PROGRAM
FOR HANDLING
YARD WASTE
IN WEST VIRGINIA

GASTON CAPERTON, GOVERNOR

DEPARTMENT OF COMMERCE
LABOR, AND ENVIRONMENTAL
RESOURCES

Prepared by:
THE SOLID WASTE MANAGEMENT BOARD

WEST VIRGINIA
YARD WASTE PROGRAM

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Editor's Note: The ban on landfilling yard waste was extended to <u>January 1, 1997</u>, by the Legislature.

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SECTION 1 INTRODUCTION

Composting of yard waste is an attractive disposal option for many communities who wish to recycle plant nutrients, save landfill space and comply with West Virginia laws prohibiting yard waste disposal in sanitary landfills. Composting can be a low-effort, cost-effective and environmentally sound method to reuse a community's yard waste. Landfill space is conserved, disposal costs reduced and a useful end product is produced with composting. Composting is a controlled process requiring advanced planning and ongoing management. Key decision areas regarding yard waste collection, processing and compost end use will be addressed in this program. Table 1 summarizes the projected time schedule needed for implementing yard waste composting projects.

Yard waste, which traditionally includes grass clippings, leaves and light brush, can easily be composted in the back yard or in centralized composting operations. A waste quantification and characterization study conducted for the West Virginia Solid Waste Management Board (SWMB) indicates that yard waste makes up about 6% of the waste stream (Source: Preliminary Feasibility Study of Alternative Project Concepts for Processing and Materials Recovery of Solid Wastes Generated Within Waste Shed "H", William F. Cosulich Associates, LTD., 1991). It should be noted, however, that this survey was conducted in November 1990. U.S. Environmental Protection Agency

(USEPA) estimates that approximately 19% of the waste stream is yard waste. This indicates composting may reduce the volume of waste going into landfills in West Virginia. If one includes other organic waste (paper, food waste, and other wood waste) the volume of material which can be composted jumps to over fifty percent of the waste stream.

A number of small-scale, low-technology composting operations are currently in operation in various parts of West Virginia. These are primarily windrow operations which use chippers and end loaders as their sole equipment. Many of these operations were originally designed to avoid the tipping fees involved in the disposal of Christmas trees. The final product, mulch or compost, is often given away. Citizens take the shredded material for mulch before it can decompose into humus.

1.1 The Major Components of a Yard Waste Program

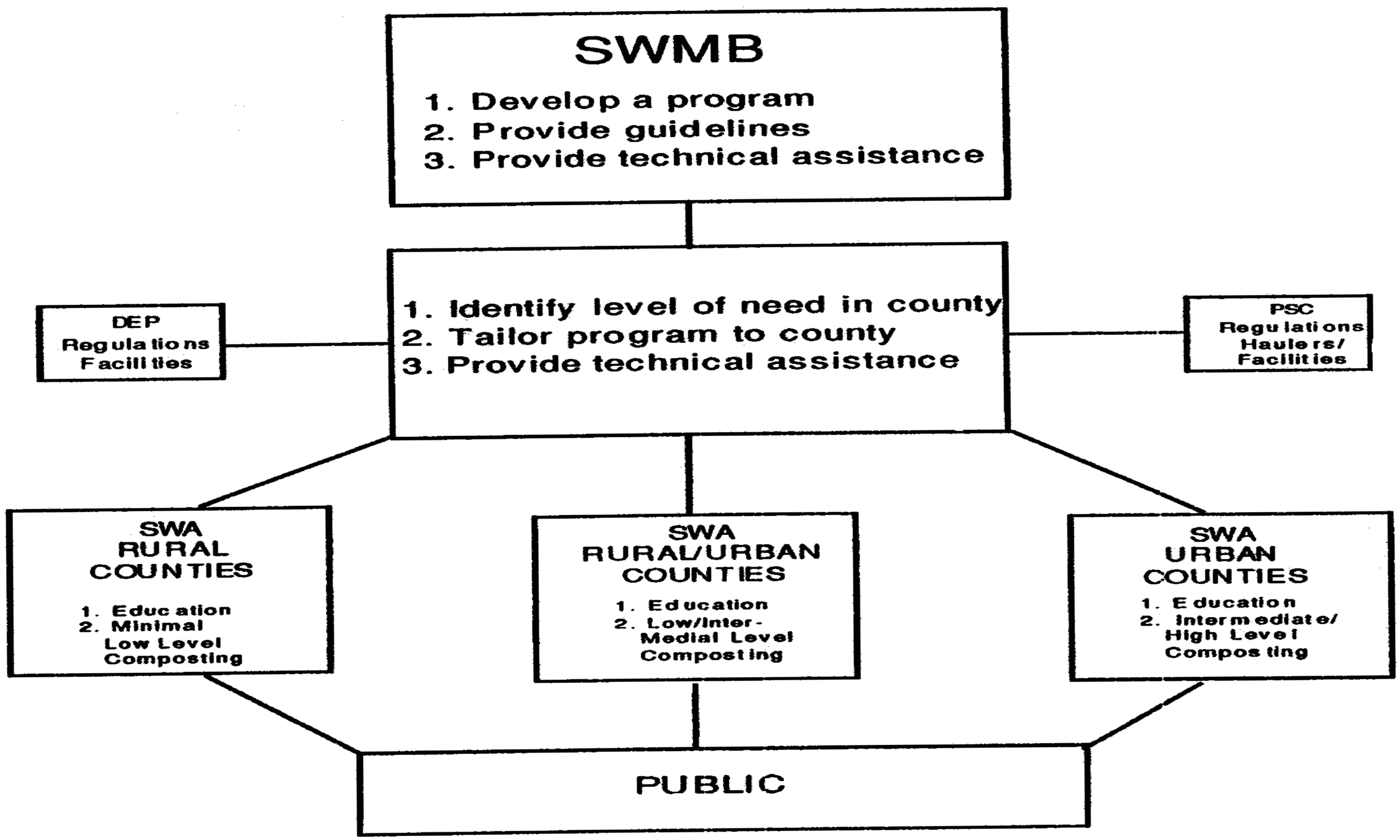
The major components of a yard waste program include:

1. Determining the volume of yard waste
2. Collection methods
3. Evaluating different composting methods
4. Choosing a site
5. Determining end uses for composting
6. Securing regulatory approvals and permits
7. Alerting and educating residents
8. Developing a protocol for monitoring the composting operation
9. Evaluating costs and benefits
10. Health and safety considerations

The major components of a yard waste program are depicted graphically in Figure 1.

SWMB Figure 1

SWMB YARD WASTE PROGRAM



SWMB Table 1:

PROJECTED TIME LINE MILESTONES FOR IMPLEMENTING YARD WASTE COMPOST

TASK	SEASON FALL	WINTER	SPRING	SUMMER	FALL
Determine yard waste volume	←	→			
Identify site end use and composting method	←	—	→		
Determine personnel equipment needs	←	→			
Budget	←	—	→		
Design and permits (if necessary)		←	→		
Construct site			←	→	
Train personnel			←	→	
Begin operations				←	→

SECTION 2   DETERMINING THE VOLUME OF YARD WASTE

Estimating the volume of yard waste is necessary to determine the size and type of operation as well as to compute the amount of finished compost that may be available.

One way to measure yard waste volumes is to monitor the spring and fall collection periods by measuring truck loads collected. The volume of yard waste managed at a composing site will vary with the size of the area serviced, the method of collection and the convenience of the collection site to residents and haulers. The density of yard waste varies significantly but averages about 350 pounds per cubic yard when collected.

Although municipal waste generation is typically estimated on a per capita basis, the relationship between population and generation rates for yard wastes varies widely according to community characteristics such as population density, number of trees, annual rain fall and average lawn size.

The more rural areas of the State will have little yard waste to go to a composting facility. Most yard waste will be disposed of by being left on the lawn or left on an area of the property. In the urban areas, such as those in Wasteshed H, collection will become more significant and the class of composting needed will be greater.

The types and amount of yard waste generated varies significantly throughout the year. Leaves account for most of the yard wastes generated from October through November, with about a six-week collection period. Grass clippings, shrub prunings, trees and garden wastes predominated from April through October for approximately 26 weeks.

Although an estimation of yard wastes is necessary to determine what type of site is necessary, the only accurate generation rates will come from recording the amounts that are actually collected and/or delivered to the composting site during the first years of operation.

SECTION 3 YARD WASTE COLLECTION

Yard waste collection involves municipal and private haulers and independent hauling by residents and groundskeepers. The best method of yard waste collection is actually no collection. Residents are encouraged to leave grass clippings on their yard. Education will be necessary for proper care of the lawn with mulching mowers or blades.

3.1 Methods of Collection

Decision makers for cities or counties providing for yard waste collection must make a series of choices about collection techniques and equipment. Cities and counties that provide for a collection system for solid waste may want to also provide one for yard waste not composted by the resident.

There are three basic methods of collecting yard waste for composting:

1. A drop-off system at the landfill or transfer station
2. Curbside collection in bags
3. Bulk collection in which yard waste is scooped, shredded, raked, swept or vacuumed directly off the streets and along rights of way.

The best combination of collection techniques and equipment choices for a county or municipality is the one which most efficiently provides the compost required by the end user. Yard waste can be collected bagged or unbagged. Bagged yard waste typically has little extraneous material and can be collected quickly with a standard compactor truck. However, labor is required at the composting site to remove the yard waste from the bags, and there may be a need to dispose of the bags afterward. Unbagged yard waste can be collected with a vacuum truck or a front loader. This process is more time-consuming and the amount of extraneous material is likely to be higher than when yard waste is bagged. A vacuum recovery works well on dry yard waste; the front loader is more efficient for wet and frozen yard waste material.

Woody materials such as trimmings and branches need to be separated from leaves and grass for size reduction shredding prior to being added to the compost pile. The presence of large chips in compost may limit its potential end use. Therefore, screening is necessary.

A section of the composting site should be set aside for garbage to be placed in a roll-off box to be hauled to the landfill.

In designing a collection system, the following should be considered:

1. Capital, operating and maintenance costs of equipment
2. Availability and cost of labor
3. Convenience for residents and businesses
4. Cost of bags
5. Existing equipment
6. Effectiveness in excluding extraneous material
7. Susceptibility to adverse weather
8. Hazards associated with placing yard waste at curb or in street
9. Potential noise and dust from collection equipment
10. Training of workers - worker safety

3.2 Drop-off Sites

Drop-off sites will be used to a greater extent if they are well-advertised. Leaflets or newspaper ads with a map and the hours the site is open will enhance public awareness of the new program. Residents of small communities may also be encouraged to empty their own yard waste, saving the bags for reuse.

3.3 Collection Schedules

New collection methods and schedules will run more smoothly if residents are well-informed and schedules are uniformly adhered to. Newspaper articles, television and radio spots, and neighborhood promotion prior to collection days will increase the level of compliance. If special bags must be purchased for yard wastes, this fact should be advertised along with the purchase locations.

SECTION 4 COMPOST METHODS

4.1 Composting as a Waste Management Alternative

Composting has been used as a means of converting organic wastes into a useful material for thousands of years. Composting was originally done to generate a beneficial soil amendment without an emphasis on waste management. However, during the last thirty years it has been recognized that composting can serve as a means of recycling many types of wastes.

The initial emphasis on the use of composting technologies as a waste management alternative was focused primarily on sewage sludge. During the 1960's and 1970's, a great deal of research was conducted on technologies applied to yard waste composting.

Since the early sludge composting research, almost all types of organic waste have been evaluated for their suitability for composting. Animal, food processing, pharmaceutical, petroleum, pulping, textile and other wastes have all been composted with some degree of success. In addition, efforts have been made to compost organic portions of municipal solid waste. Although, some MSW composting facilities are operational, the inability to remove glass, plastic and some metal has limited the applicability of this technology. Compost produced from MSW often contains small pieces of glass and metal that prevent it from being distributed and used. It appears that improved segregation of MSW before collection or at a centralized post collection site will be necessary before MSW composting can become a standard practice.

Some yard waste composting has occurred for many years. However, the current focus began in the mid 1980's with work conducted by Strom and Finstein (1986) at Rutgers University. During the last six years, efforts have been made to adapt composting technologies to best handle yard waste. This work will be discussed in more detail later in this program.

4.2 The Composting Process

Composting is an oxygen demanding process of controlled decomposition of organic materials. The controlled process is very similar to natural leaf decomposition but occurs at an accelerated rate. When leaves first fall, they remain on the surface for extended periods but slowly begin to decompost due to fungal and bacterial activity. Because the temperatures of natural leaf decomposition aren't high, some of the survivors are harmful plant pathogens. Controlled composting produces temperatures that kill and pasteurize, thus removing over-wintering harmful fungi and bacteria. The technologies used to control the environmental factors will be discussed in more detail later.

4.3 Backyard Composting

Backyard composting is the first logical step in reducing the amount of organic wastes going into our landfills. Processing yard wastes at the point of generation not only has a positive environmental impact, but the costs of collecting, transporting, processing and marketing by the municipality can all be reduced if home composting is encouraged.

Many people, especially organic gardeners, have been engaged in composting for many years as a way to improve their soil. The addition of organic matter rich compost has many beneficial effects for the soil, including:

1. increasing the water-holding capacity and reducing the chance of erosion
2. improving soil tilth, making it easier to cultivate
3. preventing soil crusting and aiding in seeding emergence
4. providing a food source for desirable soil micro-organisms and earthworms from the added organic matter
5. increasing the fertilizer-holding ability of the soil by increasing the cation exchange capacity (CEC)
6. providing some nutrients for plant growth

Overall, compost improves the physical, chemical, and biological properties of soils. Compost is not considered a primary fertilizer source because it is low in nutrient content, but it is an excellent soil conditioner.

Municipalities should encourage backyard composting as a part of their overall yard waste management program. Participation in backyard composting will depend in part on the public's understanding of the cost and problems associated with landfilling or otherwise disposing of yard wastes. Seattle, Washington, for example, has a program where they train "master composters" who in turn give demonstrations and advice on backyard composting to other people.

There may be local ordinances is some areas that discourage or prohibit backyard composting. While it is true that not all backyard composting operations are an asset to the neighborhood or the environment, if properly constructed and maintained, a compost bin need not produce objectionable odors or attract unwanted animals.

Efforts should be made to increase backyard composting. Not only are savings made in landfill space but the cost of collecting and transporting the materials is reduced. The potential savings are so great that even modest increases in backyard composting would justify a substantial public education effort. Individuals interested in backyard composting need to contact their local county extension agents, since the cooperative extension service has composting manuals and trained personnel.

Recently more manufacturers of yard equipment have begun to market “mulching” mowers. These mowers allow grass clippings to return to the soil of the owner’s yard. The price of these mowers is relatively higher when compared to traditional mowers; but as more competition develops, the price should begin to drop. One can also retrofit mulching blades on old mowers.

In West Virginia’s rural areas, yard waste is less likely to be sent to a landfill when compared with more urban areas of West Virginia. Municipalities in West Virginia that are mandated to develop recycling plans could have the handling of yard waste as part of their plan.

As more landfills close in West Virginia due to legislative changes, regulations, liner requirements, and overall costs, these sites may be developed into composting facilities. These closed landfills may have some of the facilities already in place that could be used in a composting operation.

4.4 Yard Waste Composting Technologies

For any compostable material, there are several technologies available for composting. The most appropriate technology depends upon a combination of the following factors: the material, available land area, nuisance potential, equipment availability, available resources, potential environmental harm and regulatory requirements. Strom and Finstein (1986), researchers on the use of composting, classified yard waste composting procedures into four levels of technology based on equipment and resource requirements, composting time, land area requirement and quality of the finished product. Municipalities and/or SWAs could cost-share and cooperatively use equipment supported by funded proposals to the SWMB or other sources. These four levels are discussed below.

4.4.1 Minimal Technology

Generally, minimal technology is best suited to a locality with a large site, isolated from heavily populated areas. At least one acre of storage/process space is recommended for every 5,000 cubic yards of yard waste (Strom and Finstein, 1986). This does not include any buffer zone, the size of which will vary for each site dependent upon location, terrain and regulatory requirements. The yard waste brought to the site is immediately formed into large windrows, (e.g. 12 ft. by 24 ft. wide) using a front-end loader. Though it is not essential, the yard waste may be wetted while the windrows are formed. Wetting may be necessary only in dry seasons, since the large piles will conserve moisture and will be exposed to precipitation. If formed, the piles are turned only once a year for reforming and mixing. It takes 3 years or more to get a finished product.

A serious limitation for this system is that the pile interior becomes anaerobic in a short period of time and will only receive a new supply of oxygen each time the pile is turned. Meanwhile, the pile exterior may dry and become moldy. The center of the pile may also reach high temperatures (>140 F, 60 C) especially during the first year. Also, unpleasant odors will be produced in this anaerobic environment, and will be released into the air even without turning the pile. At one apparently isolated site in New Jersey, ten odor complaints were filed during the first eight months of 1989. A quarter of a mile or more between composting windrows and neighboring residential uses is recommended as a minimum buffer zone. Besides the odor problem, the surface mold flora may contain aspergillus fungi that can cause human pneumonitis.

The main advantage to this system is that it is relatively inexpensive, requiring little equipment and labor. A front-end loader is only needed to form the initial windrows and to do the yearly turning. Screening and grinding of the finished product is required if the compost is to be sold or given to the public. If, however, it were to be incorporated into farm land, screening would be optional to remove large pieces of trash and plastic bags.

The major disadvantages are the odors produced, the length of time required to get a final product, the large land area required, the low quality of the finished product and, last but not least, a worker health problem. Minimal technology is only appropriate for small volume facilities with large land areas where end product use is not a major concern. Minimal technology facilities are not likely to be acceptable for use by many West Virginia localities.

4.4.2 Low-Level Technology

The low-level technology system, in which moisture content, oxygenation, and temperature are all monitored and controlled, will increase composting rate with minimal additional capital investment and generate a more usable end product.

To obtain the 50% moisture content necessary for optimum decomposition, the yard waste may need to be sprayed with water prior to or as the windrows are being formed. Spraying the piles after formation leads to the water running off with little penetrating to the inside of the pile. A rule of thumb for checking for proper moisture level is that it should be possible to squeeze a few drops of water out of a handful of yard waste. About fifty gallons of water will need to be added per cubic yard of dry collected leaves with that amount reduced as the amount of grass clippings added increases.

The size of the windrows has a direct effect on the amount of oxygen that gets into the windrows, which in turn affects the temperature and the microbial activity inside the piles. The windrows should be large enough to conserve heat and moisture and minimize area requirements but not so large as to create anaerobic conditions or increase the temperature above the optimum for microbial growth. No single size pile can meet these seemingly conflicting demands. One possible solution is to start with two moderately sized piles, stacked close to each other, and combine them after one month. Researchers in New Jersey recommend the piles be 6 feet high by 12 to 14 feet wide, but this size may need to be increased in colder areas of the state to maintain internal temperatures. This will allow the first burst of microbial activity to occur heating up the piles and significantly decreasing their size. The act of combining the windrows will then re-aerate the piles and maintain adequate pile size to keep temperatures optimum allowing microbial activity to continue.

The windrows may be left as is over the winter; but as early as possible in the spring, they should be turned. Again, as with the minimal-level technology, this may be done with a front-end loader. Efforts should be made to turn the piles "inside-out", thoroughly mixing them, which will re-oxygenate the interior, and expose the cooler outer edges to the warmer internal temperatures. At this turning, odors may be detected because the pile has been anaerobic for an extended period. Care must be taken to turn the pile at a time of day when odor complaints are least likely. Also, wind direction must be considered. If the piles are dry, water should be added at this time to maintain the 50% optimal level. Additional turnings during the summer are useful to increase the decomposition rate; but with this level of technology, they are optional. Unless the piles are turned once per month or more frequently, the compost will not be stabilized by the time the next leaf season begins, (a finished product can be expected in 16-18 months) and room will need to be made for the incoming leaves.

The best managed low technology sites use temperature probes and turn the piles whenever internal temperatures exceed about 140 F. This may result in weekly turning during the first several weeks particularly if the piles contain a mixture of leaves and grass clippings. However, if the piles are turned more frequently based on internal temperature, composting time can be reduced to six to twelve months and the end product is usually higher quality.

After composting, the material may be moved to a curing area around the perimeter of the site where it will continue to slowly decompose. This curing pile may be as large as needed to conserve space. At this point, the material's oxygen demands are low and production of odors is unlikely. Again, grinding and screening of the finished material is optional, but is recommended to improve the appearance of the product. Screening can also help to break up large pieces and remove any unwanted materials such as branches, rocks, plastic, cans, etc. This step is fairly labor intensive and requires the purchase of additional equipment. One way to reduce costs is to share a shredder/screener between neighboring operations.

Low level technology requires less total land area and produces finished compost in a shorter time than minimal technology. The finished compost is of moderately high quality for use after grinding and shredding. The primary disadvantages are increased labor and equipment use and the fact that more than one year may be required to complete composting. Low level technology in which the materials are monitored and frequently turned so as to achieve composting in less than one year, may provide the most appropriate technology for many small and medium size composting facilities. These size facilities would be needed in West Virginia.

4.4.3 Intermediate-Level Technology

This next level of technology requires the purchase of specialized equipment but can produce a finished compost in less than 6 months. For this technology, a mechanical windrower is used to turn the piles. The size of the windrows is restricted by the height and width of the windrow-turning machines which is usually not greater than 8 feet high by 12 to 18 feet wide. There are several types of windrowers available: some straddle the windrow, while others turn half of the windrow during each pass. (These will be discussed in more detail in the appendix on equipment). These machines vary widely in their cost, capabilities and flexibilities. Some can be attached to the PTO of a farm tractor or a front-end loader while others are self powered units.

The use of these machines offers several advantages. The time required to produce a finished product is greatly reduced. The machine mixes, aerates and grinds the yard waste all in one step which can eliminate the need to grind or shred the compost as a final step.

As the yard waste is brought to the composting area, it is wetted if necessary and turned and mixed while being formed into windrows by the machine. Additional high nitrogen wastes can be added during the windrow formation to increase the rate of composting (if leaves only are being composted.) During the first few weeks, the windrows may be turned several times a week, then once per week, or once every two weeks. The need for turning should be monitored either by measurement of temperature (or oxygen concentration) within the pile. As the temperature reaches 140-150 degrees F, the pile in

the composting process.

This technology offers several advantages. The total area required is less than with the previous technologies. The windrows can be formed close together because the

This technology offers several advantages. The total area required is less than with the previous technologies. The windrows can be formed close together because the windrower actually requires less turnaround space than a front-end loader. Also, as stated above, the machine will mix, aerate and grind the leaves as it moves along the piles eliminating any additional grinding. Screening the finished compost is still necessary. The finished product is a very high quality material that is ready for use or marketing after curing.

This technology is the best available for composting leaves, leaf/grass, or leaf/manure mixes. Due to the cost of mechanical windrowers, it is probably only practical for medium to large compost facilities. Because of the shorter composting period, the alleviation of grinding and the high quality end product, it may be desirable for several localities to share a windrower or for a private sector firm to provide windrowing service to multiple localities. The disadvantage is the cost of the windrower. However, the savings in time, land area required, and the elimination of the grinding step will help offset this cost. This is probably the most appropriate technology for medium and large facilities.

4.4.4 High-Level Technology

This last level of technology is probably not practical for most communities. It was originally used in composting sewage sludge but has been adapted for yard wastes.

This method consists of using a system of pipes under the piles to run forced air through the piles with a blower controlled by a temperature feedback system. When the temperature inside the pile reaches a preset level, the blower automatically comes on to cool the pile and assure aerated conditions. During the initial start-up period, the blowers would come on frequently under control of a thermocouple. After 2 to 10 weeks, the aeration system would be removed and the piles turned periodically.

Obviously, this type of system is much more expensive to operate, but its advantages include the formation of large windrows to save space and the most rapid composting rate. Anaerobic conditions do not develop in these large piles due to the forced air. Composting can be completed within several months due to the rapid initial decomposition. Additional high nitrogen wastes, such as manures, could be added to the piles easily at this level of technology to speed up decomposition and raise the nitrogen content of the finished product.

4.5 Personnel

4.5.1 Requirements

The number of personnel needed for a compost operation depends upon the method of collection. In curbside collection, the frequency of pickup and total curb miles will determine personnel requirements. At the composting facility, personnel are needed to: monitor yard waste deliveries; supervise the compost operation; run the composting operation; maintain records; and transport finished compost. During the fall leaf collection period, continuous staffing is usually necessary. However, full time monitoring is not required in other seasons at sites which only compost leaves.

Additional personnel will be needed for some types of operations. If there is a public drop-off site, more employees will be needed to run the facility on a busy spring or autumn weekend than on a quiet weekday. If nondegradable plastic bags are used, they must be opened soon after delivery. Manual debagging requires considerable labor (typically over an hour for each ton of leaves). During fall leaf collection, seasonal labor may be needed to assist in raking leaves and loading trucks, and a mechanic should be dedicated to vehicle maintenance to ensure that vehicles are operating at all times. It may be possible to borrow personnel from other local and/or county departments such as public works, highway maintenance or parks and recreation to assist with these labor intensive activities.

4.5.2 Development of Operator Training Certification Program

In order to properly, safely and efficiently compost yard waste, it will be necessary to provide a training program for operators of such facilities. This training program should consist of but not be limited to:

1. A classroom training program of equipment operation and maintenance
2. Composting science
3. Completion of a facility design project
4. Composting quality control
5. Record keeping/business math
6. Worker safety

The classroom training program should include technical and detailed instruction on composting technology, site planning, operations planning and identification of factors required to successfully establish a yard waste composting business.

SECTION 5 CHOOSING A SITE

Each solid waste authority (SWA) siting plan defines which areas are authorized for composting facilities. Proper siting is a prerequisite to the establishment of a safe and effective yard waste composting facility. Design requirements, and to some extent operations, are influenced by site conditions. A suitable site controls design and construction costs and operational problems over the life of the facility.

The three primary considerations for site selection:

1. Area - The site must be large enough to contain a composting facility with the capacity to easily process projected volumes of yard waste, and to

provide room for storage of the finished compost.

2. Protection of surface and groundwater - Site should be evaluated for its potential impact on waters of the state. Of primary concern are proximity to wetlands, floodplains and surface waters and the depth of groundwater.

3. Relationship between site and surrounding land uses - Site should be adequately buffered from sensitive adjacent land uses such as residences, schools, and parks.

5.1 Site Area Requirement

The required space needed for the active composting site depends on the degree of technology used to compost. Basically, the lower the level of technology, the lower the cost. A minimum of one acre of land for every 5,000 cubic yards of yard waste should be used for planning for facilities which compost only yard waste. The amount of land needed for land application of yard waste varies according to the amount of material applied.

5.1.1 Location

Attention should be given to the impact of traffic on neighborhoods along the major delivery routes and just how centrally located the site is. Distance traveled to the site by residents and/or haulers may affect the cost or the participation rate. A site which requires delivery routes through densely populated areas would receive the lowest rating. A site which is centrally located in a sparsely populated area would rate high.

5.1.2 Zoning

The compost operation should be in compliance with local zoning laws and compatible with adjacent land use such as commercial, industrial or agricultural sections. If local zoning ordinances do not allow composting in a proposed location, the alternative is to ask for a variance or find a new location.

5.1.3 Topography

The site selected should be somewhat flat with a one to three percent slope(an open field with a wooded buffer would be ideal) and remote from residential areas. The site should not be located on wetland or flood plains or on land with a high water table.

5.1.4 Buffer Zone

A buffer zone between the site activities and neighboring areas will minimize possible odor, noise, dust and visual impacts. At least 100 feet should be provided between the yard waste composting operation and any existing habitable buildings.

5.1.5 Water Source

Yard waste composting projects normally require only natural rainfall to support the degradation process. Drainage can become a problem if precipitation is excessive. For large operations, on-site water is a necessity. Approximately 20 gallons of water are required for each cubic yard of very dry yard waste. Experience has shown that watering yard waste before windrow formation or during a turning event will be more efficient. Therefore less water will be required because recently windrowed yard taste tends to shed water applied from above. Water is needed when moisture content within the pile falls below 40 percent (by weight). Water can be applied manually through a hose or from a water truck, or by a sprinkler or seep watering system, which could operate without the need of an on-site attendant. Facilities also need a source of water for fire protection which could include water trucks, fire hydrants and fire ponds.

5.1.6 Groundwater/Bedrock

The distance to groundwater and/or bedrock is important. Enough soil should exist between the surface and subsurface waters or bedrock to insure runoff is adequately diverted and mitigated during heavy precipitation rather than becoming an environmental concern. In order to prevent soaking the compost piles, the situation of a high water table or shallow depth to bedrock must be avoided as this can increase the likelihood of standing surface water during heavy precipitation. General draining information can be obtained from U.S. Geological Survey topographical maps, and soil water table information is available from the County Soil Conservation District.

5.1.7 Wetland and Stream Encroachment

A composting facility can not be established in a flood plain as the windrows may impede water flow and/or waters could wash into the stream during times of high water. Flooding of the site could pose serious operational difficulties with equipment access and operation. Flooding of the windrows could lead to extensive anaerobic conditions which would cause odor and slowed decomposition rate. To allow runoff to move between, rather than through, windrows, they should run up and down rather than across slopes.

5.1.8 Soil Considerations

Moderate soil percolation is needed for an ideal composting site so that ponding will not be a problem. Although an impervious surface such as a paved site offers advantages in terms of vehicle access, equipment operation, and groundwater protection, these advantages must be weighted against the loss of direct contact between composting materials and soil microorganisms, as well as the difficulties in managing runoff.

5.1.9 Ownership

Composting facilities can be placed on land currently owned by a unit of government or private leasing parties. If the land is leased with a private landowner, the lease should clearly specify operations intended to occur on the property. It is also possible to have a private group operate a composting facility on government owned property. In such cases, cover the operation with an umbrella insurance policy or be certain the private individual operating the facility has proper liability insurance protecting the individual and the unit of government in the event of a liability claim.

SECTION 6 QUALITY AND SITE CONTROLS

Quality control is necessary to avoid negative impacts on the environment. Quality control reduces the likelihood for nuisance conditions that may adversely affect residents of the community.

Proper public education is the first consideration of a quality control program. By informing citizens of what type of organic waste will be accepted at the composting site, as well as how the materials should be separated and collected, a minimal amount of noncompostable materials will be incorporated into the windrows. Regardless of the public's efforts to minimize noncompostables in the collection system, all incoming wastes should be carefully monitored to control the dumping of inappropriate waste.

Those noncompostables that do enter the composting piles tend to "float" to the top of the pile as the volume of organic matter decreases due to the decomposition process. These noncompostables can be removed during the turning and curing of pile formations. Finally, a screening step can be employed to remove objects missed from previous procedures. Quality control monitoring should continue throughout the entire composting process.

6.1 Green Wastes

To avoid odors, green wastes such as grass and garden wastes should not be composted alone nor stored for long periods of time before incorporation into existing windrows. Because grass clippings are high in nitrogen and moisture, when added to an existing pile, these green wastes enhance the composting conditions and increase the rate of degradation. Grass clippings (and yard waste) arriving in degradable bags may be left in the bags; however, the degradable bags should be opened by some means before composting.

6.2 Quality of the End Product

Contaminants are not likely to be present in yard waste composts. An analysis of the total concentration of heavy metals in the overall solid waste compost should be required.

6.3 Site Control

Safety precautions standard to any operation using heavy machinery should be exercised. Heavy equipment can crush fellow workers, shredders can send rocks flying, broken bottles can cut hands, belts or chains can catch loose clothing, inhaled dust can cause breathing disorders, and a simple injury may be fatal if an operator is working alone. Simple precautions including hard hats, steel-toed shoes, gloves, OSHA approved goggles and dust masks will prevent health hazards from becoming worker safety problems.

Also, access control should be designed with safety in mind. Public access should be restricted (if a drop-off site is provided, make certain the area is secure) and adequate liability insurance should be maintained.

6.4 Record Keeping

The importance of keeping records cannot be over-emphasized. Operators should keep a log to track the volume, weight and origin of incoming yard waste. This data will be useful for:

- developing estimates on the amount of compost that will be produced
- determining the adequacy of the site for handling projected levels of yard waste
- isolating the origin of contamination problems, and
- developing a cost/benefit analysis.

In addition, records of any problems and the steps taken to mitigate the problems may be valuable in resolving negative public relations.

Further record keeping includes temperature monitoring and ambient weather conditions. The purpose of this monitoring indicates the composting methods change of temperature over time, as well as provides an indication when turning the pile will be needed. Graphic representations of internal pile conditions to external conditions will also demonstrate how effective operating procedures maintain optimum biological activity. Records of analysis of the quality of finished solid waste compost should be developed and made available to prospective end-use markets.

6.5 Contingency Plan

Operators must develop alternate plans for managing yard waste and municipal solid waste (MSW) composting operations, in the event that the compost operation is disrupted by natural disaster, fiscal problems, staffing shortages or equipment failure. A permitted solid waste processing or disposal facility should be available as a backup measure. If the composting facility is inoperable for a longer period than the site storage capacity will allow, no additional yard or municipal solid wastes should be accepted.

SECTION 7 ROLE OF THE PRIVATE SECTOR IN YARD WASTE COMPOSTING

As landfill costs rise all over the country, municipalities in search of ways of reducing waste management costs are looking towards composting yard waste. To date, several states, including West Virginia as of June 1, 1994, have banned leaves and/or grass clippings from going to landfills. As the movement toward utilization of yard waste grows, the management methods are also changing. While some municipalities have the land, equipment and expertise to convert to a composting system, many do not. Increasingly, the private sector is seeing an opportunity to provide municipalities with yard waste processing services. Nursery and landscape businesses are a natural market for compost as much of the finished product could be used “in house” for potting soil mixes, field nursery crops, mulches and soil amendments for bedding plants and lawn establishment/renovation. Others in the private sector who may be interested in managing compost operations would be farmers, who probably already have the land available and some type of equipment. Farmers are accepting land clearing debris to be composted, and the finished product utilized on the farm for a soil additive.

Waste management companies are another area of the private sector who are becoming involved in yard waste composting. Solid waste collectors view yard waste processing as a means of reducing their tipping fees or as a way of expanding their services. Private companies that provide management services to municipalities with yard waste composting facilities are becoming more popular.

SECTION 8 MARKETS AND USES FOR YARD WASTE

One of the first considerations in planning a compost program is to determine local end uses for the compost. Adequate information on the potential users' requirements for quality and quantity is a mandatory prerequisite for defining the composting method, equipment and operations necessary to produce a compost meeting the user's demands.

8.1 User Types

There are four categories of compost users: commercial, residential, public agencies and land reclamation.

SWMB Table 2: Compost Users

Commercial	Public Agencies
Landscape Contractors	Park Maintenance
Nurseries	Decorative Painting
Greenhouse	Curb Repair
Turf Farms	Backfilling
Topsoil Suppliers	Community Gardens
Soil Blenders	
Golf Courses	
Residential	**Land Reclamation**
Garden, Lawn and Flower Revegetation	Landfill Cover
	Mined & Derelict Land

A number of organic matter sources currently in use could be replaced by yard waste compost. In most cases, compost could be substituted for commercial potting soil mixes, and it could be substituted for peat moss. If all of the peat and one-half of the potting soil mix could be replaced by compost, a potential market for several thousand cubic yards of compost per year would result. Nursery operators and extension agents feel the compost material would be more suitable for use in lawn establishment/renovation and home garden soil improvement.

In addition to replacing potting soil mixes and peat moss, yard waste compost is an excellent soil conditioner. Incorporation of compost into areas for flower beds or field-grown nursery crops also represents a substantial potential market use for compost.

It is also likely that state and local government agencies could make use of large quantities of the material. In Minnesota, the Governor has issued an executive order requiring the use of composted yard waste when available. Given the need to increase use of compost in West Virginia, the state should require and/or encourage use of yard waste compost by state and local governments. It is also apparent that the public, including state and local agency personnel, are unaware of the potential uses of yard waste compost. A public education program on the use of compost could result in substantial increases in the use volume.

Potential use and sales by nursery operators could account for about 50% of the composted yard waste material. Increased use by state and local government will account for a substantial amount of the remaining compost. A public education program will result in substantial increases in the homeowner use. It is estimated that with the programs recommended to increase compost use and to reduce collection of grass clippings, the total volume of yard waste generated in West Virginia can be recycled and utilized. Care must be taken to minimize market competition among localities in the major metropolitan areas. However adequate use/market appears to exist with reasonable distances to handle the yard waste compost supply.

8.2 Transportation

Compost can be transported cost-effectively within a certain radius because of its relatively low value. It is important to reconcile potential revenue or avoid soil purchase costs against the cost to transport compost to users. Distributing primarily through a pick up program and charging a fee for delivery that covers costs are the most economical programs.

8.3 User Resistance to Change

Unless there is a significant price difference, there is little incentive for potential users to change if they are already satisfied with existing materials. Offering compost for free can make potential users suspect that there must be something wrong with it since it is being given away. Resistance must be overcome by providing accurate product information, user trials, cooperative extension and university testing programs, extensive public education and possibly demonstration plots in visible areas.

8.4 Demand

The following information must be gathered from potential users in order to determine the potential demand for compost:

1. Specifications for organic materials
2. Capacity to use compost (both seasonal and annual)
3. Shipping and handling requirements
4. Potential revenue from sales of compost
5. Price of competing materials such as topsoil, peat moss or other compost products

Maintaining an adequate, stable demand for compost will be greatly dependent on having adequate supplies of a high quality compost at competitive prices. The spring and early summer months are the highest demand times for compost. Public education will help increase product demand by informing potential markets of the values and benefits of compost and stressing the value of adding organic matter as well as nutrients to the soil. Also contributing to a steady demand is the fact that the compost is a locally produced resource.

8.5 Distribution and Marketing Options

There are four potential market distribution options.

1. Local public agencies and divisions can obtain compost free

of charge utilizing their own equipment to load and transport compost off-site to various job sites or storage areas.

2. Private operations can be charged on a volume or vehicle basis for bulk material picked up at the compost site or delivered for an additional charge.

3. Residents can be encouraged to pick up compost at no charge or for a minimal fee. This provides an excellent opportunity to publicize the advantages of composting and resource recycling in general. It increases public awareness and participation in the collection program and instills a greater sense of community identity and pride.

4. Compost can be sold at wholesale to soil blenders, topsoil suppliers and other large-scale suppliers of organic materials. Although this option does not provide maximum revenue or publicity, it requires the least effort on the community's part to assure that all the compost is distributed for productive use.

SWMB TABLE 3: POTENTIAL MARKETS AND COMPOST CHARACTERISTICS

Potential User	How Used-Desired Characteristics	Concerns and Limitations	Comments
Homeowners	Soil amendment, mulch	Aesthetics Nonbiodegradables	
Groundskeeper	Soil amendment, mulch	Aesthetics, Handling Nonbiodegradable	
Golf Courses	Soil amendment	Aesthetics	A somewhat reluctant market
Nurseries (media)	High organics	PH Soluble salts NH4+	Potentially high paying market but stringent specs
Nurseries	Soil amendment	Varies with species	Requirements less specific than for media
Parks	Soil amendment Soil extender	Aesthetica Handling	
Landscape Contractor	Soil amendment Soli extender	Handling	
Agriculture	Nutrient source Possible lining	Nutrient Content Availability Handling	

Source: Compost Operations Manual, Minnesota Pollution Control Agency, Groundwater and Solid Waste Division, St. Paul, MN: May 1989

SECTION 9 REGULATORY APPROVALS AND PERMITS

Those facilities composting yard waste may not need a solid waste facility permit; however, the facility, management and operations must comply with the attendant regulations pursuant to W.Va. Code § 20-11-8. Land application of yard waste should be done in compliance with these same regulations.

A solid waste facility permit would be required to construct and operate a solid waste composting facility that would compost all other items and must comply with all state and federal regulations. For further information regarding permit requirements contact: WV Division of Environmental Protection.

SECTION 10 PUBLIC EDUCATION

Any community composting program will be more successful if it is accompanied by a well-organized and vigorous public information campaign. Because citizens are the generators of a significant portion of the yard waste to be treated, their cooperation is essential. If citizens understand why the community is composting yard wastes, how the system is organized, and what the participant's role is in the program, participation will likely occur.

Begin planning public awareness and participation well in advance: two months should be considered a minimum when developing a timeline and plan. Contacting the public can be a formidable task. In preparing information to be released to both print media and nonprint media sources, work with the following considerations:

- Who is the audience?
- What is the goal?
- Keep the message simple
- Avoid times when other media publicity is heavy (election time, holidays)

The extent of publicity will depend upon financial resources. A limited budget is not a hinderance to good publicity; there are many inexpensive ways to publicize.

The following table lists several vehicles of communication, divided into three cost categories. Low cost activities require only photocopying and mailing expenses. Medium cost vehicles may require the work of a graphic artist or printer, or may involve duplicating several thousand copies. High cost activities will require a large expenditure, up to several

SWMB Table 4: METHODS OF PUBLICITY

Low Cost	**Medium**	**High Cost**
News releases	Flyers	Commercials, TV, Radio
News advisories	Posters	Billboards
Public Service Announcements	Fact Sheets	Media Events
Community Calendar Announcements	Briefing papers	Calendars
Letters to the Editor	Media Events	Advertisements
News articles	Slide show	Public Relations Firm
Newsletter articles		
Speeches		
Guest spots on Radio, TV		

10.1 Using the News Media

News Releases are used to inform the media about a project. A news release should concisely answer the who, what, when, where, why and how of the item. News advisories alert the press to an upcoming event. A news advisory is not a news release, but gives details about the event, which is where the news will be. Advisories should be sent out at least one week prior to the event. As in a news release, the advisory should be dated and contact names, addresses and telephone numbers should be included.

thousand dollars.

Public service announcements are written statements sent to radio stations. The announcements will be aired at the station's convenience. To be most efficient, prepare 10-, 20-, or 30 second PSAs. Many radio stations have community calendars, which air announcements about special events, such as start ups of community programs.

There are other ways to contact the media, although the methods listed above are the most popular and effective. These include news conferences; news events; letters to the editor; broadcast news releases (for television); and appearing on talk shows.

A news event or conference attracts attention to a program. A news event is an informal conference designed to provide the visual media, particularly television, with news material. Such events have a variety of formats.

10.2 Publicity Without the News Media

In addition to the news media there are other ways to communicate and encourage participation in a community's composting program. Examples of publicity without the news media include: 1) flyers; 2) posters; 3) fact sheets; 4) briefing papers; 5) letters to the editor; 6) newsletters and 7) other procedures; such as billboards, advertisements and calendars.

SECTION 11 EVALUATING THE COST OF YARD WASTE COMPOSTING OPTIONS

The economic benefits of composting will assist a community in justifying the renewed costs on the following year's budget. Benefits may be expressed in the form of avoided "tipping fee," the volume of landfill space conserved, avoided transportation costs, money saved by not purchasing soil or any actual revenues received if the compost is sold. Land conservation and revitalization of soils are other benefits of composting which may not be quantifiable.

Any composting operation is likely to require some capitol cost and will have operating expenses. However, comoposting offers the following advantages: extends the life of landfills, avoids expensive landfilling fees and produces a useful organic material in an environmentally acceptable manner. Thus, composting appears to be the most efficient means of yard waste management.

CONCLUSION - COMPOSTABLE YARD WASTE

Using the program elements described in this document, it should be feasible to eliminate landfill disposal of yard waste. Implementation of a “Don’t Bag It” program would be the easiest way to keep grass clippings out of landfills. Another alternative to landfilling yard waste is composting at centralized facilities operated either by the public or private sector. The major obstacles that must be overcome to successfully implement a statewide program include: lack of public and governmental awareness, inadequate demand to meet supply, inadequate understanding of composting technologies by local and state officials, complex regulatory requirements or lack of regulations, and cost of establishing facilities. If the recommended programs and actions are followed, these obstacles can be overcome, and a successful program implemented.

ACTION AGENDA FOR YARD WASTE MANAGEMENT

- The Solid Waste Management Board will establish a public information program telling people that yard waste will no longer be accepted at landfills after June 1, 1994.

- The Solid Waste Management Board and the WV Cooperative Extension Service should encourage localities to restrict collection of grass clippings either bagged or bulk. Promotion of a “Don’t Bag It” program is important.

- The Solid Waste Management Board will provide technical assistance to localities in the establishment of composting operations.

- The Solid Waste Management Board will develop a list of nurseries and farms that would serve as a market for compost.

- The Solid Waste Management Board will develop a list of firms having experience in composting operations.

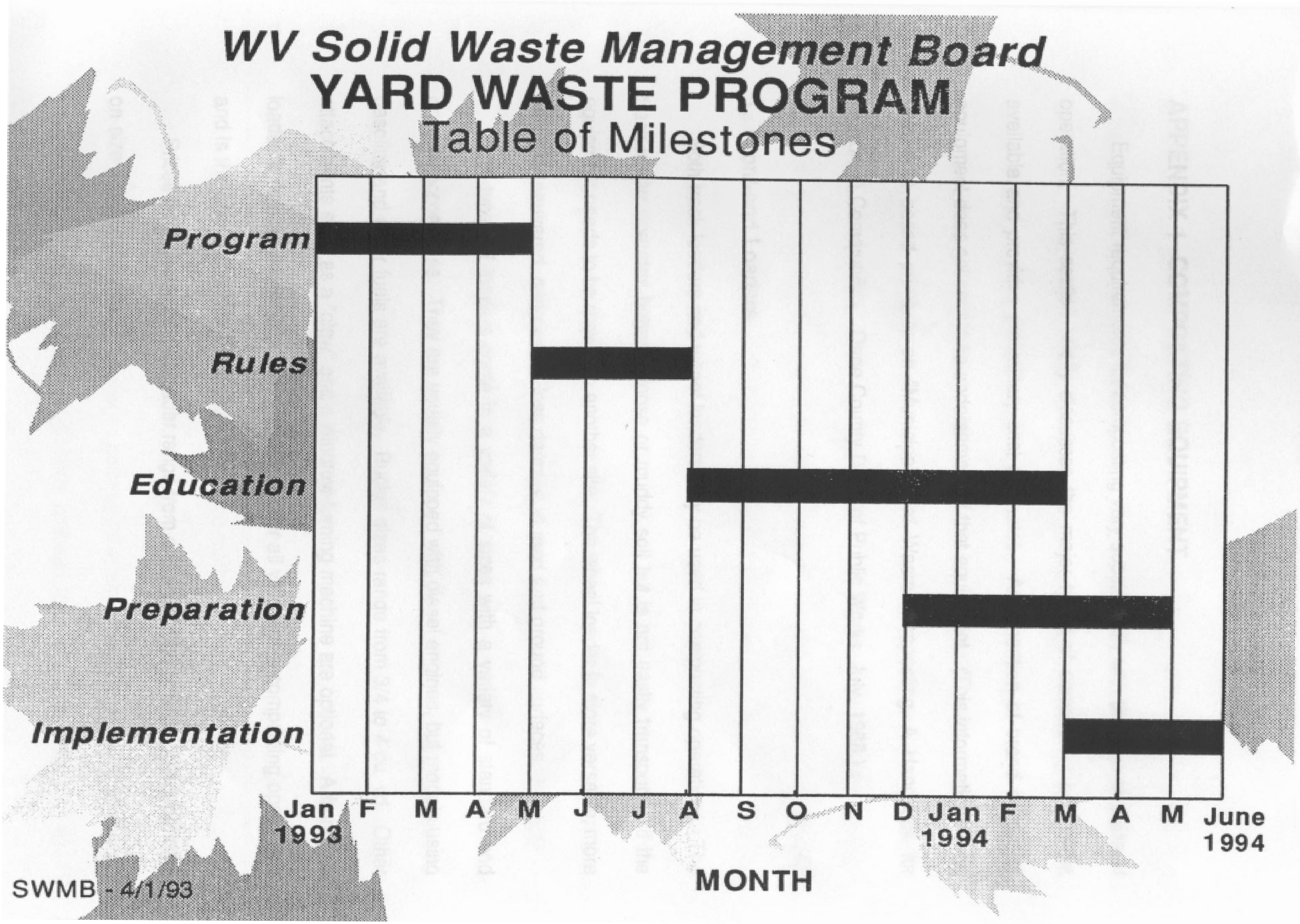
- The State of West Virginia pursuant to W.Va. Code § 20-11-7 should require state and encourage local government to use yard waste compost in their landscaping and grounds maintenance operations.

- The Division of Environmental Protection pursuant to W.Va. Code § 20-11-8 has written rules for the establishment of commercial yard waste composting operations utilizing minimal, low, intermediate, and high technology to be used in appropriate rural or urban counties, Title 47, Series 38E.

- The Division of Environmental Protection has minimized regulatory requirements for farmers and nursery operators managing compost facilities accepting less than 5000 cubic yards of yard waste per year and using all the finished compost in their own farming or nursery operation.

- The Division of Environmental Protection has established clear and simple regulatory procedures for compost facilities accepting yard waste only or yard waste mixed with solid animal wastes.

- The Division of Environmental Protection will develop a training and certification program for composting facility operators.


WV Solid Waste Management Board
YARD WASTE PROGRAM
Table of Milestones
Program
Rules
Education
Preparation
Implementation
Jan 1993
F
M
A
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Jan 1994
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June 1994
MONTH
SWMB - 4/1/93

APPENDIX 1 COMPOSING EQUIPMENT

APPENDIX 1 COMPOSTING EQUIPMENT

Equipment requirements for composting vary substantially with the type and size of operation. This section briefly discusses the major types of composting equipment available and provides preliminary cost estimates. Any mention of brand names of equipment does not constitute endorsement of that equipment. (This information in this section is based primarily on "Municipal Yard waste Composting, A Handbook for Wisconsin Communities", Dane County Dept. of Public Works, July, 1988.)

1. Front-end Loaders

Both track loaders and wheel loaders may be used in composting operations. The track loader operates better in loose or muddy soil but is not easily transported if the equipment needs to be moved to another site. The wheel loader is more versatile, more easily maneuvered, and causes less damage to road and ground surfaces.

Both types of loaders come in a variety of sizes with a variety of standard and optional accessories. They are usually equipped with diesel engines, but models using gasoline and other fuels are available. Bucket sizes range from 3/4 to 4 cu. yd. Other attachments such as a "claw" and a windrow-turning machine are optional. A front-end loader is the one essential piece of equipment for all yard waste composting operations and is the only equipment used by many.

Prices for a new front-end loader range from about $50,000 to $150,000 depending on size and accessories.

2. Vacuum Leaf Collectors

Vacuum leaf collectors are designed to collect leaves that have been raked into the street or along the curb. Tag-along units are towed behind a truck into which the leaves are blown. Self-powered units are also available some with compaction capacity up to 32 cubic yards per load. Most have manually operated intake hoses ranging from 7 to 18 inches in diameter. Some models include an internal shredding system. This equipment works best with fairly dry leaves and cannot be used for collection of grass clippings.

Trailer vacuum units cost from $15,000 to $20,000. Self-contained units cost from $50,000 to $110,000.

3. Grinders

Tub grinders are characterized by a rotating tub-type intake system. The material is loaded with a front-end loader into the tub and moved across a fixed floor containing hammermills that shear the material. As the material is reduced in size, it is forced through a screen and onto an elevator belt that discharges the material into standing piles or onto a transfer vehicle.

Tub grinders are available in different models, which have significantly different capabilities. Forage grinders are lighter-duty machines designed for grinding crop wastes such as straw, corn stalks, etc. These may be suitable if grinding only yard wastes. Larger heavy-duty grinders are made for grinding large amounts of dry wood and brush. These machines are capable of handling from 10 to 20 tons per hour depending on factors such as type of plant waste, screen size used, and waste moisture content. Although the larger units are capable of grinding pieces of wood up to four inches in diameter, the machine will occasionally jam. Proper mixing of wastes and use of varying screen sizes will reduce jamming and increase efficiency.

Tub grinders cost from about $60,000 to $140,000 delivered and require regular maintenance, including rotation and replacement of the hammers. A new set of hammers costs approximately $900 to $1400. Downtime to replace hammers is several hours. Hammers need to be rotated after about 50 hours of use and replaced after 140-240 hours of use.

4. Chippers

Chipping machines are designed to chip brush, limbs and other woody debris. Chippers are typically hand-fed and have blades that range in size from 12 to 16 inches but will only handle material up to 6 inches in diameter. Some models are equipped with heavy-duty blades that can handle an occasional can or rock without damage to the machine. Chippers produce large chips, suitable for mulch. Chippers are powered with gasoline or diesel engines or from a power takeoff shaft.

Chippers cost from $10,000 to $40,000. Replacement blades cost from $70 to $200 and may last up to a year.

5. Shredders and Screeners - Finishing Equipment

Shredders and screening devices are frequently used to refine or finish the compost. After the material is loaded into a receiving hopper, it is carried to the top of a conveyor. The conveyor drops the material onto a belt; and by a system of adjustable, variable sweep fingers, the material undergoes a continuous raking action to shred and aerate the load. Oversized pieces are forced back for further shredding while items such as sticks, stones, metal and glass are rejected and discharged through a trash chute. Shredders can process from 25 to 250 cu. yd. per hour and cost from $30,000 to $95,000 depending on size and options selected.

There are a variety of screening devices that can be used in compost operations including grizzly screens (scalper), trommels (rotating screens), and shaking/vibrating screens. Grizzly screens are used primarily for crude screening at 2 inches or more, trommels and shaking screens for separations above 1/2 inch. Vibrating screens can be used for coarse or fine screening depending on the configuration of the screen.

Vibrating screens and trommels come in a wide range of models, sizes, and prices. Units capable of processing from 25 to 50 cu. yd. per hour range in price from $35,000 to

$170,000 including screens, feed hoppers, and conveyors.

6. Compost Turners

Compost turners are designed especially for windrow turning and aeration. The large models are self-propelled and straddle the windrow. Middlebush Compost in New Jersey uses a Scarab model 18 to turn windrow at a 200,000+ cubic yard per year facility. This machine has metal teeth on a rotating drum and as it moves over the windrows, the teeth shred, break up, and aerate the compost. A skirt or fender reforms the windrows into a pyramidal shape.

Smaller units that are side mounted on front-end loaders or tractors are available. This type is driven down one side of the windrow then up the other requiring two passes for each pile. These also come in a variety of sizes and are well suited for small and medium operations. A windrow turner is a necessary piece of equipment for a compost operation to rapidly produce a high quality product.

The large self-contained units can also process from 2,000 to 4,000 cu. yd. per hour and cost from $100,000 to $185,000 delivered. The loader/tractor mounted units are designed to turn smaller windrows and cost from $10,000 to $60,000. The major maintenance requirement of turners is regular replacement of the flails or teeth that cost from $375 to $500 per set.

7. Monitoring Equipment

Thermometers may be the only instruments needed to monitor the composting operations. Other testing equipment such as Ph meters, colorimeter tests, moisture monitors, etc. are optional.

There are two types of thermometers that are useful for composting: the long-stemmed dial type and the infrared scanner. The long-stemmed type should be 2 to 4 feet long so it can be inserted into the middle of the windrow. Several should be inserted into each windrow for daily readings and removed when the windrows are turned. These cost about $50 each. They are also available in a digital readout model that cost about $500 each.

The infrared scanner contains a sensor module that converts radiant energy to an electric signal. They are hand-held and can be used to measure the temperature of all sections of a windrow at a distance. Infrared thermometers cost about $1,200 including the basic accessories.

GLOSSARY

Aeration - The process of exposing bulk material, such as compost, to air. Forced aeration refers to the use of blowers in compost piles.

Aerobic - Oxygen present or oxygen demanding. Aerobic composting is desirable due to the fact that it is a rapid decomposition that minimizes odors.

Anaerobic - Oxygen absent. Anaerobic composting can lead to production of undesirable products such as methane and ammonia, leading to odor problems.

Buffer Zone - The area between the composting operation and neighboring land uses.

Compost - The end-product of the composting process that is thoroughly decomposed, cured and ready for application to the soil.

Composting - The manipulation or control by humans of the natural aerobic process of biological decomposition of organic materials under proper moisture conditions. This process is carried out by successive microbial populations which function at increasing temperatures to break down the organic materials into carbon dioxide, water, minerals and stabilized organic matter. The final product (compost) is sufficiently stable for storage or application to the soil.

Cubic yard - A standard measure of volume containing 27 cubic feet. One ton of incoming yardwaste contains 4 to 5 cubic yards of material. Due to the volume reduction during the composting process, one ton of finished compost contains approximately 2 cubic yards.

Curbside Collection - Programs where recyclable materials are collected at the curb, often from special containers, to be brought to various processing facilities.

Decomposition - The biological degradation or breaking down of organic materials, such as leaves, by microorganisms. Different from composting in that it is not controlled and does not result in thermophilic temperatures.

Drop-off Center - A method of collecting recyclable or compostable materials in which the materials are taken by individuals to collection sites and deposited into designated containers.

Heavy Metals - Metallic elements with high molecular weights and a specific gravity of five or more. Some of these elements can be poisonous to humans, animals and/or can adversely affect plant growth.

Landfill - A facility or part of one at which solid waste, or its residue after treatment, is intentionally placed in or on land, and at which solid waste will remain after closure. The term “landfill” does not include a land application unit, surface impoundment, solid waste disposal surface impoundment or injection well.

Microorganisms - Microscopically small living organisms that digest decomposable materials through metabolic activity. Microorganisms are active in the composting process.

Municipal Solid Waste (MSW) - Garbage, refuse, trash and other solid waste from residential, commercial, and community activities.

Pathogens - Organisms capable of producing infections or disease, often found in waste materials. The high temperatures in a compost pile kills many pathogens.

pH - A measurement of acidity/alkalinity that is measured on a scale from 1 to 14,with 7 being neutral. Values below 7 represent acid conditions, above 7 are alkaline.

Runoff - Flowing water and associated contaminants originating from any part of the compost facility that drains over the land. Windrows should run up and down the slope so that runoff does not collect between the windrows.

Screening - A process in which the finished compost is run through a series of screens, each with different size openings, to remove trash such as plastic, metal and glass. This can improve the quality of the end product and increase marketability.

Shredder - A mechanical device used to break up waste materials into smaller pieces to increase the surface area. Can be used on woody waste to produce mulch. Not always a necessary piece of equipment for all types of yard waste. Types of shredders include hammermills, shears, tub grinders and rasp mills.

Soil Amendment/Soil Conditioner - An organic matter source that when added to the soil improves the general physical, chemical and biological properties of the soil, but doesn't necessarily add nutrients.

Windrow - An elongated pile in which the yard wastes are placed. The piles are typically 8 feet high by 12-18 feet wide and as long as needed to accommodate the yard waste.

Yard waste -Material such as leaves, grass clippings and brush and tree prunings. This material may all be recycled either by composting or chipping to make mulch.

BIBLIOGRAPHY

Decision-Makers Guide to Solid Waste Management, EPA/530-5W-89-072

Derr, D.A. 1985. Economics of Leaf Composting. Biocycle. Vol 2610/85 pp 36-38

Derr, D.A. 1989. Minimizing the Cost of Leaf Composting. Biocycle. Vol. 304/89 pp 45-48

Derr, J., 1989. Composting Economics, John Wiley & sons, New York

Diener, R.G. 1991. Guidelines for Compost Facilities. Draft submitted to the WV Division of Natural Resources, September 11. Available from the author.

Diener, R.G. and J.H. Martin, 1990. Observations and Solutions to the Solid Waste Dilemma. Unpublished monograph available from authors. West Virginia University, Morgantown, WV 26506.

Diener, R.G. and J. H. Martin, 1991. Effective Solid Waste Management. Unpublished Monograph. West Virginia University, Morgantown, WV 26506

Glenn, J. 1988. Encouraging Yard Waste Utilization. Biocycle. Vol 29 8/88 pp 49-52

Glenn, J. 1989. Private Management of Yard Waste. Biocycle. Vol 30 1/89 pp 26-28

Interviews with Paul Benedum and Charles Capet, Division of Environmental Protection

Municipal Yard Waste Composting: A Handbook for Wisconsin Communities, Dane County Department of Public Works, July 1988

Preston, C.M. 1990. Composting in the Northwest, Canada Journal of Soil Science 90:187-198

Simpson, T.W. and J.H. May 1990. The Feasibility of a Statewide Yardwaste Composting Program for Virginia. House Document No.34, Virginia General Assembly, Commonwealth of Virginia, Richmond, V A

Strom and Finstein, Composting, Rutgers University, New Brunswick, New Jersey, 1986

Taylor, A.C. and R.M. Kashmanian 1988. Study and Assessment of Eight Yardwaste Composting Programs Across the United States. U.S. Environmental Protection Agency, Washington, DC 20460

The Minnesota Project, 2222 Elm Street, Minneapolis, MN 55414, Phone: (612) 378-2142

West Virginia University Extension Service, Cooperative Extension Service, Managing Solid Waste, MSW5, January 1992

William F. Cosulich Associates, L TD., 1991. Preliminary Feasibility Study of Alternative Project Concepts for Processing and Materials Recovery of Solid Wastes Generated Within Waste Shed “H”

Wilson, Larry J., Director Iowa Department of Natural Resources, Local Government Composting Guide for Iowa Communities, May 1991

Zucconi, F., 1989. Evaluating Composting, Biocycle 22:54-57