document is to provide instructions and operating procedures for the operation of a yard waste composting facility operating under permit-by-rule.

APPLICABILITY: This guidance applies to all persons, municipalities, and counties who own or operate a yard waste composting facility operating under 25 Pa. Code Section 271.103(h) Permit-By-Rule.

DISCLAIMER: The policies and procedures outlined in this guidance are intended to supplement existing requirements. Nothing in the policies or procedures shall affect regulatory requirements.

The policies and procedures herein are not an adjudication or a regulation. There is no intent on the part of DEP to give the rules in these policies that weight or deference. This document establishes the framework within which DEP will exercise its administrative discretion in the future. DEP reserves the discretion to deviate from this policy statement if circumstances warrant.

PAGE LENGTH: 19 pages

LOCATION: Volume 6 Tab 27

DEFINITIONS: The definitions listed below are found in 25 Pa. Code Section 271.1.

“Yard Waste”: Leaves, grass clippings, garden residue, tree trimmings, chipped shrubbery, and other vegetative material.

“Yard Waste Composting Facility”: A facility that is used to compost leaf waste, or leaf waste and grass clippings, garden residue, tree trimmings, chipped shrubbery, and other vegetative material. The term includes land affected during the lifetime of the operation, including, but

not limited to, areas where composting actually occurs, support facilities, borrow areas, offices, equipment sheds, air and water pollution control and treatment systems, access roads, associated on-site or contiguous collection and transportation activities, and other activities in which the natural surface has been disturbed as a result of or incidental to operation of the facility.

Table of Contents

	<u>Page</u>
Introduction.....	1
Technical Guidance for The Operation of a Yard Waste Composting Facility Under Permit-By-Rule	3
Yard Waste Composting Facility Application Form	8
Land Application of Yard Waste	12
Land Application of Yard Waste Application Form	15

INTRODUCTION

Composting has been demonstrated to be an effective waste management technique that can produce a useful end-product while diverting a portion of the wastestream from disposal. It has been estimated that yard wastes--including leaves, trimmings, grass, and related yard debris--can comprise up to 18 percent of the municipal waste stream, with a greater percentage realized in some municipalities on a seasonal basis.

Certain yard waste composting facilities are eligible for permit-by-rule under Section 271.103(h) of the municipal waste regulations if they comply with these guidelines. Section 271.103(h) provides that a person, municipality, or county that operates a yard waste composting facility that is less than 5 acres, other than an individual backyard composting facility, shall be deemed to have a municipal waste processing permit-by-rule if the person, municipality, or county meets the requirements of Subsections 271.103(a)-(c)(relating to storage, PPC plan, daily records, financial assurances, and inappropriate activity), and the facility is operated in accordance with these guidelines on yard waste composting.

These guidelines have been established to promote yard waste composting and reuse in the Commonwealth while providing protection to human health and the environment. Health or environmental problems, resulting from the improper operation of a yard waste composting facility operated under Section 271.103(h), will be treated in the same manner as health or environmental problems at other solid waste management facilities.

More than 450 municipalities and counties in the Commonwealth are conducting yard waste collection and composting programs. In an effort to increase awareness of the benefits of composting and to promote the proper environmental and technical practices involved, the Department has designated several of these facilities as yard waste composting demonstration sites. Many of the other sites also present backyard composting demonstrations for homeowners. The Department has developed a reference manual, brochures, and educational videos to provide further information. To learn more about these and other related resources, contact your DEP regional office or the Web site at www.depweb.state.pa.us.

Yard waste composting operations must comply with these guidelines to comply with Section 271.103(h) of the municipal waste regulations. Please contact your DEP regional office for further information.

DEP REGIONAL OFFICES

REGION 1:	DEP SOUTHEAST REGION 2 East Main Street Norristown, PA 19401 Telephone: 484-250-5960	Counties Served: Bucks, Chester, Delaware, Montgomery and Philadelphia
REGION 2:	DEP NORTHEAST REGION 2 Public Square Wilkes-Barre, PA 18711-0790 Telephone: 717-826-2516	Counties Served: Carbon, Lackawanna, Lehigh, Luzerne, Monroe, Northampton, Pike, Schuylkill, Susquehanna, Wayne and Wyoming
REGION 3:	DEP SOUTHCENTRAL REGION 909 Elmerton Avenue Harrisburg, PA 17110-8200 Telephone: 717-705-4706	Counties Served: Adams, Bedford, Berks, Blair, Cumberland, Dauphin, Franklin, Fulton, Huntingdon, Juniata, Lancaster, Lebanon, Mifflin, Perry and York
REGION 4:	DEP NORTHCENTRAL REGION 208 West 3rd Street, Suite 101 Williamsport, PA 17701 Telephone: 717-327-3653	Counties Served: Bradford, Cameron, Center, Clearfield, Clinton, Columbia, Lycoming, Montour, Northumberland, Potter, Snyder, Sullivan, Tioga and Union
REGION 5:	DEP SOUTHWEST REGION 400 Waterfront Drive Pittsburgh, PA 15222-4745 Telephone: 412-442-4000	Counties Served: Allegheny, Armstrong, Beaver, Cambria, Fayette, Greene, Indiana, Somerset, Washington and Westmoreland
REGION 6:	DEP NORTHWEST REGION 230 Chestnut Street Meadville, PA 16335-3481 Telephone: 814-332-6848	Counties Served: Butler, Clarion, Crawford, Elk, Erie, Forest, Jefferson, Lawrence, McKean, Mercer, Venango and Warren

TECHNICAL GUIDANCE FOR THE OPERATION OF A YARD WASTE COMPOSTING FACILITY UNDER PERMIT-BY-RULE

A person, municipality, or county that operates a yard waste composting facility under permit-by-rule shall comply with these guidelines, as required by 25 Pa. Code Section 271.103(h).

General Requirements

The following operational information must be submitted to the Department on the attached Yard Waste Composting Facility Application Form:

- a. The name, address, and telephone number of the operator of the facility.
- b. The sponsoring municipality or county (where applicable).
- c. The location of the facility, including identification of the site by outlying perimeter site boundaries on a United States Geological Survey 7.5 minute topographic map.
- d. Proof that the operator has the legal right to enter the land and perform the approved activities.
- e. A general site plan drawn to scale for the facility indicating the following:
 - i. The location of access roads and gates in relation to public and private roads, wells, and property lines.
 - ii. The location of the tipping area.
 - iii. The location of the processing area, including compost piles and windrows.
 - iv. The location of storage and curing areas.
 - v. Surface water controls.
- f. The operational narrative describing:
 - i. The yard waste collection methods that will be employed by the facility.
 - ii. The methods that will be utilized at the facility to construct compost piles.
 - iii. The proposed dimensions of compost piles and windrows at the facility.
 - iv. The source of supplemental water that will be used to maintain an optimal 50 percent moisture content of compost piles or windrows at the facility.
 - v. The proposed method of turning windrows, the turning frequency for composting at the facility and the method for determining that frequency.

- vi. The proposed duration of the composting process, including curing time, storage time, and the proposed term of compost distribution.
 - vii. A plan for the marketing and distribution of the finished compost.
 - viii. A residue disposal plan, including the location of disposal sites.
 - ix. Provisions for emergency response.
 - x. A public information and education program.
- g. The projected volume of material that will be processed by the facility during the calendar year.

Siting Restrictions

Yard waste composting operations, including storage, composting, and curing, shall not occur in the following areas or the following distances, unless the operator takes special precautions and receives written authorization from the Department:

- a. In a 100-year flood plain.
- b. In or within 300 feet of an exceptional value wetland.
- c. In or within 100 feet of a wetland other than an exceptional value wetland.
- d. Within 100 feet of a sinkhole or area draining into a sinkhole.
- e. Within 300 feet measured horizontally from an occupied dwelling unless the owner has provided a written waiver consenting to the facility being closer than 300 feet.
- f. Within 50 feet of a property line, unless the operator demonstrates that only curing of compost is occurring within that distance.
- g. Within 300 feet of a water source.
- h. Within 3.3 feet of a regional groundwater water table.
- i. Within 100 feet of a perennial stream.

Access Control

- 1. A gate or other barrier shall be maintained at all potential vehicular access points to block unauthorized access to the site.
- 2. Access to the site shall be limited to those times when an attendant is on duty.

Operational Requirements

1. No person, municipality, or county shall bring to or receive any material at a yard waste composting facility other than shrubbery and tree trimmings that have been shredded or chipped, unless shredding or chipping is provided at the facility, leaves, grass, and similar related yard debris.
2. The Department may prohibit the use of grass clippings at a yard waste composting facility if the grass clippings cause or contribute to nuisances, or if the site is adversely affecting, or has potential to adversely affect, the citizens or environment of the Commonwealth. Grass clippings shall not be brought to or received at a yard waste composting facility unless:
 - a. Grass clippings delivered to the yard waste composting facility in bulk, bags or other collection containers are emptied of all grass clippings within 24 hours of delivery to the facility.
 - b. Grass clippings are incorporated into the windrows of partially composted leaves or other yard waste within twenty-four (24) hours of delivery to the facility.
 - c. Grass clippings are incorporated into the partially composted windrows of partially composted leaves or other yard waste at a ratio not to exceed one part grass clippings to three parts yard waste, by volume.
3. No more than 3,000 cubic yards of yard waste shall be placed, stored, or processed on any acre of a facility where composting activity occurs or is planned to occur.
4. A person, municipality, or county operating a yard waste composting facility shall, for the duration of yard waste composting activities, identify the operation by posting and maintaining signs that are clearly visible at the junction of each access road and public road. The signs shall be easily seen and read. They should be constructed of a durable, weather-resistant material. The sign wording shall include the name, address, and telephone number of the person(s), municipality(ies), or county(ies) operating the facility, the operating hours, and the materials that can be received by the facility.
5. Each yard waste composting facility shall be operated in a manner which results in the active biological decomposition of the vegetative material received.
6. Yard waste compost piles or windrows shall be constructed and maintained as follows:
 - a. The compost area shall be constructed in a well drained area with a workable surface and slope of 2-4 percent to prevent ponding and control surface water.
 - b. The size of the compost piles or windrows should not exceed eight feet in height or sixteen feet in width unless the composting technology can adequately manage the compost piles, and is approved by the Department.
 - c. Compost piles or windrows shall be constructed within one week following receipt of compostable material at the facility.

- d. During the active composting process, the optimal moisture content of the windrows or compost piles shall range from 40 to 60 percent to promote decomposition.
 - e. All surface water shall be diverted away from tipping, processing, composting, curing and storage areas. Surface water controls shall be based on a 24-hour precipitation event to be expected once every 25 years. Proper drainage must be maintained to prevent ponding and excessive moisture.
 - f. To promote decomposition, compost piles and windrows shall be turned and reconstructed at least once every three (3) months. A higher turning frequency may be required, depending on the composting technology unless the composting technology requires more intensive management.
7. The operator shall maintain sufficient distance between windrows or piles to allow the proper use of equipment during the deposit, removal, and turning of the compost.
 8. The operator shall establish an adequate frequency for inspecting the facility to detect hot spots in any composting, curing or storage areas, dust or litter accumulation, surface water accumulation, erosion or sedimentation, vectors, odors, and other problems. The operator shall take prompt, necessary corrective actions.
 9. The operator shall not allow compostable materials or residues to be blown or otherwise deposited offsite.

Residue Disposal

1. The operator shall not allow non-compostable residues or solid waste other than yard waste to accumulate at the facility, and shall provide for proper disposal or processing.
2. Yard waste and other municipal waste received at the facility that are not suitable for composting shall be removed weekly and disposed or processed at a permitted municipal waste facility.

Nuisance Control

1. The operator shall not cause or allow the attraction, harborage, or breeding of vectors.
2. The operator shall not cause or allow conditions that are harmful to the environment or public health, or which create safety hazards, odors, noise, or other public nuisances.

Emergency Response

1. Adequate space shall be maintained to allow the unobstructed movement of emergency personnel and equipment.
2. The operator of each yard waste composting facility shall immediately contact local police or fire departments or other appropriate state or local emergency response agencies in the event of fire, spill, or other hazards that threaten public health, safety, and welfare, or the environment, and whenever necessary in the event of personal injury.

Air Resources Protection

1. The operator shall implement fugitive dust control measures.
2. No person, municipality, or county shall cause or allow open burning at the facility.

Water Quality Protection

1. The operator shall manage surface water and control erosion and sedimentation in accordance with the requirements of 25 Pa. Code Chapter 102, Erosion Control.
2. The operator shall not cause or allow a point or non-point source pollution discharge from or on the facility to any surface waters of the Commonwealth.



YARD WASTE COMPOSTING FACILITY APPLICATION FORM

Please familiarize yourself with the Pennsylvania Department of Environmental Protection GUIDELINES FOR YARD WASTE COMPOSTING FACILITIES prior to filling out this form.

1. Operator (Name and Mailing Address) _____ Telephone Number _____

2. Name of Facility _____ Contact Telephone Number _____
 Contact Person _____
 Property Owner's Name _____
 Address of Facility _____

(include Access Road Name and Legislative Route Number)

State _____ Zip _____
 City-Borough-Township _____
 County _____
 Sponsoring Municipality (where applicable) _____

Attach a United States Geological Survey 7.5 minute topographic map identifying the yard waste composting facility site boundaries outlined on it.

Provide proof the operator has the legal right to enter the land and perform the approved activities.

3. The proposed composting method _____
 Total Acres of the composting facility _____
 The maximum quantity of yard waste and composted materials to be on the site at any one time:
 Yard waste in cubic yards _____
 Finished compost in cubic yards _____

4. Prepare and include in this application a general site plan* for the facility which illustrates the location of the following items:
 Access roads in relation to the nearest public road and private roads, wells, and property lines
 Tipping area
 Gate location
 Surface water controls, erosion and sedimentation controls
 Processing area including location, orientation, and size of compost piles or windrows
 Curing or storage areas
 North arrow scale of drawing

**Please note that a hand drawn sketch that includes site dimensions is acceptable. An engineer's drawing is not required.*

5. Please address the following items: (attach additional sheet(s) if necessary)

- Provide a complete list of source(s) of yard waste to be received.

- Describe how the yard waste will be collected and received at the facility.

- Describe the method for inspecting incoming yard waste and for removing unacceptable material.

- Describe the windrow construction methods including equipment to be used.

- Describe the windrow size: Initial dimensions will be _____ wide x _____ high x _____ long.

- Describe the source of supplemental water which will be used to maintain an optimal 40 to 60% moisture content of compost piles or windrows.

- Indicate the frequency of windrow turning. _____
Indicate the temperature range to be maintained. _____
Indicate the method of windrow turning. _____

- Describe method for determining turning frequency.

- Describe the approximate duration of the composting cycle (in days). _____
Describe the composting process. _____
Describe the curing period for compost. _____
Indicate the time required for storage and distribution. _____
Indicate the total time required for the composting operation. _____

- Describe the marketing and distribution plan for the finished compost product.

- Describe the residue disposal plan and identify the disposal or processing site(s) to be used.

- Describe the plan for emergency response (fire, police, etc.).

- Outline the public information and education program (attach samples of literature if available).

LAND APPLICATION OF YARD WASTE

A municipality or county that collects yard waste and delivers it to any person to land apply as part of a normal farming operation, shall comply with the following guidelines in order to comply with the permit-by-rule requirements of 25 Pa. Code Section 271.103(h).

General Requirements

1. A municipality or county must notify the Department with the following information:
 - a. Sponsoring municipality or county.
 - b. Responsible official/contact person, including name, address, and telephone number.
 - c. Location, including identification of the site on a U.S.G.S. 7.5' topographic map.
 - d. Operational plan:
 - i. A general site plan must be included which contains the following information for land application sites:
 - A. Access road
 - B. Tipping area
 - C. Surface water controls (tipping area only)
 - D. Farm soil conservation plan and nutrient management plan.
 - ii. The operational narrative must include a description of each of the following:
 - A. Operational hours for receiving yard waste
 - B. Land application and incorporation frequency
 - C. Plan for removal of yard waste from bags
 - D. Spreading and incorporation methods and frequency
 - E. Source of leaves and grass clippings.
 - iii. Volume of yard waste processed during the previous year or expected to be processed during the first year of operation.

Operational Requirements

1. All surface water shall be diverted away from the tipping or storage area. Proper drainage must be maintained to prevent ponding.

2. Yard waste should be delivered to the farm in bulk. Where bags or other containers are used for collection, the bags or containers must be emptied of all yard waste delivered to the farm by the end of each day.
3. The Department may prohibit the use of grass clippings at the farm if the grass clippings cause or contribute to nuisances, or if the site has the potential to adversely affect the citizens or environment of the Commonwealth. Grass clippings shall not be brought to or received at a farm unless:
 - a. The grass clippings are delivered to the farm in bulk. Where bags or other containers are used for collection, the bags and containers must be emptied of the grass clippings delivered to the farm by the end of each day.
 - b. The grass clippings are to be spread in layers not to exceed six (6) inches in depth within one (1) week of delivery to the site.
 - c. Grass clippings mixed with manure and stored in an acceptable manure storage facility may be stored for up to 120 days, provided the storage of the material does not create a nuisance or environmental impact.
4. The operator shall not allow compostable materials or residues to be blown or otherwise deposited offsite.
5. No yard waste may be disposed of in waters of the Commonwealth.

Residue Disposal

1. The operator shall not allow non-compostable residues or solid waste other than yard waste to accumulate at the farm, and shall provide for proper disposal or processing.
2. Yard waste and other municipal waste that is received at the farm, that is not suitable for land application, shall be removed weekly and disposed or processed at a permitted municipal waste facility.

Nuisance Control

1. The operator shall not cause or allow the attraction, harborage, or breeding of vectors.
2. The operator shall not cause or allow conditions that are harmful to the environment or public health, or that create safety hazards, odors, noise, and other public nuisances.

Air Resources Protection

1. The operator shall implement fugitive dust control measures when necessary.
2. No person, municipality, or county shall cause or allow open burning at the facility.

Water Quality Protection

1. The operator shall manage surface water and control erosion and sedimentation in accordance with the requirements of 25 Pa. Code Chapter 102, Erosion Control.
2. The operator shall not cause or allow a point or non-point source pollution discharge from or on the facility to any surface waters of the Commonwealth.



LAND APPLICATION OF YARD WASTE APPLICATION FORM

Please familiarize yourself with the Pennsylvania Department of Environmental Protection GUIDELINES FOR LAND APPLICATION OF YARD WASTE prior to filling out this form.

1. Sponsoring Municipality or County (Name and Mailing Address) _____ Telephone Number _____

2. Name of Farm _____ Contact Telephone Number _____
 Contact Person at Farm _____
 Property Owner's Name _____
 Address of Facility _____

(include Access Road Name and Legislative Route Number)
 _____ Zip _____
 City-Borough-Township _____
 County _____

Attach a U.S.G.S. 7.5" map identifying the farm and the yard waste site boundaries.

3. Total acres for farm land application area: _____

4. Volume of yard waste to be received annually in cubic yards: _____

5. Prepare and include in this application a general site plan* for the facility which illustrates the location of the following items:

- Access roads in relation to the nearest public road
- Tipping area
- Surface water controls (tipping area only)
- Fields proposed for land application.

* Please note that a hand drawn sketch that includes site dimensions is acceptable. An engineer's drawing is not required.

6. Please address the following items:

- A complete list of source(s) of yard waste to be received.

- Describe the method for inspecting incoming yard waste.

- Describe the plan for rejecting or disposing of unacceptable materials and residuals.

- Provide the name and location of the disposal or processing site for unacceptable materials and residuals.

- Attach the farm soil conservation plan and nutrient management plan.

- Describe the volume of yard waste processed during the previous year or expected to be processed during the first year of operation.

- Please provide an operational narrative which includes a description of each of the following:

- Operational hours for receiving yard waste
- Land application and incorporation frequency
- Plan for removal of yard waste from bags
- Spreading and incorporation methods and frequency
- Source of leaves and grass clippings.

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APPENDIX E
CUMBERLAND COUNTY SWA COMPOST
OPERATORS GUIDE

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**CUMBERLAND COUNTY SOLID WASTE AUTHORITY
CUMBERLAND COUNTY, PENNSYLVANIA**

**MUNICIPAL YARD WASTE COMPOSTING FACILITY
OPERATOR'S REFERENCE GUIDE
AND HANDBOOK**

JUNE 1999



**MUNICIPAL YARD WASTE COMPOST FACILITY
OPERATOR’S REFERENCE GUIDE AND HANDBOOK**

TABLE OF CONTENTS

	Page No.
I. INTRODUCTION	1
A. Purpose and References	1
B. Pennsylvania’s Yard Waste Management Regulations	2
II. COMPOSTING PROCESS	4
A. Key Factors and Conditions	4
1. Substrate.	4
a. Carbon to nitrogen ratio (C:N)	4
b. Surface area/particle size.	5
c. Inoculents	5
2. Moisture Content	5
3. Oxygen	6
4. Temperature	7
5. pH	7
B. Types of Systems	8
1. Turned Windrow System Technology	8
a. Construction	8
b. Turning	10
c. Curing	11
d. Screening	11
e. Limitations	11
C. Health and Safety Precautions	11
III. TROUBLESHOOTING	13
IV. COMPOST USE	14
V. MONITORING PROCEDURES	15
A. Monitoring Parameters	15
B. Record-keeping	16

TABLE OF CONTENTS - Continued

LIST OF ATTACHMENTS

- ATTACHMENT NO. 1 Guidelines for Yard Waste Composting Facilities (not available in Web version)
- ATTACHMENT NO. 2 Turned Windrow System Technology
- ATTACHMENT NO. 3 Yard Waste Composting Facility Troubleshooting Guide
- ATTACHMENT NO. 4 Yard Waste Composting Facility Monitoring Procedures

MUNICIPAL YARD WASTE COMPOST FACILITY OPERATOR'S REFERENCE GUIDE AND HANDBOOK

I. INTRODUCTION

A. Purpose and References

This handbook was developed to provide technical assistance to operators of yard waste composting and processing facilities. This handbook includes basic information on the composting process as well as technical information for the proper operation and management of a municipal yard waste composting facility. Recommended operating procedures and conditions, as well as record-keeping guidelines and troubleshooting suggestions are included in this operator's reference guide and handbook.

The information contained in this handbook is based on a variety of references and highly regarded sources. Acknowledgment is given to the following:

Cornell Composting, Tom Richard, Dept. of Agricultural & Biological Sciences, Cornell University, Ithaca, NY, <http://www.cals.cornell.edu/dept/compost/Fact.sheets>

Composting and Recycling Municipal Solid Waste, Luis F. Diaz...[et. al.], Lewis Publishers, Boca Raton, FL, 1993.

Municipal Yard Waste Composting Reference Manual, Gershman, Brickner & Bratton, Inc., [et.al.] for Pennsylvania Department of Environmental Resources, Harrisburg, PA, October 1991.

Curbside Recycling: How-To Guide for Pennsylvania Local Governments, The Pennsylvania State Association of Township Supervisors for Pennsylvania Department of Environmental Resources, Harrisburg, PA, September 1990.

The BioCycle Guide to Yard Waste Composting, edited by the staff of BioCycle Journal of Waste Recycling, The JG Press, Inc., Emmaus, PA, 1989.

Guidelines for Yard Waste Composting Facilities, Policy Guidance Document, Pennsylvania Department of Environmental Protection, Harrisburg, PA, April 1997.

Guide to Municipal Yard Waste Composting, Pennsylvania Department of Environmental Protection, <http://www.dep.state.us/dep/deputate/airwaste/wm/rotate/Compost/Mun1.htm>

B. Pennsylvania's Yard Waste Management Regulations

PA Act 101 of 1988, the "Municipal Waste Planning, Recycling and Waste Reduction Act," establishes the framework for separating and recycling components of the municipal wastestream in certain communities in Pennsylvania. Regulations developed by the Pennsylvania Department of Environmental Protection (PADEP) under Act 101 establish requirements for separating and processing leaf wastes. For larger "mandated communities" (there are eleven such municipalities in Cumberland County), leaf wastes must be separated from other residential wastes that are collected for disposal. Further, since September of 1990, no waste disposal facility may accept shipments comprised primarily of leaf wastes, unless provisions are made to compost those leaf loads. These regulatory requirements have stimulated the establishment of over 80 municipal leaf composting facilities in Pennsylvania.

Composting of municipal wastes in Pennsylvania is regulated and permitted under Chapter 281 of PADEP's Municipal Waste Regulations. However, under Section 271.101(h) of the regulations, yard waste composting that is conducted by persons, municipalities or counties within established PADEP guidelines is deemed to comply with the regulations as a "Permit-by-Rule" facility. These guidelines establish minimum siting, operating, and reporting criteria that divert yard wastes from the waste stream for composting in an environmentally safe manner. These guidelines contain a "Yard Waste Composting Facility Application Form" that must be completed and submitted to PADEP for a facility to operate as a permit-by-rule facility. A copy of PADEP's Guidelines for Yard Waste Composting Facilities, including the application form, is contained in Attachment No. 1 of this handbook. PADEP defines yard waste composting as follows:

"Yard Waste": Leaves, grass clippings, garden residue, tree trimmings, chipped shrubbery and other vegetative material.

"Yard Waste Composting Facility": A facility that is used to compost leaf waste, or leaf waste and grass clippings, garden residue, tree trimmings, chipped shrubbery, and other vegetative material. The term includes land affected during the lifetime of the operation, including, but not limited to, areas where composting actually occurs, support facilities, borrow areas, offices, equipment sheds, air and water pollution control and treatment systems, access roads, associated on-site or contiguous collection and transportation activities, and other activities in which the natural surface has been disturbed as a result of or incidental to operation of the facility.

Table 1 presents a summary of current yard waste management activities in Cumberland County. All operating yard waste composting facilities in the County are believed to comply with the PADEP guidelines.

TABLE 1**MUNICIPAL YARD WASTE COMPOSTING PROGRAMS**

Municipality	Collect Leaves	Collect/Drop-off Other Yard Waste	Leaf Compost Operation	Leaves/Grass Compost	Land Application⁽³⁾
Carlisle Borough	X		X		
Camp Hill Borough	X	X	X		
East Pennsboro Township	X				
Hampden Township	X		X		
Lower Allen Township	X	X	X		
Mechanicsburg Borough	X				X
New Cumberland Borough	X				X
North Middleton Township	X				
Shippensburg Borough	X	X	X	X	
South Middleton Township	X	X			
Upper Allen Township	X		X		
Lemoyne Borough	X	X			X
Mt. Holly Borough					
Shiremanstown Borough ⁽¹⁾	X				
Silver Spring Township ⁽²⁾	X		X		
Wormleysburg Borough					X

⁽¹⁾ Utilizing Camp Hill compost facility.

⁽²⁾ Designated citizen leaf drop-off only.

⁽³⁾ Direct land application of leaves only.

Source: From Table 4-4, Cumberland County Municipal Waste Plan Revision, 2/97, updated 6/99.

II. COMPOSTING PROCESS

Composting is a biological process; it is the controlled decomposition of organic matter by microorganisms into a relatively stable humus-like product. The microorganisms responsible for composting are aerobic, or oxygen-loving. Thus, composting occurs in the presence of oxygen. The microorganisms require water and nutrients, and the microorganisms generate heat as they decompose wastes. The illustration on the following page reflects a typical leaf or yard waste windrow composting pile. The key factors and conditions for successful composting are described in the following sections.

A. Key Factors and Conditions

The key conditions for successful composting include substrate, moisture content, oxygen, temperature, and pH. These environmental factors work together to provide the desired extent and rate of decomposition. The key factors for successful composting are based on the waste to be composted, also called the substrate (in this case, leaf and yard wastes). The substrate determines the available nutrients, the particle size and the need for inoculents.

1. **Substrate.** The substrate, or the type(s) of waste to be composted, provides the nutrients necessary for biological decomposition. The nutrients of primary importance in composting are carbon and nitrogen. The size of the substrate may or may not require processing to achieve optimal particle size for microbial decomposition.

- a. Carbon to nitrogen ratio (C:N). The microorganisms required for composting use carbon sources to obtain energy and consume nitrogen for protein and synthesis of new cellular material (population growth). Carbon sources include leaves and brush. Nitrogen sources include grass clippings, garden vegetation, and digested sewage sludge (although composting of sewage sludge requires a PADEP permit). The ideal proportion of carbon to nitrogen, for optimal aerobic microbial action, is about 30 parts carbon to 1 part nitrogen by weight, although this ratio may need to be adjusted based on the bioavailability of carbon and nitrogen.

Insufficient nitrogen limits the growth of the microbial population, and the rate of composting will slow down if the C:N ratio is very high. Conversely, excess nitrogen leads to rapid microbial growth and accelerates decomposition, but this can quickly deplete available oxygen, causing the

compost mixture to go anaerobic and create serious odor problems .

The C:N ratio of leaves tends to range from 40:1 to 80:1; thus, leaf composting is on the slow side as far as composting operations go. Leaf composting can be improved by reducing the C:N ratio via addition of grass clippings or other nitrogen sources. Keep in mind, however, that most materials with a high nitrogen content require more careful management to ensure adequate aeration and mixing.

- b. Surface area/particle size. The microorganisms act on the surface of the substrate. Smaller particles have greater surface area (for the same amount of material) and are broken down more quickly. However, very small particles compress together, limiting porosity and limiting movement of water and oxygen. Furthermore, the size reduction of some fresh vegetation turns the waste into a slurry material which is harder to manage and has a very low porosity.

Some size reduction is recommended for branches and twigs, primarily to make handling easier. Tearing or shredding of leaves may be considered if the composting rate is inadequate (too slow) or if uneven decomposition within the compost piles is evident; usually, leaves compost well without shredding. Little or no size reduction is recommended for fresh, green vegetation.

- c. Inoculents. Decomposition is performed by the microorganisms naturally present in leaf and yard wastes. These microorganisms grow rapidly on the organic material, using it as a source of food. Naturally occurring microorganisms are present in sufficient quantities for proper yard waste composting operations. Rarely does composting require inoculums, or the deliberate addition of microorganisms to the substrate.

Although typically not needed for leaf and yard waste composting, should an inoculum be desired, the following sources of microbes can be considered: finished compost, decomposed horse manure, or a rich and loamy soil.

2. **Moisture Content.** Water is essential to the survival of microorganisms.

Moisture aids in dissolving nutrients and provides a suitable environment for bacterial population growth. The optimal moisture content for leaf composting should be between 40 and 60 percent; this is about the consistency of a wrung-out sponge...the leaves should feel damp but with only a drop or two of water expelled when tightly squeezed. Leaves very often require water at the start of the composting process. As a rule of thumb, dry leaves initially need about 20 gallons of water for every cubic yard of leaves. Keep in mind that excessive moisture inhibits the flow of oxygen, and anaerobic conditions start to develop.

Water for compost pile wetting can be provided from potable or non-potable piped sources (such as a hydrant connection), from a stream/pump discharge, from a well supply, or from a tanker truck. Rewetting of the pile during turning may be necessary to maintain optimal moisture conditions. Water can be added to the compost pile by hosing as the windrow is turned, by turning the piles on a rainy day, or by injecting water to the center of the pile via pressurized means.

The shape of the composting pile also has a lot to do with its moisture content. Piles forming a peak tend to shed water, thus minimizing absorption; this is the recommended method of pile construction during wet weather periods. Piles with a depression on top, forming a concave shape, maximize water absorption. Concave piles, however, are a potential breeding ground for mosquitos and insects.

3. **Oxygen.** The microorganisms responsible for composting are aerobic, or oxygen-loving. Thus, composting occurs in the presence of oxygen. An adequate supply of air is necessary for rapid decomposition of organic material. The oxygen content of the air we breathe is about 21 percent. The compost microorganisms can survive at oxygen levels to about 5 percent; below this, aerobic microorganisms die. Below the oxygen level of 10 percent, parts of the compost can become anaerobic. Such anaerobic conditions can lead to decreased composting efficiency and can cause odor problems. Therefore, maintaining an adequate oxygen supply is essential to proper compost operations.

Air can be supplied by forced aeration systems, though these systems are generally suitable (cost justified) only when nitrogen sources are causing frequent odor problems or if the yard waste is being composted with sludge. Air is most commonly added by turning the compost piles with equipment, like a front-end loader or specialized compost turner. This only provides several hours worth of

oxygen, but it also loosens the piles allowing air to flow more freely in and through the pile via natural convection. Natural convection is driven by a chimney effect, with cool outside air pulled in from the bottom sides of the piles, while heated air from the pile center/core rises out of the top of the pile. The effectiveness of natural convection depends upon the particle size, moisture content and pile construction.

4. **Temperature.** Heat is generated by the metabolism of the microorganisms as they naturally decompose waste. The optimum temperature range is between 90°F and 140°F (32 - 60°C). Below 90°F, decomposition slows down significantly, and above 140°F, the rate of decomposition rapidly declines as beneficial organisms begin to die or become dormant. The compost piles may also be susceptible to spontaneous combustion at these higher temperatures.

Compost pile temperature not only depends on the heat generated by the microorganisms, but also by the heat lost through aeration or surface cooling. During periods of cool weather, piles may need to be larger than usual to minimize surface heat loss. In specialized compost operations that process large amounts of nitrogen-high sources like grass clippings or sludge, smaller piles and frequent turning may be needed to both provide oxygen and release excess heat.

As a key environmental factor affecting biological activity, the temperature should be monitored frequently; ideally, temperature readings should be taken weekly along every 65 to 75 ft section of the pile (i.e. at least 3-4 measurements per windrow). There is an initial high temperature period of a few days to several weeks, followed by a gradual drop in temperature. Turning the piles reintroduces oxygen and exposes new surfaces to decomposition, causing temperatures to rise again. It is important to monitor temperatures and turn the compost when temperatures exceed 140°F to prevent problems previously mentioned. When the compost temperature drops below 70°F (21°C), the composting process is nearly complete. Turning the compost whenever temperatures get above or below the optimum range (90 to 140°F) will help produce a high quality compost in the shortest possible time. The frequency of taking temperature readings can be extended as the windrow pile material stabilizes.

5. **pH.** It is common for the pH of the material to become slightly acidic (i.e., down to 5.0) during the early stages of decomposition because of organic acid formation.

The pH then begins to rise to near neutral conditions, and may reach levels as high as 8.5. Normally, leaf composting operations should not present a pH (acidic) problem, especially when keeping the pile in an aerobic state. Because decomposition takes place most efficiently under neutral pH conditions, the pH of the material should be monitored periodically.

B. Types of Systems

The three main types of composting systems are the mechanical system, the static windrow system, and the turned windrow system. The mechanical system is an enclosed system, where a reactor provides adequate aeration as well as adds moisture. Some reactors rely on tumbling mechanisms while others utilize forced air techniques. The mechanical process is not economically attractive and is primarily for high volume applications. These are cost-prohibitive for yard waste composting operations.

The static system is sometimes referred to as the forced aeration style of composting. It involves the forcing of air through the compost piles, while the composting materials are not moved/disturbed. The static system works best for a substrate of relatively uniform particle size in which the size does not exceed 2 inches in any dimension; static systems are used primarily for sewage sludge composting. Forced-aeration systems are typically not utilized in yard waste composting, as they are cost-prohibitive.

The turned windrow system is the conventional yard waste composting method. The term “turned” refers to the method of aeration used in this windrow system. The basic idea of the turned windrow system is to build the compost pile, tear it down, and rebuild it. The turned windrow system is primarily for yard wastes. The following section of this handbook deals with the operational requirements of the turned windrow method.

1. Turned Windrow System Technology. Key aspects of windrow construction and turning are described below, and summarized for quick reference in Attachment No. 2 of this handbook.

- a. Construction. Windrow construction should occur within one week, but preferably within 1-2 days of delivery of the yard wastes. If several different types of waste are to be composted together, they should be thoroughly mixed. Grass clippings are sometimes placed on top of an existing windrow pile and incorporated into the pile. PADEP guidelines

require grass clippings to be incorporated in partially decomposed windrow piles within 24 hours of grass delivery, at a ratio of no less than 3 parts leaves to 1 part grass. Mixing of yard wastes can be performed using a front-end loader, but when mixing with grass clippings, which tend to mat together, use of a windrow turner is recommended.

Pile construction is an important watering period. Water should be added to reach the desired moisture content (between 40 and 60 percent for leaf composting).

The form and shape of the windrow affects several key conditions of the composting process. For instance, if the piles are too large, oxygen cannot reach the center, and if the piles are too small they will not reach optimum temperatures. The ideal windrow size varies with the substrate and with seasons of the year. Windrows of autumn leaves can be constructed 6 to 8 feet tall and 12 to 18 feet wide at the base; these piles may be built to 8 to 10 feet tall in mid-winter months. Larger or smaller piles can create problems for leaf composting operations. Windrows of grass clippings with leaves may need to be smaller, often only 5 feet high and 10 feet wide (however, with a 3:1 minimum ratio of leaves to grass, reduction of the windrow pile size is probably not necessary).

Cumberland County owns two Scat-brand windrow turners that can handle piles up to 6-1/2 feet in height and 18 feet wide (the Scat has a 9-foot working face and turns half of the pile in each pass). Certain Cumberland County municipalities share the use of the Scat turners at their yard waste sites under an agreement with the County that outlines the shared operating and maintenance cost responsibilities. Annual use costs per municipality are very reasonable. For sites using the Scat turner, a windrow pile size of 6 feet high by 18 feet wide are optimal.

When constructing the windrow, care should be taken not to drive on or compact the material. The material should be allowed to cascade down from the bucket of a front-end loader to form a loose pile. Space permitting, windrows should be constructed in pairs for later combining of piles (if a Scat turner is used, a 7-foot clearance between piles is necessary for equipment passage).

- b. Turning. The main goals of turning the compost pile are to promote decomposition by moving material from the outside to the inside of the pile, and to “fluff” the material so it will be more porous, allowing air to move freely through the pile. Turning the piles increases the rate of decomposition by mixing of materials and exposing new surface areas.

Turning frequency should be based on temperature, since temperature reflects decomposition taking place in the pile. Whenever temperatures drop below 90°F or exceed 140°F, turning should be performed. If the compost is staying within the 90° to 140°F range by itself, turning can still help accelerate decomposition. Windrows may be turned within 1 to 2 weeks after initial windrow construction. Windrows composed entirely of leaves may only need turned a few times a year, and should be left alone during winter months, as severe cold weather may decrease the decomposition rate. Windrows which include grass clippings in the substrate will require more frequent turning to prevent odors caused by anaerobic conditions. However, if a 3:1 grass:leaves ratio is maintained, this should not be a major issue.

Should anaerobic conditions become apparent, turning the pile will temporarily add oxygen but will also create offensive odors. Before turning, try to identify the cause of the problem so remedial action can be taken as the pile is being turned. Common problems and recommended solutions are included the troubleshooting section of this handbook. Turning of piles during breezy days with preferred prevailing wind directions can help dissipate offensive odors safely.

Although several types of equipment are available for turning windrows, front-end loaders may be the only equipment necessary for smaller composting facilities. When turning the piles with a front-end loader, let the compost cascade out of the bucket so that the materials drop through the air to keep it as loose as possible. As in initial construction, when turning/reconstructing the piles care should be taken not to compact the material. As noted earlier, the County’s shared Scat windrow turner program provides an economical and convenient means of turning piles.

Windrows may only need to be turned 3-4 times between initial fall delivery

(pile construction) and the middle of the next summer.

- c. Curing. After a period of 8-10 months, decomposition in the windrows has slowed substantially. At this time, the material can be moved from the windrow composting area and stacked 10-12 feet high in curing piles (height limited by the capabilities of the site's front-end loader equipment). The material will slowly continue to stabilize. Further turning of the pile should not be necessary at this time, as long as the material stacked is stable due to proper windrow decomposition.
- d. Screening. Often, finished yard waste compost is used as a mulch, soil amendment or conditioner, without further processing. To improve product quality, a mechanical screen or shredder may be used to size-reduce and/or size-separate various grades of material. This can improve demand and potential end-uses of the material.
- e. Limitations. There are two potential limitations associated with the turned windrow system. These are odors and pathogens. Odors can periodically be a part of the composting process, even with appropriate operating procedures. Proper site and operations management will minimize odor occurrences. Pathogens are generally applicable to operations that involve the processing of wastewater sludges or residues from other animals, and should not be an issue in yard waste operations.

C. Health and Safety Precautions.

As with all processing operations, health and safety precautions must be taken to avoid injury or illness at a municipal yard waste composting facility. To avoid injury, care must be taken when heavy equipment is operating. This includes waste drop-off vehicles, front-end loaders, and any specialized mixing, shredding or aeration equipment. Proper safety apparatus may include eye, ear and head protection.

Possible illness due to the potential threat of microorganisms does exist, but depends on the type of waste being composted and on the worker's resistance to disease. Many different types of fungi, mold and bacteria thrive in compost, including municipal yard waste compost. Although few organisms of public health significance are found in yard wastes, it is important to take proper sanitary measures, such as washing hands before touching the face or food, etc. During dry and

dusty conditions, Occupational Health and Safety Administration (OSHA)-approved dust masks or respirators should be worn to minimize the risk of infection, especially during windrow turning activities.

Individuals sensitive to mold and fungi may experience allergic reactions when exposed to a composting environment. Exposure to large quantities of airborne endotoxins (noxious substances produced by certain bacteria) can produce flu-like symptoms in humans. Individuals who have allergies, asthma or a weakened immune system (due to cancer/cancer treatments, HIV, organ transplants, among others) should not work in the composting operation. In addition, some medications such as antibiotics and hormones, or a punctured eardrum, can predispose individuals to infection or an allergic reaction; these people should not work in the composting operation.

III. TROUBLESHOOTING

Understanding the basic concepts and limitations of the composting process will help operators run a successful operation. Frequent monitoring of the piles is important, as the pile characteristics are clues to the composting process. Pile characteristics can be used to identify problems within the process. Pile characteristics are included in the monitoring procedures section of this handbook.

Symptoms such as high or low temperature, odor, ponding, leachate discharge and others, are indications of problems. Commonly encountered problems, as well as possible causes and solutions, are included in the troubleshooting guide, included as Attachment No. 3 of this handbook.

IV. COMPOST USE

The key elements determining demand for finished compost are quality and consistency. Yard waste compost typically has a higher and more consistent quality than other types of compost. Yard waste compost is aesthetically pleasing; it has a dark color, relatively small and uniform size, an earthy odor, an absence of contaminants, and a desirable moisture and nutrient content and organic matter. Yard waste compost is easy and safe to handle. The primary users and common uses of yard waste compost are noted in the following table.

**TABLE 2
COMPOST USE**

Market Segment		Standard	Desired Compost
Sector	User	Application/Use	Quality
Residential	Home gardeners	Mulch and soil amendment	High
Commercial	Landscape contractors Sod/sodding services Nurseries Soil conditioner services/suppliers	Mulch and soil amendment	High
Public	Parks and recreational areas Landfills, quarries, strip mines Roadside and median strip maintenance	Soil amendment and top dressing; mulch	High for parks and recreational areas; Low for others

V. MONITORING PROCEDURES

The key elements for successful composting include moisture content, oxygen, temperature, pH and substrate. These environmental factors work together to provide the desired extent and rate of decomposition. Frequent monitoring of the compost piles is important, as the pile characteristics are clues to the composting process. Good record-keeping practices allow the operator to study the monitoring results and better address problems and concerns. Standard monitoring parameters and record-keeping requirements are summarized below. Sample forms which may be used for monitoring and record-keeping purposes are included in Attachment No. 4 of this handbook.

A. Monitoring Parameters.

At a minimum, the following parameters should be monitored:

- Moisture - Water is essential to the survival of microorganisms. Excessive moisture, however, inhibits the flow of oxygen and anaerobic conditions start to develop. The optimal moisture content for leaf composting should be between 40 and 60 percent; this is about the consistency of a wrung-out sponge...the leaves should feel damp but with only a drop or two of water expelled when tightly squeezed. Leaves very often require water at the start of the composting process. As a rule of thumb, dry leaves initially need about 20 gallons of water for every cubic yard of leaves.
- Temperature - As a key environmental factor affecting biological activity, the temperature should be monitored frequently; temperature readings should be taken at least two times per week along every 65 to 75 ft section of the pile. It is important to monitor temperatures and turn the compost when temperatures exceed 140°F to prevent problems. Turning the compost whenever temperatures get above or below the optimum range (90 - 140°F) will help produce a high quality compost in the shortest possible time. When the compost temperature drops below 70°F (21°C), the composting process is nearly complete.
- Appearance - Visual inspection of the windrows should be conducted. Items of concern include ponding water and leachate discharges; pile reconstruction or turning may be necessary. When turning the piles, look to see whether the moisture content of the material looks uniform, or if portions are too wet or too dry; watering and/or mixing/turning methods may need to be modified. Look to see whether the

decomposition looks uniform, or if portions look like they did when received while other portions look decomposed; again, watering and/or mixing/turning methods may need to be modified.

- pH - Decomposition takes place most efficiently under neutral pH conditions, so the pH of the material should be monitored periodically. It is common for the pH to be low (down to 5.0) during the early stages of decomposition; then the pH begins to rise to near neutral conditions. By keeping the pile in an aerobic state, via proper turning methods, leaf composting operations should not present a pH (acidic) problem. Testing for pH can be done on-site with a soil pH testing kit.
- Odor - Foul odors will develop under anaerobic conditions, and the rate of composting slows dramatically under anaerobic conditions. An adequate supply of oxygen is crucial to efficient composting. Should anaerobic conditions become apparent, turning the pile will temporarily add oxygen but will also intensify offensive odors. Before turning, try to identify the cause of the problem so remedial action can be taken as the pile is being turned. For instance, problems other than lack of oxygen may include windrows that are too large and failure to construct windrows soon enough (i.e., storing leaves).

B. Record-keeping.

Good record-keeping provides the operator of composting operations with readily available site-specific data. Such data can be used to better manage site operations and to address problems which may arise. Records should be kept for all windrows constructed. Information to be collected should include, but is not limited to, the following (also see Attachment No. 4 for sample forms which may be used for monitoring and record-keeping purposes):

Initial Data (to be recorded upon pile construction)

- type and quantity of materials used as substrate
- method of size reduction
- method of mixing
- amount of water added and method of watering
- date of windrow construction
- size and shape of windrow

Process Data (to be recorded periodically or during turning as recommended)

- temperature (3-6 foot long temperature probe)
- pH
- moisture content
- oxygen levels (if equipment is available)
- odor
- texture

ATTACHMENT NO. 1

GUIDELINES FOR YARD WASTE COMPOSTING FACILITIES

(PADEP Document No. 254-5403-100, dated April 30, 1997 is Attachment 1)

ATTACHMENT NO. 2

TURNUED WINDROW SYSTEM TECHNOLOGY

ATTACHMENT NO. 2 TURNED WINDROW SYSTEM TECHNOLOGY

This attachment summarizes the two key aspects of the turned windrow system technology, which are construction and turning, as applicable to a municipal leaf composting facility.

The key points of construction include the following:

- Construction should occur within one week, but preferably within one to two days of delivery of the yard wastes.
- If different types of wastes are to be composted together, they should be thoroughly mixed, using a front-end loader, Scat turner, or special equipment as necessary.
- Water must be added to reach the desired moisture content. Desire 50 % moisture content. Add approximately 20 gallons of water per each cubic yard of leaves.
- The recommended form for windrows of autumn leaves is 6-8 feet tall and 12-18 feet wide at the base. These piles can be built to 8-10 feet tall in mid-winter months. Smaller or larger piles can create problems. 6 foot high by 18 foot wide piles are optimal if a Scat turner is to be employed. There is no length limitation on windrow construction.
- Lift and drop the leaves/materials to be composted; don't push or run over the piles. Care must be taken not to compact the material.
- Space permitting, windrows should be constructed in pairs for later combining of piles. If a Scat turner is used, a 7-foot clearance between piles is necessary for equipment passage; a 3-foot clearance is preferred when using a front-end loader.
- Grass clippings must be incorporated into windrows of partially composted yard waste within 24 hours of delivery to the facility, at a ratio not to exceed one part grass to three parts yard waste. One leaf windrow may need to be dedicated to receiving and incorporating grass clippings. Placement of grass on top of the windrow and then mixing/turning the pile in is recommended. The minimum 3:1 leaf to grass ratio should be maintained.

The key points of turning include the following:

- Move material from the outside to the inside and “fluff” the material so it will be more porous.
- Per regulatory requirements, piles shall be turned and reconstructed at least once every three months.
- Turning frequency should be based on temperature. Turning should be performed whenever pile temperatures drop below 90°F or exceed 140°F.
- Windrows composed entirely of leaves may only need to be turned a few times a year, and should be left alone during winter months.
- Water can be added to the compost pile by hosing the windrow during turning or by turning on a rainy day.
- When turning, combining or reconstructing piles, keep the material as loose as possible. Care should be taken not to compact the material.
- Combine and stack stable composted material for final curing (should be stockpiled at designated area on-site).

The following pages illustrate six common steps at leaf composting sites utilizing turned windrow system technology.

ATTACHMENT NO. 3

**YARD WASTE COMPOSTING FACILITY
TROUBLESHOOTING GUIDE**

**ATTACHMENT NO. 3
YARD WASTE COMPOSTING FACILITY TROUBLESHOOTING GUIDE**

This attachment serves as a troubleshooting guide for the operation of a municipal yard waste composting facility. Commonly encountered problems, as well as possible causes and solutions, are included in this attachment.

Troubleshooting Guide		
Problem	Cause	Recommendation
Foul odor	Anaerobic conditions: Piles too large Piles too wet or excess grass Temperature too high Leaf compaction Surface ponding	Reduce windrow size...no wider than 16-18 ft, no taller than 6 ft. Turn or mix windrow; maybe add dry matter. Turn windrow. Turn windrow or reduce windrow size. Eliminate ponding.
Standing water / surface ponding	Ruts and holes Inadequate slope Improper construction	Regrade or reconstruct; use careful equipment operation. Regrade at recommended slope design. Align windrows to run downslope, not across.
Inadequate composting rate - with low windrow temp. - with high windrow temp.	Insufficient moisture Uneven distribution of air, moisture or nutrients Windrow too small (heat loss) Lack of nitrogen Windrow too large or dense (anaerobic conditions)	Add more water initially, or add water while turning. Consider size reduction methods; turn pile, adding water if necessary. Construct piles to min. of 6 ft tall or higher for cold seasons. Mix in a nitrogen source. Make piles smaller; turn to loosen compacted materials.

Troubleshooting Guide, continued		
Problem	Cause	Recommendation
Fires / dry piles	Temperature too high Not enough water Stray sparks / embers	Make piles smaller; turn to loosen compacted material. Add water and turn piles. Keep potential fire sources away from piles.
Surface water pollution	Leachate discharge	Configure windrows perpendicular to slope to eliminate surface water accumulation; treat leachate before it leaves the site by approved methods (such as conveying to catch basin or pass through filter area); practice stormwater management methods to divert surface water away from compost or curing piles.
Mosquitoes	Presence of stagnant water	Reconstruct piles to eliminate ponding.
Noise	Equipment operation	Avoid equipment that creates excessive noise; locate facility away from residential areas.
Dust	Turning operations	Avoid turning dry piles on windy days; use standard dust control methods; locate facility away from residential areas and downwind from sensitive areas.

ATTACHMENT NO. 4

**YARD WASTE COMPOSTING FACILITY
MONITORING PROCEDURES**

ATTACHMENT NO. 4
YARD WASTE COMPOSTING FACILITY MONITORING PROCEDURES

This attachment identifies the monitoring parameters recommended for proper operation and management of a municipal yard waste composting facility. The following forms may be used as examples of record-keeping procedures to track the data and characteristics of a yard waste composting operation. The forms include a delivery truck log sheet (one sheet for each yard waste collection truck), a delivery summary reporting sheet (for converting volumes to tonnages of yard wastes delivered to a composting facility, and for reporting totals to Cumberland County), and a compost pile monitoring form (containing pile-building data and process operations information - one sheet for each compost windrow). Good record-keeping is important in correcting problems that may arise with windrow operations, and provides a basis for adjusting operating procedures and planning future operations.

MUNICIPAL YARD WASTE COLLECTION TRUCK LOG SHEET

Municipality: _____

Type of Collection Vehicle: _____

Truck Number: _____

Truck Bed Capacity (cy or dimensions): _____

Driver: _____

Location Delivered to: _____

Trip No.	Date and Time of Delivery	Full or Partial Load (% Full)	Estimated Cubic Yards Delivered	Type of Yard Waste/Comments
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				

MUNICIPAL YARD WASTE COMPOST MONITORING FORM

Pile Identification/Designation: _____

Size and Shape of Windrow: _____

Date of Construction: _____

Length _____

General Weather Conditions: _____

Width _____

Shape _____

Watering Details:

Amount of water added: _____

Method of watering: _____

Details of Pile Construction:

Type of Material(s)	Quantity	Method of Size Reduction (if any)	Method of Mixing

Operation/Process Data:

Date	Pile Characteristics					
	Temp.	Moisture Content	Oxygen Level	pH	Odor	Texture

Pile Activity:

Date	Reason for Activity, routine or other (describe)	Description of Action(s) Taken (include method if applicable)

Comments: _____

MUNICIPAL YARD WASTE DELIVERY SUMMARY REPORT

Municipality: _____
 Delivery Location: _____

Load(s)	Date	Type of Yard Waste	Total Cubic Yards	Total Tons **
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

TOTAL TONS COLLECTED = _____ (Please use the following information to convert cubic yards to tons:)

Cubic yards collected x typical density (from below) x $\frac{1 \text{ ton}}{2,000 \text{ lbs.}}$ = tons collected

TYPICAL DENSITY OF YARD WASTE		
Material	Condition	Typical Density(lbs/cubic yard)
Leaves (uncomposted)	loose (dry)	200-260
Leaves (uncomposted)	vacuumed/shredded (dry)	250-350
Leaves (uncomposted)	vacuumed/shredded (moist)	350-450
Leaves (uncomposted)	compacted (dry)	300-400
Leaves (uncomposted)	compacted (moist)	450-630
Leaves and Brush (mixed)	dry, co-collected	100-300
Grass Clippings (uncomposted)	loose	300-450
Grass Clippings	compacted	500-1500
Yard waste (mixed)	as collected	350-950
Yard waste (mixed)	shredded	450-600
Compost	finished	500-1,200
Wood Chips/Ground Mulch		500-625

Source: Municipal Yard Waste Composting Reference Manual, PADER, 1991, and Converting to the Standard Recycling Rates, USEPA, 1996.