

1. Report No. FHWA/TX-97/1352-2F		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle THE USE OF COMPOST AND SHREDDED BRUSH ON RIGHTS-OF-WAY FOR EROSION CONTROL: FINAL REPORT				5. Report Date November 1995 Revised: July 1996	
				6. Performing Organization Code	
7. Author(s) Beverly B. Storey, Jett A. McFalls, and Sally H. Godfrey				8. Performing Organization Report No. Research Report 1352-2F	
9. Performing Organization Name and Address Texas Transportation Institute The Texas A&M University System College Station, Texas 77843-3135				10. Work Unit No. (TRAIS)	
				11. Contract or Grant No. Study No. 0-1352	
12. Sponsoring Agency Name and Address Texas Department of Transportation Research and Technology Transfer Office P. O. Box 5080 Austin, Texas 78763-5080				13. Type of Report and Period Covered Final: December 1994 - August 1995	
				14. Sponsoring Agency Code	
15. Supplementary Notes Research performed in cooperation with the Texas Department of Transportation, U.S. Department of Transportation, Federal Highway Administration, and the Texas Natural Resource Conservation Commission. Research Study Title: The Use of Compost and Shredded Brush on Rights-of-Way					
16. Abstract <p>Highway construction practices have historically been viewed as a major contributor of non-point source pollution. Damage control measures implemented for construction site erosion can include erosion control nets, open-weave geotextiles, geosynthetic mattings, erosion control blankets, loose mulches, hydro-mulches, and chemical soil binders. The Texas Department of Transportation is taking a proactive approach to erosion control research by investigating the use of shredded brush and composted organic waste from right-of-way clearing operations as erosion control measures. Testing was done at the TxDOT/TTI Hydraulics and Erosion Control Field Laboratory at the Texas A&M University Riverside Campus in a simulated highway environment.</p> <p>The testing consisted of six plots, three sand and three clay, on a 1:3 slope. Three materials were applied to the test plots: compost, consisting of mixed yard debris and municipal sewage sludge; shredded wood with a polyacrylide tackifier; and shredded wood with a hydrophillic colloid tackifier. Rain simulations for 1-year, 2-year, and 5-year storm events were +tested for sediment loss on the plots. The percentage of vegetative cover was analyzed using the Vegetation Coverage Analysis Program.</p> <p>The results demonstrated that compost and shredded wood with tackifier are as effective as many of the standard erosion control materials and surpass others in cost effectiveness, vegetation establishment, and slope protection.</p>					
17. Key Words Erosion Control, Compost, Shredded Brush, Mulch, Recycling, Highway Construction, Slope Stabilization, Roadside Management, Stormwater Management			18. Distribution Statement No restrictions. This document is available to the public through NTIS: National Technical Information Service 5285 Port Royal Road Springfield, Virginia 22161		
19. Security Classif.(of this report) Unclassified		20. Security Classif.(of this page) Unclassified		21. No. of Pages 240	22. Price

**THE USE OF COMPOST AND SHREDDED BRUSH ON RIGHTS-OF-WAY
FOR EROSION CONTROL: FINAL REPORT**

by

Beverly B. Storey
Research Assistant
Texas Transportation Institute

Jett A. McFalls
Research Associate
Texas Transportation Institute

and

Sally H. Godfrey
Assistant Research Scientist
Texas Transportation Institute

Research Report 1352-2F
Research Study Number 0-1352
Research Study Title: The Use of Compost and Shredded Brush on Rights-of-Way

Sponsored by the
Texas Department of Transportation
In Cooperation with
U.S. Department of Transportation
Federal Highway Administration
and the
Texas Natural Resource Conservation Commission

November 1995
Revised: July 1996

TEXAS TRANSPORTATION INSTITUTE
The Texas A&M University System
College Station, Texas 77843-3135

IMPLEMENTATION STATEMENT

The findings from this work have immediate application in the planning, design, construction, and maintenance of highway sites requiring erosion control or vegetation establishment. Research methods used to evaluate the field performance of compost and shredded brush (shredded/chipped wood) as an erosion control measure should provide engineers and landscape architects with realistic performance characteristics for 1:3 slopes.

Results from the study support TxDOT's *Annual Approved Materials List* included in the Standard Specifications for the Construction of Highways, Streets, and Bridges. Benefits include the use of organic waste from right-of-way clearing operations that would normally be landfilled or burned. The recycling of this organic debris is useful not only as an erosion control material, but also as a soil amendment for vegetation establishment. The results of this research will continue to keep TxDOT in the forefront as a proactive leader in highway-related environmental concerns.

DISCLAIMER

The contents of this report reflect the views of the authors who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official view or policies of the Texas Department of Transportation. This report does not constitute a standard, specification, or regulation.

NOTICE

The United States Government and the State of Texas do not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the object of this report.

ACKNOWLEDGMENT

The research team would like to thank the Federal Highway Administration, the Texas Department of Transportation, and the Texas Natural Resource Conservation Commission for their support in this research study.

TABLE OF CONTENTS

LIST OF FIGURES	x
LIST OF TABLES	xi
SUMMARY	xiii
INTRODUCTION	1
EROSION AND SOIL TEXTURE	3
COMPOST	5
COMPOSTING FACILITIES	7
COMPOSTING POLICY IN TEXAS	11
COMPOSTING STUDIES FOR EROSION CONTROL	11
SHREDDED BRUSH AS MULCH	17
MULCH STUDIES FOR EROSION CONTROL	18
COMPOST/SHREDDED - OTHER APPLICATIONS	19
SUMMARY OF LITERATURE REVIEW	21
HYDRAULICS AND EROSION CONTROL LABORATORY	25
COMPOST AND SHREDDED BRUSH STUDY	29
OBJECTIVE	29
METHODOLOGY	29
INSTALLATION PROCEDURES	33
STUDY AREA PREPARATION	33
SEED APPLICATION	33
MATERIAL INSTALLATION	34
DATA COLLECTION	35
SEDIMENT DATA	35
VEGETATION DENSITY DATA	36
PERFORMANCE ANALYSIS	37
COMPOST	37
WOOD CHIPS WITH GRANULAR POLYACRYLAMIDE TACKIFIER	37
WOOD CHIPS WITH HYDROPHILIC COLLOID TACKIFIER	37
COST COMPARISON OF EROSION CONTROL MATERIALS	43
CONCLUSIONS AND RECOMMENDATIONS	45
GLOSSARY	47
REFERENCES CITED	49
APPENDIX A: RECYCLING FACILITIES IN TEXAS	53
APPENDIX B: METRO'S PROPOSED SEDIMENT FENCE/COMPOST BARRIER CONFIGURATION	73
APPENDIX C: 30 TEXAS ADMINISTRATIVE CODE, CHAPTER 332	77

LIST OF FIGURES

FIGURE 1. Right-of-Way Refuse Disposal Techniques for Transportation Agencies	2
FIGURE 2. Centralized Compost Facilities in Texas	22
FIGURE 3. TxDOT/TTI Hydraulics and Erosion Control Field Laboratory	26
FIGURE 4. Section through Sediment Collection Trough	27
FIGURE 5. Vegetative Cover 11 Weeks Post Installation on 1:3 Slope - Clay	39
FIGURE 6. Vegetative Cover 9 Weeks Post Installation on 1:3 Slope - Sand	39
FIGURE 7. Vegetative Cover 9 Weeks Post Installation on 1:3 Slope - Sand	41
FIGURE 8. View of 1:3 Sand Test Plots	41

LIST OF TABLES

TABLE A. Soil Erodibility Guide	4
TABLE B. Carbon/Nitrogen Ratio of Common Organic Wastes	6
TABLE C. Common Problems Associated with Composting and Recommended Solutions ..	10
TABLE D. Beaujolais Compost Study - Water Storage Capacity Comparison	12
TABLE E. Johnson City Compost Study - Foliage Density Comparisons	13
TABLE F. St. John's Landfill and Murray Boulevard Study Results	14
TABLE G. Metro Compost Study	15
TABLE H. Beaujolais Mulch Study - Wood Materials Effectiveness Comparison	19
TABLE I. Shredded Brush Erosion Control Applications	20
TABLE J. 1995 Rainfall Simulations	36
TABLE K. Performance Analysis	38
TABLE L. Cost Comparison of Erosion Control Materials	43

SUMMARY

Highway construction practices have historically been viewed as a major contributor of non-point source pollution. Damage control measures implemented for construction site erosion can include erosion control nets, open-weave geotextiles, geosynthetic mattings, erosion control blankets, loose mulches, hydro-mulches, and chemical soil binders. The Texas Department of Transportation is taking a proactive approach to erosion control research by investigating the use of shredded brush and composted organic waste from right-of-way clearing operations as erosion control measures. Testing was done at the TxDOT/TTI Hydraulics and Erosion Control Field Laboratory at the Texas A&M University Riverside Campus in a simulated highway environment.

The testing consisted of six plots, three sand and three clay, on a 1:3 slope. Three materials were applied to the test plots: compost, consisting of mixed yard debris and municipal sewage sludge; shredded wood with a polyacrylide tackifier; and shredded wood with a hydrophillic colloid tackifier containing germination stimulant. Rain simulations for 1-year, 2-year, and 5-year storm events tested for sediment loss on the plots. The percentage of vegetative cover was captured using the Vegetation Coverage Analysis Program.

The results demonstrated that compost and shredded wood with tackifier are as effective as many of the standard erosion control materials and surpass others in cost effectiveness, vegetation establishment, and slope protection.

INTRODUCTION

Non-point source pollution is cited as being the most prevalent cause of contamination in receiving waters in the United States. Although agriculture has historically been viewed as the culprit, the rate of erosion from construction activities is 10 to 20 times greater than that of its agricultural counterparts (27). With common sediment control methods, such as sediment control fences, straw bales, and sediment ponds, performance quality depends upon the quantity of site erosion and maintenance. A better management practice is to minimize or prevent the first phase of erosion, which is detachment (3). Site management practices that promote erosion prevention include:

- Minimizing disturbed area;
- Preserving existing natural vegetation;
- Revegetation (stabilization practices);
- Slowing water velocities; and
- Developing sheet flow rather than concentrated flow.

This is generally done using a variety of erosion control devices, such as erosion control nets, open-weave geotextiles, geosynthetic matting, erosion control blankets, loose mulches, hydro-mulches, and chemical soil binders. Most are designed to absorb the kinetic energy of rainfall by minimizing its contact with the soil and reducing the velocity of the flow (30). Erosion control blankets and mulches are a standard for many transportation agencies, including the Texas Department of Transportation (TxDOT). Other effective erosion control methods include construction practices that avoid long slopes, landform grading techniques, and phased construction that limits disturbed soil exposure time.

The U.S. Environmental Protection Agency (EPA) issued final regulations regarding the Federal Water Quality Act of 1987 in November 1990 requiring National Pollution Discharge Elimination System (NPDES) permits for storm water discharges associated with industrial activity. These regulations identify activities, including grading, clearing, and excavating, as needing storm water permits. The permits are required for municipalities with populations greater than 100,000 and for discharges for industrial activity. Construction practices that disturb over 2 hectares are considered industrial, although the EPA is currently considering reducing the minimum impact area to .405 hectare. Highway construction usually falls into this category (27).

Legislation such as the Texas Recycling Law HB 1340 and environmental campaigns like CLEAN TEXAS 2000, sponsored by the Governor of Texas and the Texas Natural Resource Conservation Commission (TNRCC), combined with a nationwide expansion of waste reduction mandates and controlled burning of debris prompted TxDOT to investigate recycling the roadside refuse from right-of-way clearing operations. The Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 encourages the environmentally safe use of compost and other products derived from treated municipal sewage sludge by state and local

governments along the rights-of-way of federally funded highways. Uses mentioned are highway planting projects, recultivation, and erosion control (5). The shredding of brush and other green matter for use as mulch and compost is a logical and desirable organic residual management option (37).

TxDOT surveyed transportation agencies across the United States and Canada to report on waste reduction efforts. Highway construction and maintenance operations, including right-of-way refuse disposal, were among the areas of concern for TxDOT. Results of the survey, found in *Waste Reduction and Buy Recycled Efforts within North American Departments of Transportation* (35), revealed that the majority of the DOTs chip, burn, and/or landfill their clearing operation debris. Figure 1 summarizes disposal techniques for transportation agencies.

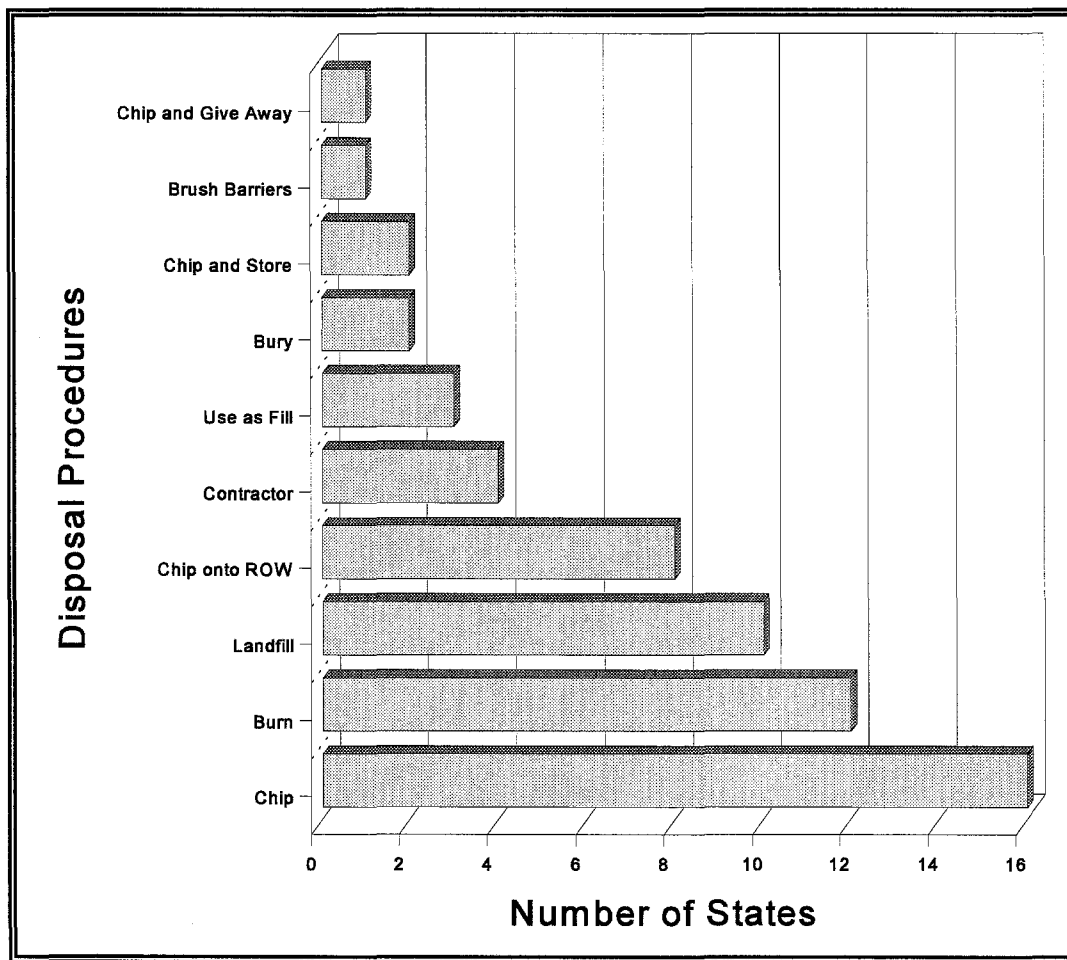


Figure 1. Right-of-Way Refuse Disposal Techniques for Transportation Agencies.
Source: Waste Reduction and Buy Recycled Efforts within North American Departments of Transportation (35).

EROSION AND SOIL TEXTURE

Surface layers of soil are worn away by the natural forces of wind, water, and ice. Human intervention into this natural process greatly accelerates its destructive effects. Soil erosion involves the processes of particle detachment, entrainment and transport. Erosion is initiated by drag, impact or tractive forces acting on individual particles of soil at the surface. Detachment of the particles can occur by the impact of rainfall or by the shear of flowing water. Shear force detaches soil particles when the shear force is great enough to overcome the cohesive, friction, and gravity forces that hold the soil in place. Aggregates will then break from the soil mass. Detachment by raindrops depends upon drop characteristics, soil type and surface conditions. Detachment by shear is primarily a function of soil resistance and flow characteristics (3).

Soil texture, structure, and aggregate characteristics have a direct impact on the soil's ability to resist erosive forces. Soil texture is the relative amount of sand, silt, and clay in the soil. The soil structure is the manner in which these particles combine into stable collections or aggregates. Aggregates are secondary units or granules composed of many soil particles adhered together by *organic substances*, iron oxides, carbonates, clays, and/or silicas. Natural aggregates are called peds and vary in their water stability (10). The ability of the soil to produce these aggregates is greatly enhanced by the presence of organic matter in the soil. The polysaccharide gums produced by the microbial action of decomposition of organic matter are responsible for improving the physical condition of the soil (31). According to Bosschner, the erodability of the soil *decreases* as:

- the infiltration rate increases;
- the particle size or stable aggregate size increases; and
- the organic matter of the soil increases.

A numeric representation of the soil's ability to resist the erosive forces of rainfall is the "K" value. This value, as well as the soil's VM factors, can be altered through construction practices. In *Temporary Erosion Control Measures Design Guidelines for TxDOT*, researchers noted that soils with a greater amount of organic matter had less sediment yield (15). Table A shows the relationships among soil texture, K value, and sediment yield.

Vegetation as a surface condition is known to be the most effective erosion control. Vegetation effectively:

- reduces the impact of rainfall;
- slows the flow of water over the surface;
- evapo-transpires water back into the atmosphere, thereby reducing the possibility of over saturation of the soil; and
- holds the soil together within the rootzone.

Soil type, texture, and organic content affect the ability of the soil to produce vegetation substantial enough to keep the soil intact.

Table A. Soil Erodibility Guide.

SOIL ERODIBILITY GUIDE		
Soil Texture	K Value Range	Sediment Yield
Sand	0.02 - 0.05	High
Fine Sand	0.10 - 0.16	High
Very Fine Sand	0.28 - 0.42*	Medium to High
Loamy Sand	0.08 - 0.12	Low
Fine Loamy Sand	0.16 - 0.24**	Low to Medium
Very Fine Loamy Sand	0.30 - 0.44*	Medium to High
Sandy Loam	0.19 - 0.27**	Low to Medium
Fine Sandy Loam	0.24 - 0.35	Medium
Very Fine Sandy Loam	0.33 - 0.47*	Medium to High
Loam	0.29 - 0.38	Medium
Silt Loam	0.33 - 0.48*	Medium to High
Silt	0.42 - 0.60	High
Sandy Clay Loam	0.21 - 0.27	Medium
Clay Loam	0.21 - 0.27	Medium
Silty Clay Loam	0.26 - 0.37	Medium
Sandy Clay	0.12 - 0.14	Low
Silty Clay	0.19 - 0.25**	Low to Medium
Clay	0.13 - 0.20**	Low to Medium

*>0.38 = High Yield

**>0.19<0.38 = Medium Yield

Source: *Temporary Erosion Control Measures Design Guidelines for TxDOT* (15).

COMPOST

Compost, as defined by Texas Senate Bill 1340, is “the disinfected and stabilized product of the decomposition process that is used or sold for use as a soil amendment, artificial top soil, growing medium amendment, or other similar uses.” The EPA defines compost as “the relatively stable decomposed organic material resulting from the composting process, also referred to as humus”(44). Nature provides this material through processes like litter decomposition on a forest floor. As leaves and tree debris fall to the soil’s surface, microbial action takes over and breaks down the debris into a form useable for plant uptake. The organic horizon of a soil profile consists of:

- **litter** - the unaltered dead remains of plants and animals;
- **fermentation** - partly decomposed organic matter so that the source can still be identified; and
- **humification** - well-decomposed amorphous organic matter (33).

The residual of decomposition is a substance referred to as humus, a dark amorphous product. Construction practices that denude land and apply impervious surfaces over the soil make it tough on these natural cycles.

Composting requires enough time for organic matter to decompose into a mature, stabilized material for use as erosion control or soil amendment. Many view mature compost as a dark, crumbly, soil-smelling substance. Stability is defined by its microbial activity (12). The amount of time required for this to occur is contingent upon particle size, initial carbon/nitrogen ratio of the feedstock, moisture content, and maintenance of aerobic conditions. This time can vary from 48 hours to several months (29).

In Rodale’s *Complete Book of Composting*, the essentials for proper composting are described as:

- **shredding the material** - Optimum size should be about 50 mm. The larger chips of wood take longer to decompose and support smaller populations of microbes.
- **optimum carbon/nitrogen ratio** - If too high or too low, the end product is affected due to prolonged duration or loss of nitrogen as ammonia. An optimum level is about 30:1 (25). A 30:1 ratio means that for every thirty parts of carbon, there is one part of nitrogen available for decomposition. This essentially means the right balance of wood, or bulk, to leaf and grass debris. Grass, which has a high nitrogen content, has a profound effect upon this balance. It generates heat and produces anaerobic conditions very quickly. Table B contains C/N ratios for common organic wastes.

- **moisture content** - With low moisture content, bacterial decomposition is arrested and N escapes as ammonia and other volatile forms of N. With very high moisture levels, anaerobic conditions set in and decrease the rate of decomposition. Moisture content can vary between 40 to 60% depending upon feedstock material.
- **aeration** - This is a must for rapid decomposition, controlling flies, and odor reduction. It insures aerobic decomposition, which is faster than anaerobic, and assures complete destruction of harmful pathogens.
- **temperature** - At a thermophilic temperature, 50° to 60°C, harmful pathogens, insect eggs, and weed seeds are destroyed. Above 70°C may result in rapid dehydration, possible self-combustion, and the destruction of beneficial organisms.

Table B. Carbon/Nitrogen Ratio of Common Organic Wastes.

WASTE TYPE	C/N RATIO
Sewage Sludge Activated	6:1
Digested	16:1
Food Waste	15:1
Grass Clippings (Fresh)	20:1
Manure	20:1
Weeds (Fresh)	25:1
Hay (Dry)	40:1
Corn Stalks	60:1
Leaves (Fresh)	40-80:1
Straw (Dry)	100:1
Sawdust	500:1
Wood	700:1

Adapted from *Management Strategies for Landscape Waste* (21).

Composting wood chips as opposed to other types of organic debris (grasses, leaves, etc.), is more time consuming. As seen by the list of wood materials below, the rate of decomposition after 50 days can vary greatly with the feedstock used:

- Dextrose 60%;
- Wheat straw 48%;
- Red alder 40%;
- Ponderosa pine sawdust 33%;
- Western red cedar sawdust 33%;
- Douglas fir sawdust 30%;
- Pitch 30%;
- Western hemlock sawdust 27%;
- Bark 26%; and
- Lignin 6% (29).

COMPOSTING FACILITIES

With well over three thousand nationwide, composting facilities are becoming more prevalent as an effective real practice for green waste management (6). Tree trimmings, shrubs, leaves and even grass are being utilized in concerted efforts to recycle yard debris into useable products while providing a place for disposal. As landfills reach capacity, the near future will undoubtedly see a progression of tougher regulations on yard waste disposal. Many states have compost regulations, standards, and procurement programs. As of 1992, 14 states have adopted manuals to assist their municipalities in establishing compost programs (19). The facilities' management has addressed several public concerns. Odor and contamination are issues that are being resolved through proper operational procedures.

Centralized composting/mulching facilities have spread across the State of Texas. According to the *TNRCC Texas Directory of Recycling Resources & Information* (36), there are currently 61 city operated facilities and four county facilities. Many privately owned facilities also exist. Recycling efforts in general have grown throughout the state. Appendix A contains a list of the municipal and county programs in Texas.

Composting technology ranges from low-level technology to high-level technology. The low-level consists of windrowing the organic debris, turning the piles about a month after the initial mix, and leaving them for several months, usually over winter. High nitrogen wastes, such as grass, are mixed into the partially decomposed debris during the months when grass is readily available. The windrows are then turned every three months. The final product is ready in approximately 18 months. Medium-level technology is similar in technique to low-level technology, but with more frequent turnings and more specialized equipment, i.e. windrow turner. The advantage of this level of composting is the ability to maintain aerobic conditions, which reduces odor and accelerates decomposition. The quality of the finished product is superior to that of low-level technology. Composting time for medium-level technology is generally about 12 months. High-level technology is highly mechanized using forced aeration, moisture control, mechanized turning, and final shredding, and screening. This technology has rather high costs associated with it, yet it produces a high quality product in 3-4 months with a minimum of odor and leachate.

The composting facility in Bryan, Texas, Brazos Valley Biosoils, is built on the old City of Bryan landfill site. This 5 hectare facility composts yard wastes and biosolids from a seven county region. The mixture of biosolids, mulched yard waste, and wood chips are thermophyically processed for 18 to 30 days at 55°C to meet EPA regulations for unrestricted use of biosolids. The windrows, 3.7 m wide and 1.8 m high, are turned every two to three days, or more if the daily monitored temperature reaches 70°C, to avoid damaging the microorganisms and dehydrating the material. The composted material is then left to cure for 30 days before it is sold for consumer use. The compost is processed on an impervious surface with detention ponds to manage runoff. The composted products comply with EPA and TNRCC requirements for use as soil conditioners.

Many such municipal facilities noted that the most cost intensive aspect of the operation is the machinery used for processing the compost. Typically this consists of a windrow turner, front end loader, screen filter, and tub grinder. Green waste is layered with the bulking agent (wood chips) and set in windrows. Screening of the finished material results in three products available for use from the Bryan facility. These are: woodchips, heavy grained compost, and fine grained compost. The fine grade compost is sifted through a 6.35 mm screen; the coarse grade is a residual of this process that produces pieces up to 38 to 51 mm. The shredded wood (wood chips) is processed through a 76 mm screen. Disposal fee for yard waste is \$13.75/Mg and purchase price for finished products is \$22.00/Mg.

The Hornsby Bend Composting Facility in Austin, Texas boasts of its Dillo Dirt. This is composted biosolids, yard wastes, and tree trimmings. The majority of the bulking agent (wood chips) used at the facility comes from tree trimming/shrub removal operations along utility corridors in the City of Austin. Such recycling efforts help reduce landfill volumes (composting can reduce green waste volumes by 50 to 85%) (34). The facility produces about 9180 m³ of Dillo Dirt annually, which is used in private and public sectors. The product is sold for \$9.15/m³ to licensed brokers. There are many other facilities in Texas that promote their composted products. The Brazos River Authority in Belton, Texas, sells its TriGro for \$6.50/m³ (less for large loads) (6, 34).

Other facilities follow similar techniques for disposal and recycling of green waste. Of the composting/mulching facilities currently in operation throughout the country, some are publicly owned and operated while others are privately owned. Many supply public entities, parks, roadside development, municipal buildings, etc., with finished products for use in the landscape.

The Cedar Grove Compost Company in Seattle, Washington, began its operation in 1989 in response to Seattle's ordinance banning yard waste disposal as residential garbage. The facility is sited on 16.2 ha, 4.86 ha of which are composting windrows. These windrows are turned and composted for six weeks and cured for another six weeks. The product is then screened and sorted by size. Materials filtered through the 11 mm screen are used as compost. Anything up to 19 mm is sold as mulch. The usable remainder is recycled back into composting.

An ongoing problem with this facility and others is odor and contamination of feedstock. Yard debris often contains just that, yard debris—hoses, chairs, old pots. Filtering out harmful debris is labor intensive for many composting facilities. Grass clippings are also problematic. The bagged grass is an ideal environment for anaerobic decomposition, and with this process comes very foul odors. The grass heats up and becomes sour very quickly. Inherent problems of debagging grass has motivated many municipalities to turn to paper bags for yard waste disposal. The bags themselves are compostable, thereby eliminating the debagging process.

Tipping fees for the Seattle facility in 1991 were \$27.50 to \$33/Mg for brush and yard waste and \$33 to \$44/Mg for clean wood (25). The range of tipping fees and finished product cost varies throughout the country. The cost on the east coast tends to be higher than the costs in the Midwestern states. According to a 1988 report by the EPA, the range of disposal fees is \$5.50 to \$151/Mg (31). The bulk product, called Cedar Grove, is sold for \$11 and \$13.70/m³ depending on quantity purchased (34).

A troubleshooting guide adapted from the New Jersey Department of Environmental Protection, Office of Recycling, depicts common problems associated with composting, as shown in Table C.

Table C. Common Problems Associated with Composting and Recommended Solutions.

SYMPTOMS	PROBLEMS	RECOMMENDATIONS
Odor; piles are wet and smell sour.	Piles too large; not enough air.	Form piles no wider than 4.25 m, no higher than 2 m.
	Windrows not formed immediately.	Allow no more than 1-2 days between collection and windrow formation.
	Piles too wet.	Spread to fry. Add dry matter. Improve drainage.
Inadequate composting rate.	Material too dry.	Add water initially or as corrective measure when turning.
	Pile too large, leading to anaerobic conditions.	Make piles smaller, add limestone if necessary to raise pH and control odors.
	Uneven distribution of air, moisture, or nutrients.	Turn or shred pile, wetting if necessary.
Center is dry and contains tough materials.	Not enough water.	Chip wood materials. Moisten and turn.
Piles are damp and sweet smelling but will not heat up.	Lack of nitrogen.	Mix in a nitrogen source, such as grass clippings or urea.
Standing water.	Inadequate slope.	Establish 1-2% slope with proper grading.
	Improper windrow alignment.	Run windrows down slope, not across.

Source: *Management Strategies for Landscape Waste* (21).

COMPOSTING POLICY IN TEXAS

The TNRCC adopted composting rules in November, 1995, found in Chapter 332 of the Municipal Solid Waste Rules. In simple terms, the General Requirements of the policy apply to:

- Backyard composting;
- Operations that produce useable materials from yard waste without composting, such as wood chips or mulch;
- Agricultural or farming operations that compost on-site for their own uses; and
- Any other operation that composts.

General requirements pertaining to discharge of waste, surface and ground water contamination, and sanitation of procedures comply with Chapter 341 of the Texas Health and Safety Code and Chapter 26 of the Texas Water Code. Specific requirements deal with the composting facility's proximity to water sources, flood plains, wetlands, and residential and/or business areas. The end product of the operation must result in a useful product. Chapter 332 of the Municipal Solid Waste Rules can be found in Appendix C.

COMPOSTING STUDIES FOR EROSION CONTROL

Several research groups in the United States and around the world have effectively demonstrated the use of compost as an erosion control measure. Compost provides a physical barrier between rainfall and the surface soil, dissipating the effect of impact energy and minimizing erosive forces, similar in concept to an erosion control blanket.

The use of compost for erosion control in Europe has also been well documented for many years. An Austrian vineyard study performed on a 30% slope using compost with a bulk density of 475 kg/m³ was applied at 356 Mg/ha, about a 7.6 cm cover. The results of the study showed the effective service life of this application was about three years. Results included a reduction of surface runoff, as well as soil loss. The decrease in runoff was attributed to the compost's ability to absorb large amounts of water, allowing it to percolate into the soil. Of course, soil type, texture, and saturation level is also relevant to percolation rates. The soil loss resulting from this application was approximately 561 kg/ha which is well below most specified erosion control guidelines (41). In comparison to TxDOT's soil retention blanket (erosion-control blanket) performance standards, these results are over 20 times better than proven erosion control blanket products for sandy soils (14). In contrast, less erodible soils, clay or tight soils, with erosion-control blankets performed 40% better than these compost trials.

Another vineyard study in the Beaujolais, France, demonstrated the effects of different mulches on inter-row erosion control, including compost and wood products. The study was sited at several vineyards, each with different applications.

Researchers tested compost at Pommiers, Limas, and Sarcey for runoff factor and eroded soil at intervals of three months, one year, and two years post-application. Compost was found to age better than the straw and pomace tested. The researchers concluded that this was due to the fact that compost is already a stabilized material with a minimum of further decomposition and that application rates were 10 times higher than that of the straw. The pomace lost its effectiveness as an erosion control by washing away rather than by decomposition, as did straw. Each were effective in absorbing rainfall impact energy, but compost demonstrated its superior ability to store water, thereby facilitating percolation, slowing the flow of runoff, and minimizing erosion (16). Table D shows the water storage capacity of the materials tested.

Table D. Beaujolais Compost Study - Water Storage Capacity Comparison.

WATER STORAGE CAPACITY (in mm = ¹⁰ m ³ /ha)				
	Straw	Compost	Pomace	Bark
Stored Volume	1.8	4.7	2.7	0.4
Drained Volume	0.9	1.8	1.6	0.9
Total	2.7	6.5	4.3	1.3

Source: *The Benefits of Permanent Grass and Mulching for Limiting Runoff and Erosion in Vineyards: Experiments using Rainfall -Simulation in the Beaujolais*(16).

A five year study conducted at the Johnson City, Tennessee, composting facility demonstrated positive results from application of compost as a mulch to highway rights-of-way. The facility composts sewage sludge and municipal solid waste (MSW). Compost was applied in conjunction with fertilizer and seed. The composted plots yielded excellent growth compared to non-composted sites. Results were attributed to compost’s (mulch’s) ability to reduce erosion and keep soil temperatures more stable during severe winter weather.

Control, compost, and compost with fertilizer plots were evaluated at a mine reclamation site using the Johnson City Facility compost. Table E shows the results of various applications, demonstrating the effectiveness of using compost to foster vegetation growth.

Table E. Johnson City Compost Study - Foliage Density Comparison.

FOLIAGE DENSITY AFTER FOUR GROWING SEASONS (in percent of plot area covered)			
Vegetation/Fertilizer Application	No Compost	Compost 160 Mg/ha	Compost 416 Mg/ha
Grass only	5	80	95
Grass plus 10-20-20	6	86	99
Grass plus 10-20-20 and lime	11	83	—
Grass plus 33-0-0	43	100	100
Grass plus 33-0-0 and lime	8	—	99
Virginia pine plus 33-0-0	30	95	70

Adapted from Utilization of Municipal Solid Waste Compost: Research Trials at the Johnson City, Tennessee Facility (39).

As seen by the preceding table, compost has a profound effect upon the production of vegetation. Reportedly, native vegetation continued to develop on the composted plots with no visible adverse toxicity symptoms (39).

W&H Pacific of Portland, Oregon, conducted a study using mixed yard debris (MYD) compost-medium grade, MYD-coarse grade, and leaf compost. Compost performance was compared with sediment control fence and wood fiber hydro-mulch with tackifier. The two sites chosen for testing were the St. John's Landfill site with eight test plots and the Murray Boulevard site with five test plots. The plot configuration consisted of a 9.8 m long by 2.75 m wide rectangle with V-shaped collection troughs down slope. The St. John's Landfill site had a slope of 34%, and the Murray Boulevard site had a slope of 42%.

Results from the study demonstrated that application of compost as an erosion control device is at least as effective as sediment control fencing and wood fiber mulch. Data collection consisted of testing for total suspended solids, settleable solids, total solids, turbidity, nutrient analysis, and heavy metal content of collected runoff samples from the five storm events. Settleable solids and total suspended solids were considered by the researchers as the most valuable for erosion control evaluation. Soil loss from the compost plots was less than that of the sediment control fence plots and similar to the hydro-mulch and tackifier plots. Table F shows settleable solids and total suspended solids for St. John's Landfill and Murray Boulevard sites.

Table F. St. John's Landfill and Murray Boulevard Study Results.

SETTLEABLE SOLIDS - ml/L (maximum)							
Site	MYD Medium	Leaf Compost	Sediment Fence	Control	MYD Barrier	Hydro-Mulch	MYD Coarse
St. John's Landfill	0.8	2.8	32	34	2.6	3	1.4
Murray Boulevard	0.7	1.2	0.5	2.5	—	—	0.6
TOTAL SUSPENDED SOLIDS - Mg/L (maximum)							
St. John's Landfill	280.0	740.0	26,000.0	31,000.0	1,300.0	740.0	690.0
Murray Boulevard	310.0	280.0	625.0	2,300.0	—	—	230.0

Adapted from Demonstration Project using Yard Debris Compost for Erosion Control: Final Report (41).

Some problems encountered by the researchers on the Murray Boulevard site dealt with the residual tackifier. Surface conditions at both sites were removed as part of the site preparation for the erosion control study, but some tackifier still remained at Murray Boulevard. The total amounts of rainfall received were 117 mm at St. John's and 94 mm at Murray Boulevard, yet the control plot at St. John's recorded a maximum soil loss of 31,000 Mg/l while Murray Boulevard had only 2,300 Mg/l of total suspended solids. Researchers believe that residual tackifier was responsible for this range of soil loss. Another problem was compost chunks rolling down slope to the collection areas. The chemical analysis of the test plots collection samples indicated that maturity and stability of the compost used has an effect upon water quality. Quality control of the compost and sediment control fences placed at the toe of the slope may help prevent this contamination in the future (41).

Subsequently, Metro, in conjunction with Unified Sewerage Agency, the Oregon Department of Transportation (ODOT) Highway Division, City of Lake Oswego, and Metro Solid Waste and Planning Departments in the Portland, Oregon, area conducted other studies on the effectiveness of compost as an erosion control method. The compost used was yard debris compost screened through a 16 mm trommel, 19 mm minus and some unscreened at 25-38 mm minus. Quantitative data on sediment loss, etc., was not available because evaluation of effectiveness was gathered through visual surveys of the sites. Table G summarizes the study results.

Table G. Metro Compost Study.

METRO'S YARD DEBRIS COMPOST STUDY				
Site	Compost Applied	Test Plots	Storm Event	Results
Springwood	<ul style="list-style-type: none"> • 16 mm minus 20% moisture content • 76 mm cover 	<ul style="list-style-type: none"> • 6-7.6 m x 7.6 m down slope • 5% top to 25% (14°) bottom 	49.5 mm during 24 hour period	<ul style="list-style-type: none"> • Major benefit for erosion prevention • Stabilized slope • Coarser compost may be more beneficial
Marylhurst	<ul style="list-style-type: none"> • 16 mm minus and 13 mm minus • 40-45% moisture content • 76 mm cover 	<ul style="list-style-type: none"> • #1 - 30.5 m down slope x 15 m, > 5% (3°) • #2 - 15 m down slope x 15 m, 15% (8°) 	30 mm and 51 mm in 24 hours respectively in January and February	<ul style="list-style-type: none"> • Controlled flow of water by absorbing and holding water • 40-45% moisture content made difficult to spread • Gentler slopes "held own" • Point flow affected steeper slopes • Coarser grade compost less aesthetically pleasing, recommend removal for landscaping
McLoughlin	<ul style="list-style-type: none"> • 19 mm minus • 15% moisture content • 76 mm cover 	<ul style="list-style-type: none"> • A-83.9 m x 3-7.6 m down slope 70% (35°) • B-47 m x 15-18 m down slope 70% (35°) • C-33.5 m x 4.6 m down slope 27% (15°) • D-10.7-15 m x 49 m down slope 1 to 9% (1 - 5°) 	Up to 51 mm in 24 hour period	<ul style="list-style-type: none"> • A, B, and C effectively stabilized. • D too level sloped to be effective • Best result on 10-65% slope and >18 m down slope • Virtually no maintenance of compost post-application • Highly effective and cost-effective method of erosion control

Guidelines were established based on the results of these studies and the 1993 project. Points of interest to TxDOT are excerpted and summarized as follows:

- A layer of compost can provide access by foot or vehicle to slopes previously inaccessible due to mud created by heavy rains on clay soils.
- A layer of compost at the exit of a site will keep mud from being tracked onto adjacent streets by vehicles leaving a construction site.
- Effective application thickness is an average of 7.6 cm.
- Application of compost with a moisture content of less than 25% will facilitate application and allow for better absorption of water during a storm event.
- High quality, mature compost will give the most effective result.
- Nineteen mm particle size was most effective as an erosion control method and as soil amendment. The larger size pieces were less aesthetically acceptable for landscape purposes, and the finer grade was less effective as an erosion control method. Coarser grades are best for steeper slopes.
- Compost can be effectively used on slopes up to 70% (35°).
- Extend compost cover for 0.61 m to 0.92 m above slope to reduce the velocity of flow or possibly a berm.
- Consider end use of area to determine which grade of compost will be best suited for the site. A future landscaped area may require a finer grade to avoid repeated application of finish grade compost for soil amendment.

The Unified Sewerage Agency and the site coordinator from ODOT recommended the use of yard debris compost for erosion control as a result of these studies (22).

SHREDDED BRUSH AS MULCH

Mulch consists of any material, organic or inorganic, applied to the surface of the soil. Its purpose is generally for reducing the energy of rainfall for erosion prevention, moisture retention, and weed control (in landscaping). The benefits of using shredded wood mulch lie in its ability to:

- act as a buffer to absorb rainfall energy;
- reduce immediately wind and water erosion (1);
- stimulate microbial activity to increase decomposition of organic materials in the soil, thereby adding to the soil structure;
- prevent soil compaction and crusting, thereby facilitating percolation;
- slow the flow of water over the surface of the soil;
- capture and retain moisture, reducing soil moisture loss and thereby facilitating plant growth (1);
- provide suitable microclimate for seed germination (42);
- capture blowing snow to increase the insulating effect of winter protection (1);
- improve and stabilize soil texture; and
- provide an outlet for using waste that might normally be burned or landfilled (4).

Mulching provides a better environment for fostering plant growth by helping regulate soil fertility, temperature, and moisture. As stated in the Virginia Erosion Control Handbook, “A surface mulch is one of the most effective means of controlling runoff and erosion on disturbed land” (40). Established vegetative ground cover and mulching can provide up to 98% reduction in erosion and site soil loss (26). Vegetation establishment is usually the prime objective of erosion control, whether as a temporary measure or as a permanent surface condition. Application of a mulch, either as compost or shredded wood, is an effective erosion control method that does not need to be removed after construction. The mulch is left in place to provide a soil amendment for vegetation establishment and landscaping. This eliminates costly post-construction slope erosion control device removal and disposal. Compared to conventional erosion-control methods, maintenance of sediment control fences, and addition of soil amendment post-construction for landscaping, organic mulches seem to be a logical course of action for transportation agencies.

Performance criteria for wood mulch included fiber length, application rate, and tackifiers. The wood fibers need to be long enough to mesh together and provide optimum protection. A length of at least 10 cm to 20 cm is adequate for loose straw and hay. Shredded wood (wood chips) has similar physical characteristics of meshing together for effectiveness, yet wood is not as subject to decomposition as hay or straw. Fiber length for the wood chips used at the TxDOT/TTI Hydraulics and Erosion Control Laboratory for the Compost/ Shredded Wood Mulch Study was approximately 7.6 cm. The *Virginia Erosion and Sediment Control Handbook* recommends an application rate of 9 to 13.5 Mg/ha or .9 to 1.3 kg/m³ for wood chips (40). A dull-bladed coulter disk or crimper can be used to anchor the mulch to the soil surface on slopes of 3 to 5%. *Storm*

Water Quality Best Management Practices for Construction Activities (26) recommends using mulches on slopes not greater than 5%.

Steeper slopes, greater than 5%, require different applications. Tackifiers are often necessary to keep the mulch in place because of runoff and wind erosion. Tackifiers cause the fibers to adhere to themselves, as well as to the slope surface. Tackifier application rates vary depending on the product, severity of site conditions, climate, and desired longevity of the installation. Most tackifiers are generally comprised of asphaltic emulsions; petroleum distillates; emulsions of copolymer acrylates; latexes and polyvinyl acetates; clay colloids; and dry powdered vegetable gums derived from guar, psyllium, and sodium alginase (1). Many of the asphaltic emulsion and petroleum distillate tackifiers are used less frequently due to water quality issues.

The use of inorganic tackifiers, such as the copolymers, is an effective erosion control device. The copolymer was chosen to ensure the most effective erosion control while maintaining water quality. Testing done by the Bureau of Land Management in southwestern Oregon used liquid copolymer with wood fiber mulch. The average slope gradient was 65% with some slopes being as much as 100%. Cut banks were as high as 23 m. The average rainfall varied from 64 to 254 cm. After 15 months, the mulch was still sticking to small inclusions of the exposed bedrock. There was no apparent need for ditches to be cleared of sediment, as was previously necessary as part of routine maintenance operations before this application. Hydraulic seeding with a wood mulch but without the tackifier failed, producing less than 15% vegetative cover.

Dr. Jerry Fifield of Hydrodynamics, Inc. in Parker, Colorado, compared the effectiveness of soil stabilizers with various hydraulic mulches and erosion control blankets on slopes of 1:3 and 1:1.5 in semi-arid climate. When combined with straw mulch, the liquid copolymer was similar in effectiveness to the erosion control blankets (18).

A drawback of the liquid copolymer application is the overspray. It has a tendency to stick to whatever it hits and is not easy to remove. This could be problematic in tight application areas, such as urban rights-of-way.

MULCH STUDIES FOR EROSION CONTROL

Mulches of straw, domestic refuse, pomace, and raw and composted bark (with and without wood fiber) were tested in vineyards of Beaujolais for their effectiveness as an erosion control measure. An oscillating nozzle rainfall simulator was used on an area of one meter square, one hour duration with uniform 60 mm/h intensity applied to each plot. The mulches proved effective during the year in which they were applied. After this time, they seem to lose their effectiveness through decomposition or because they are carried away. The application must be repeated every 2 or 3 years to maintain the effect on runoff generation (see Table H). The raw bark mulch had a moderate efficiency for runoff limitation. The composted bark and fiber are more expensive than the raw mulch with no additional advantage. Results seemed to indicate that the mulch material itself was not as important as the amount of material applied. For this experiment, the application rate was 150 m³/ha. The study indicated that a greater application rate should prove

more effective (16).

Table H. Beaujolais Mulch Study - Wood Materials Effectiveness Comparisons.

WOOD MATERIALS	Number of Applications	Runoff Factor	Eroded Soil
Raw Bark	4	66±22	3±2
Composted Bark	4	88±8	8±1
Composted Bark and Fiber	4	92±5	18±11

Results indexed in comparison with the reference plot (no-tilled bare soil = 100)(16).

There are some disadvantages to using a wood mulch as discussed in *The Mulch Book: A Guide for the Family Food Gardener* (4). The wood may attract rodents and insects. This in itself may not be a problem in a highway right-of-way environment. In addition, very fresh mulch can deplete the soil of nitrogen during the decomposition process, thereby causing nitrogen deficiencies in the plant material. *Storm Water Quality Best Management Practices for Construction Activities* (26) and the *Virginia Erosion and Sediment Control Handbook* (40) recommend the addition of 6 kg of ammonium nitrate (nitrogen) per Mg of wood chip mulch used. The *Virginia Erosion and Sediment Control Handbook* states that application costs may be offset by using wood chips from trees cleared from the site.

COMPOST/SHREDDED BRUSH - OTHER APPLICATIONS

Compost and shredded brush usefulness goes beyond surface application as an erosion control device. Many state guidelines include the use of brush berms for detention/sedimentation control, diversion dikes, and detention devices. *Temporary Erosion Control Measures Design Guidelines for TxDOT* (15) shows a VM value of 0.35 for maintained brush berms with an effective service life of 60-90 days. Similarly, using berms as detention/filtration and flow spreading/energy dissipating devices shows a VM factor of 0.35 and a service life of approximately 90 days. Table I shows application areas for brush berms.

Table I. Shredded Brush Erosion Control Applications.

SHREDDED BRUSH EROSION CONTROL APPLICATIONS				
FUNCTION	Slope	Channel	Perimeter Control	Inlets
Flow Spreading/Energy Dissipating	X	X	X	
Detention/Sedimentation	X	X	X	
Detention/Filtration	X	X	X	X

Compost applications include berm placement at the toe of a slope, in front of sediment control fences as an additional filtration, water absorption device and/or a layer above the top of the slope to slow sheet flow and dissipate the rainfall energy. Although not tested as part of the study, the compost filter was recommended in the *Demonstration Project Using Yard Debris Compost for Erosion Control* (41) study as a possible compost application. There was an estimated additional \$2.79/linear meter cost for this application, but the trenching-in of the sediment fence would not be necessary, thereby offsetting installation costs. Appendix B contains a diagram of this application. The Composting Council also recommends this application or the use of a compost berm up to .61 m high by 1.22 m wide, depending upon the severity of slope, in lieu of sediment control fencing at the toe of a slope (7).

Another advantage to compost use is its ability to chemically bind substances, such as heavy metals and toxic organics including hydrocarbons, pesticides, and herbicides. Compost effectively destroys many of these compounds through bioremediation. Compost filters have potential for “cleaning” storm water discharge before its entrance into receiving waters. As noted in the *Demonstration Project Using Yard Debris Compost for Erosion Control* (41) study, the use of high quality compost is essential in obtaining adequate pollution control. A low grade, immature or unstable compost can add to contamination of water by leaching nutrients and/or heavy metals. Compost that is relatively dry (40% water content or less) effectively binds the elements and reduces leaching (7).

Proprietary storm water management systems that utilize a specialized compost component as a treatment and filter for surface runoff are currently being marketed. According to the manufacturer’s information, the filter is capable of removing 90% of all solids, 85% of oil and greases, and 82% to 98% of heavy metals from storm water discharge, and is able to act in a sponge like manner to absorb any hazardous materials resulting from a roadway spill.

SUMMARY OF LITERATURE REVIEW

Literature indicates a potential for compost and/or wood chip mulch to be used as an erosion control measure. Actual performance of these materials on the erosive soils of a highway construction site or an erosion resistant soil (vegetative growth) within the right-of-way environment remains relatively unknown. A comparison of compost and wood mulch performance with cellulose fiber mulches, tackifiers, and erosion-control blankets is necessary for determining feasibility. Performance evaluation from the studies in the literature were based upon small plot sizes. This would indicate a need for large scale plot size testing with conditions that simulate the highway environment. Testing parameters such as these are available through the TxDOT/TTI Hydraulics and Erosion Control Field Laboratory.

Feedstock availability needs to be addressed. Wood for mulch and compostable green waste can be collected from clearing operations in the eastern regions of the state. Many districts, especially in the western part of the state, may not have enough debris to warrant this method. Other sources may need to be secured. A project specific evaluation will be necessary to ascertain feasibility of converting right-of-way debris into wood mulch and/or compost. Composting, unlike mulching, must consider time and space for processing, as well as quantity of feedstock. These may prove to be prohibitive factors for on-site composting. Composting time for mixed yard debris in a windrow configuration is a *minimum* of approximately 12 months using low to medium-level technology, depending upon feedstock. Composting with the addition of other waste products, i.e. manure, sewage sludge, or the use of higher level technology can reduce this time significantly. Construction sites within limited rights-of-way, such as urban areas, may not have enough space to do on-site composting. Construction practices that require immediate slope protection or active construction areas may not be suitable for on-site composting.

The advent of municipal and county level centralized compost/mulch facilities opens possibilities for TxDOT as a place for disposal of right-of-way refuse and as a source of ready-to-use compost and mulch. The map in Figure 2 shows the cities that are currently listed with the TNRCC as centralized composting facilities. Proximity of these facilities to major transportation corridors will factor into disposal and procurement costs.

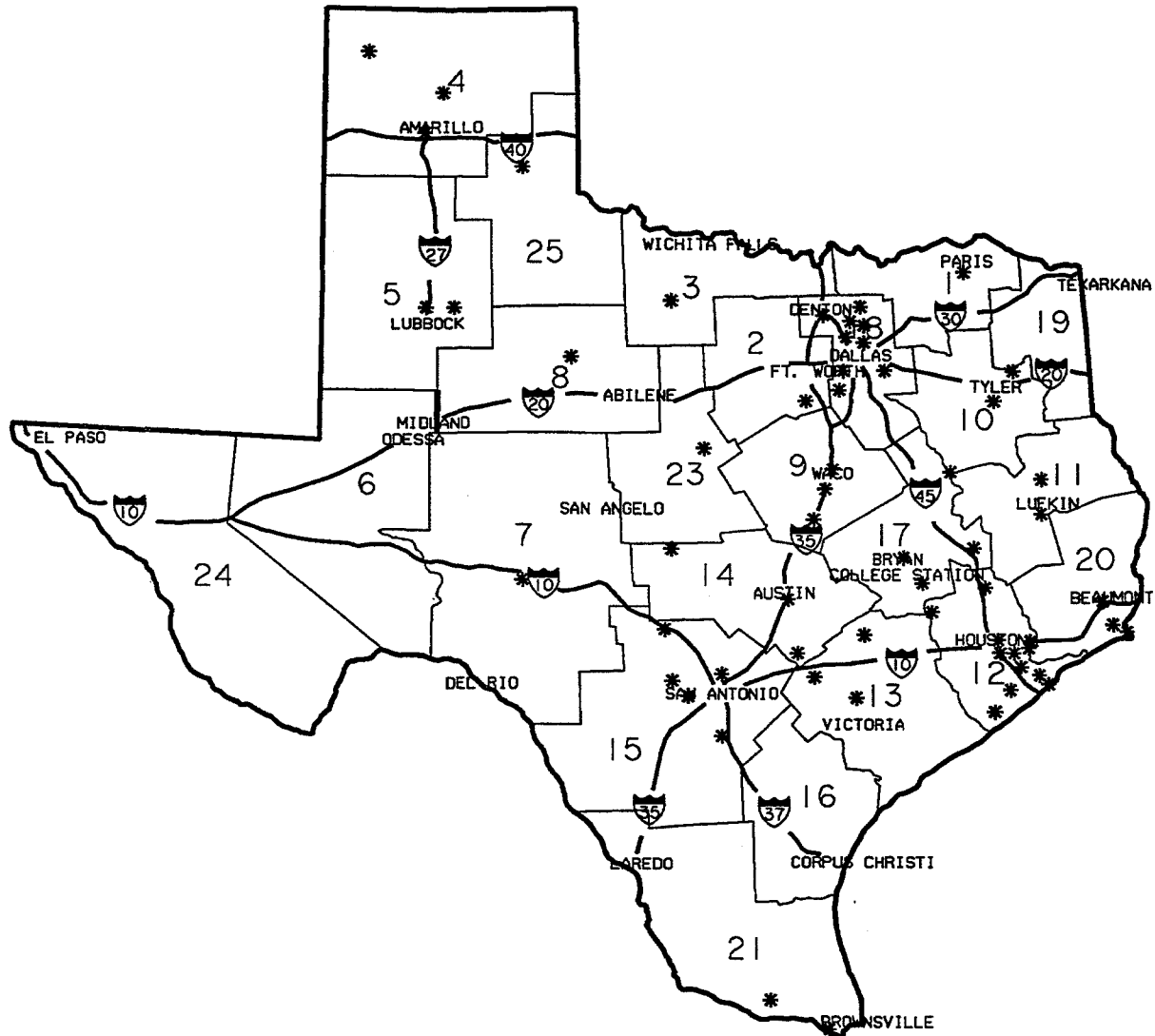


Figure 2. Centralized Compost Facilities in Texas.
 Source: *Texas Directory of Recycling Resources & Information* (36).

Although seasonal in supply, another possible source for wood mulch are the municipalities with Christmas tree disposal programs. These trees are usually fed through a chipper to produce wood mulch for use in municipal landscapes. Appendix A lists cities with this program.

Maintenance of slopes using composts as an erosion control method is minimal. Reapplication

to problem areas is relatively easy. The Compost Council in *Suggested Compost Parameters and Compost Use Guidelines* (7) states that if applied in a 76-100 mm layer on slopes up to 45%, compost will remain effective as an erosion control device for up to one to three years.

Inherent advantages of using an organic application for erosion control is that it:

- beneficially alters the texture and structure of the soil in a manner that resists erosion;
- remains in place post-construction as a soil amendment;
- uses debris that might normally be landfilled or burned;
- fosters vegetative growth; and
- complies with recycling legislation.

From the literature, the use of shredded brush and compost on rights-of-way seems to be effective, not only as an erosion control method, but as an organic residual management option.

HYDRAULICS AND EROSION CONTROL LABORATORY

Performance testing for the compost and shredded wood study was conducted at the TxDOT/TTI Hydraulics and Erosion Control Laboratory (HECL). This facility is part of the Texas Transportation Institute's proving grounds at the Texas A&M University Riverside Campus, 6.5 km west of Bryan, Texas. The laboratory site is bounded on the north, east, and west sides by runways with an open field to the south. Because the site (originally a military airport facility) is on a ridge just above the Brazos River, harsh climatic conditions exist. The soils are generally low in organic content, and the site is influenced by heat energy stored in, or reflected from the surrounding pavement. These unique physical conditions provide the most realistic conditions possible for conducting controlled experiments related to the roadside environment.

The facility was built on the 8.5 hectare site in 1990. The Texas State Department of Highways and Public Transportation 1982 Standard Specifications for Construction of Highways, Streets and Bridges governed construction. The density control method was in accordance with test method Tex-114-E. Test method Tex-115-E was the compaction control. The Texas Department of Transportation District 17 Laboratory in Bryan and the TTI Field Laboratory manager performed field testing (see Figure 3).

Nominal dimensions for the "L"-shaped embankment measured 6.75 m vertical height, 267 m in length, 1:2 sloped condition on the west side, and 1:3 sloped condition on the east side. Test plots were 6.2 m across and 15 m or 21 m down slope, depending upon the slope condition. The embankment design provided a total of 70 test plots. One-half of the test plots were sandy loam soils (SL) ($K=0.38$), and the other half were clay soils © ($K=0.20$). The post-construction soils samples were analyzed by SASI, Inc., with references made to the *National Soils Handbook* (45). The K values were determined on post-construction soil samples following SCS soil erodibility nomograph *Predicting Rainfall Erosion Losses - A Guide to Conservation Planning* (46).

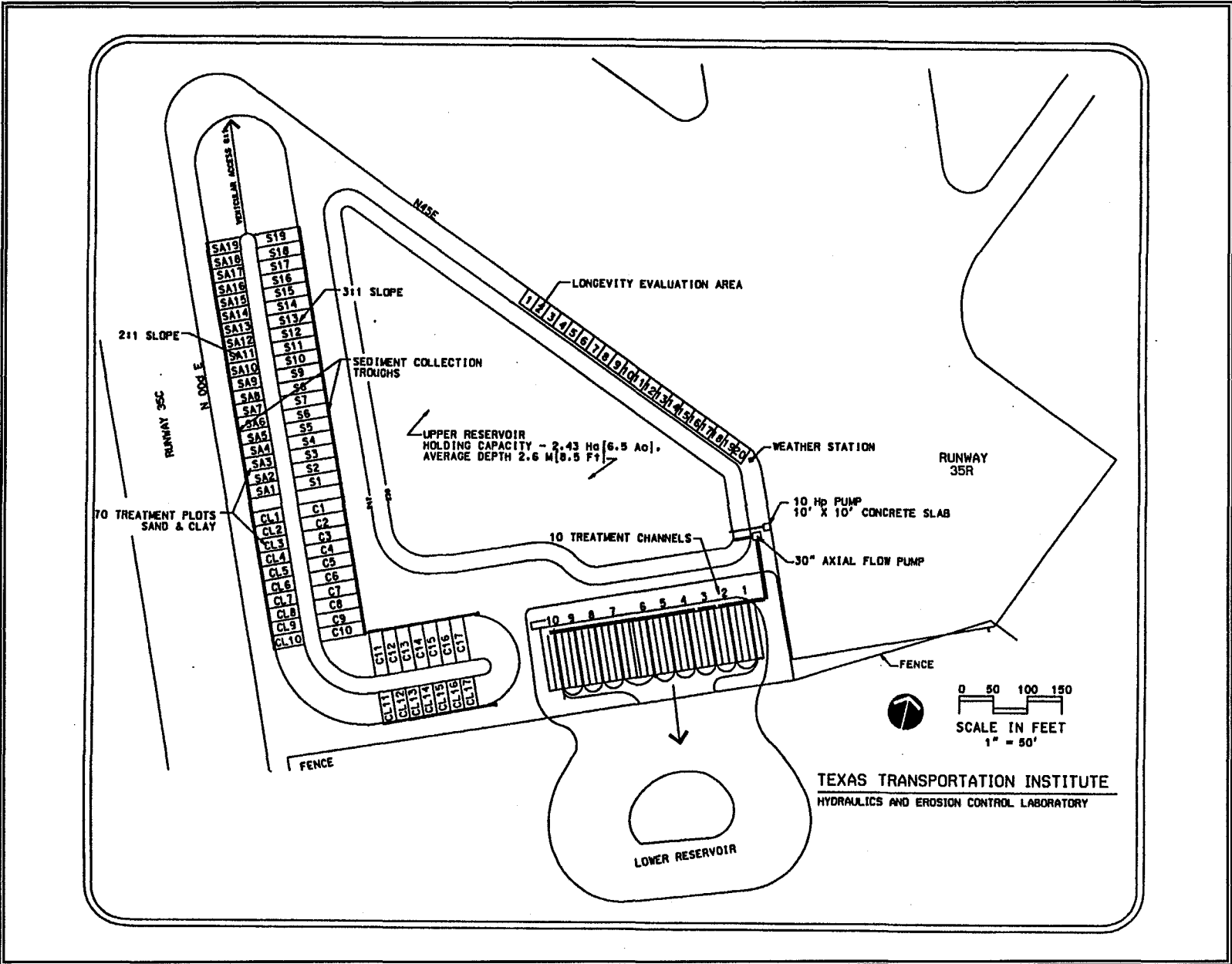


Figure 3. TxDOT/TTI Hydraulics and Erosion Control Field Laboratory

Sediment collection boxes were at the base of the embankment. These boxes are precast concrete sections that were set in the field. Physical dimensions of each box are 607 cm by 46 cm wide by 15 cm depth. The flow line is "V"-shaped, giving the box a holding capacity of approximately 418 liters. Removable plywood dividers separate the boxes (see Figure 4).

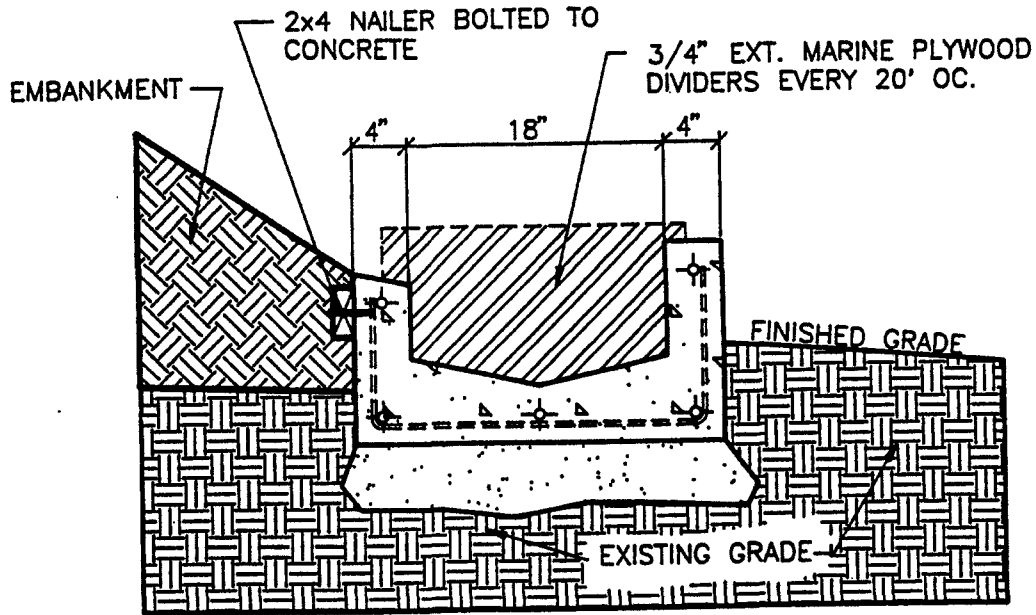


Figure 4. Section through Sediment Collection Trough.

Two reservoirs created as the result of the embankment and channel construction have a vertical elevation difference of approximately 1.5 m. The upper reservoir surface area is 2.43 ha. This reservoir was the primary water supply source for all of the experimental work. An underground water supply system located along the top of the embankment for the slope treatment plots provided water for simulated rainfall events.

A ten-horsepower centrifugal pump supplied one of four rainfall simulation machines stationed on the embankment. Each simulator unit consists of a series of arms spaced 1.5 m apart, mounted on a steel frame and set approximately 0.60 meters above the ground plane. Pressure gauges located on the arms control water flow through the coarse spray, adjustable, irrigation nozzles. The nozzles spray upwards away from the slope face approximately 1 to 1.5 m to provide greater drop velocity. Each unit may provide 25 - 300 mm of precipitation per hour as calibrated. Drop size is generally representative of natural rainfall.

The recording weather station equipment was installed at this time and was positioned on-site to provide continuous and accurate climatic conditions. Features of the weather station include a tipping-bucket rain gauge, hygrothermograph, barograph, recording anemometer, and pyrometer.

COMPOST AND SHREDDED BRUSH STUDY

OBJECTIVE

The objective of this research study was to determine the field performance of compost and shredded brush (wood chips) with tackifier as erosion-control materials for use in highway rights-of-way. Test procedures were based upon field performance evaluations conducted in a simulated highway environment. Test materials for this study were:

- compost consisting of mixed yard debris with biosolids (municipal sewage sludge) processed through a 6.35 mm screen;
- shredded wood (wood chips processed through a 76 mm screen) with TERRA TACK™SC, a granular polyacrylamide tackifier; and
- shredded wood (wood chips processed through a 76 mm screen) with RMB Plus, a hydrophillic colloid tackifier.

METHODOLOGY

The methods adopted for use in the research study were well developed and have been employed at the HECL for five consecutive years. Each test plot is at a scale that adequately represents the highway environment.

Each test material was applied approximately 76 mm deep overlaying seeded soil (sandy loam and clay) in a 1:3 slope condition. Experimental controls consisted of one plot for each soil type receiving the same vegetative treatment with no erosion-control material in place. Test plot data relative to each materials' sediment retention performance and apparent vegetative density coverage with respect to soil type was collected and statistically analyzed.

Performance Criteria

The material performance criteria for this study were as follows:

- Acceptable erosion-control materials should reduce the sediment loss from the protected treatment area greater than acceptable loss stated in the TxDOT Approved Materials List (Specification Item 169 - Soil Retention Blankets).
- Erosion-control materials should effectively protect the seed bed from a short duration and one-year return frequency rainfall event (99% probability of occurrence within a given year) within the first month after installation.
- Erosion-control materials should effectively protect the seed bed from a short duration and two-year return frequency rainfall event (50% probability) within the first three months of installation.

- Erosion-control materials should effectively protect the seed bed from a short duration and five-year return frequency rainfall event (20% probability of occurrence within a given year) throughout the testing cycle (growing season, March-November).
- In cohesive soils (clay) and a sloped condition, sediment loss should be no greater than 0.34 kg/10 m² during the testing cycle.
- In non-cohesive soils (sandy) and slopes flatter than 1:3, sediment loss should be no greater than 12.21 kg/10 m² during the testing cycle.

Vegetation establishment criteria were as follows:

- Acceptable erosion-control materials should promote significantly greater vegetative cover on the protected treatment area as stated in TxDOT's Approved Materials List (Specification Item 169 - Soil Retention Blankets).
- Acceptable erosion-control materials should promote a vegetative cover within the testing cycle by protecting the seed bed from the impacts of rain splash and preventing damaging rill formations.
- In cohesive soils (clay) and sloped conditions, vegetation density should reach a minimum coverage of 80% during the testing cycle.
- In non-cohesive soils (sandy) and sloped conditions, vegetation density should reach a minimum coverage of 70% during the testing cycle.

Material performance criteria were as follows:

- Acceptable erosion-control materials should be able to retain their physical properties during the testing cycle without excessive rill formations.
- Erosion-control materials should provide protection for the seed bed until a sufficient stand of vegetation is established, or duration of testing cycle.

Rainfall Simulation

Rainfall intensity determination was based upon rainfall intensities of anticipated storms during a typical vegetation establishment period. To adequately model the rainfall simulations for the State of Texas, the researchers chose to derive the rainfall intensity values from a 36 county area that reaches between Houston, Dallas, and Austin. This area was chosen since it contains the highest percentage of state maintained highways. The method used to derive the intensity values was the Modified Steel Formula (7), as shown below:

$$i = \frac{b}{(t_c + d)^e}$$

where b, d, and e are constants.

The values of the constants b, d, and e were obtained from the National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) Technical Paper No. 40, "Rainfall Frequency Atlas of the United States." Table 6 of the SDHPT (TxDOT) Hydraulics Manual contains the *i* values for each county. The researchers derived the intensity values for the erosion-control materials study by computing the values of *i* for the 36 county area based upon a short storm duration. The researchers assumed that more damage occurs from the impacts of rain splash in a steep slope situation (1:3 or greater) subjected to a short duration, high probability design storms than from a moderate slope situation (1:4 or less) with a larger runoff area. Therefore, the storm duration, t_c , was 10 minutes since the majority of disturbed slopes (cut slopes and embankments) are at the upper limit of the micro-watershed.

Vegetation Density

Data was needed that would accurately depict the vegetative density or apparent vegetative cover for the test cycle. The Vegetation Coverage Analysis Program (VeCAP) was used to analyze the percentage of vegetative growth on the test plots. VeCAP calculates the percentage of pixels in a sample image by color. Samples recorded in the field are converted to digital images for analysis.

INSTALLATION PROCEDURES

STUDY AREA PREPARATION

The researchers prepared each of the study areas in a similar manner by soil preparation, and seeding application, followed by material installation. The soil preparation consisted of the following steps:

- For the sloped study plots located on the embankment, an experienced roadway contractor performed the major earthwork operations that included stripping the previous year's materials, providing replacement soil, and rough grading.
- Once the treatment plots were rough graded, the researchers sterilized the soil with methyl bromide.
- The contractor then returned to the site and fine graded the plots with the research team hand-raking each plot prior to installation.

A soil analysis was performed prior to each evaluation cycle by an independent soil laboratory to verify the soil class and provide the information necessary to determine a soil erodibility factor, or "K" value. For 1995, the sloped treatment plots soil was predominantly classified as either a clay, (C), with a "K" value of 0.28 or a loamy sand (LS) with a "K" value of 0.16.

SEED APPLICATION

The seeding mixtures selected were from TxDOT's standard seeding specification, Item 164 - Seeding for Erosion Control published in the *1993 TxDOT Standard Specifications for Construction of Highways, Streets, and Bridges* (43). Since the laboratory is located in the Bryan District, the rural area species for warm-season perennial vegetation were hydraulically applied in a one-step application process. A one-step process, where seed and fertilizer are mixed in a water slurry and sprayed by a hydroseeder, is the most typical application method used by TxDOT. Specific mixtures selected included a mixture for clay or tight soils and a mixture for sand or sandy soils. In clay or tight soils, the recommended seed mixture includes the following species and rates given in kilograms of pure live seed per hectare:

- | | |
|------------------------|-----------------|
| • Green Sprangletop | 0.67 kg/ha, |
| • Bermudagrass | 0.90 kg/ ha, |
| • Little Bluestem | 1.23 kg/ha, |
| • Indiangrass (Lometa) | 1.68 kg/ha, |
| • K-R Bluestem | 0.78 kg/ha, and |
| • Switchgrass (Alamo) | 1.35 kg/ha. |

In sand or sandy soils, the recommended seed mixture includes the following species and rates given in kilograms of pure live seed per hectare:

- Green Sprangletop 1.23 kg/ha,
- Bermudagrass 1.68 kg/ha, and
- Bahiagrass (Pensacola) 16.55 kg/ha.

MATERIAL INSTALLATION

A 76 to 101 mm layer of material covered each of the 6.2 m across and 21 m downslope 1:3 test plots. The compost and wood chips were obtained from Brazos Valley Biosoils in Bryan, Texas. The materials were hand-applied using wheelbarrows and rakes. Effort was taken to maintain a consistent 76 to 101 mm layer throughout the test plots. The tackifiers were applied to the shredded wood in a water solution using a hydromulch machine. Application rates were 6.75 kg/ha for the TERRA TACK™SC and 56 kg/ha for the RMB Plus.

The materials, compost, and wood chips with RMB Plus and TERRA TACK™SC tackifiers, were installed on the clay test plots on May 15, 1995, and on the sand test plots on May 26, 1995.

DATA COLLECTION

SEDIMENT DATA

Rainfall simulations began on July 19, 1995, with each plot receiving a series of rainfall simulations for the 1-year, 2-year, and 5-year design storms. The following description details how the data was collected for each storm event to determine the sediment retention performance.

After each simulated rainfall event, the sediment and water were collected with a wet-dry vacuum into labeled buckets, covered, and temporarily stored. The sediment was allowed to settle for at least 24 hours before the top layer of water was vacuumed off and discarded. Soil samples collected from each bucket were capped, labeled, and stored in the lab office. The remaining soil in the bucket was weighed, recorded, and discarded at this time. To determine the moisture-to-sediment ratio, the soil samples were used to calculate the total dry weight of sediment.

Each soil sample was dried to arrive at the wet/dry ratio. First, the soil sample was weighed, recorded, and emptied onto a microwave cooking dish. Any material left in the sample bottle was rinsed with water and added to the cooking dish. The researcher dried the soil for several minutes followed by another weight measurement. This process continued until three consecutive weighings were equal. The dry sample weight was recorded and averaged with the other samples to determine an average wet/dry ratio. This ratio was divided into the total weight of sediment to obtain the dry weight of the collected sediment. Finally, the dry sediment weight total was divided by the number of 10 square meters for each plot to figure total sediment loss. Table J shows the rainfall simulation schedule for the 1995 compost and wood chips with tackifier evaluations.

Table J. 1995 Rainfall Simulations.

1:3 Sand Study Treatment Plots						
Material	1 yr. #1	1 yr. #2	2 yr. #1	2 yr. #2	5 yr. #1	5 yr. #2
Compost	7/19	8/18	9/07	9/13	9/28	10/09
Wood Chips with TERRA TACK™SC Tackifier	8/10	8/21	8/30	9/11	9/28	10/09
Wood Chips with RMB-plus Tackifier	8/10	8/21	8/28	9/07	9/25	10/11
1:3 Clay Study Treatment Plots						
Compost	8/10	8/18	8/31	9/13	9/27	10/09
Wood Chips with TERRA TACK™SC Tackifier	7/26	8/21	9/01	9/13	9/27	10/12
Wood Chips with RMB-plus Tackifier	7/27	8/18	8/31	9/13	9/25	10/12

The researchers adhered to the following criteria for simulating rainfall events:

- Rainfall simulations did not occur within 24 hours of natural rainfall, or during any natural precipitation;
- Simulations were not done when the wind conditions were such that most of the water blew onto the adjacent plots. If the wind was calm, the plots adjacent to the treatment plot were covered with a plastic film immediately before the rain simulation was started; and
- After each rain simulation, the plastic film was removed from adjacent plots, and the sediment and runoff was collected from the test plot trough.

VEGETATION DENSITY DATA

Each test plot was subdivided on a graph into a grid of 0.50 m² sections. A random sampling pattern established with a random numbers table was used to set the sample locations. The researchers recorded 30 samples from the 1:3 sloped treatment plots with an 8 mm camera positioned perpendicular to the sloped surface. The video analog images were converted to digital images using a Targa 16 board and TIPS software. The researchers processed each image (sample) with the VeCAP program to determine the percentage of apparent vegetation coverage. Samples were taken throughout the test cycle to determine the progress of vegetative growth. Total percentage of vegetative cover was based upon the final round of VeCAP.

PERFORMANCE ANALYSIS

Of the types of materials tested at HECL, the standards for erosion-control blankets were chosen as a basis for evaluation in this study. Although compost and wood chips with tackifier do not have that same physical properties as an erosion control blanket, the performance capabilities of these materials demonstrated in the literature suggested comparable effectiveness.

COMPOST

The compost produced 92% vegetation cover on the sand slopes. The vegetative cover on the clay slopes was 99%. Although vegetation coverage was greater than 90% on the sand and clay plots, the majority of the vegetation on the sand plot was due to Palmer amaranth (*Amaranthus palmeris*) rather than the seed mix. The plant height was approximately two meters. The undesirable seed may possibly have been in the compost itself and germinated upon application to the slope. The clay plot with the same compost, adjacent plots with other erosion control materials, and the wood chips with tackifier plots did not show a significant presence of this plant.

The compost on sand plot lost an average of 3.88 kg/10m² of sediment during rain simulations. This result exceeded the performance standard for sediment loss for erosion control blankets with the control plot losing 28.576 kg/10m². On the clay slope, sediment loss for compost was 0.34 kg/10m². This result met the maximum acceptable sediment loss for 1:3 clay. The control plot for 1:3 clay had a sediment loss rate of 1.3015 kg/10m².

The compost maintained its physical properties throughout the test cycle. The material did not significantly shift from its installed position and kept a fairly consistent depth the length of the slope. Contrary to anticipated, the compost did not blow to adjacent plots when dry or float when wet. There was minimal damage to the test plots from rill formation.

WOOD CHIPS WITH GRANULAR POLYACRYLAMIDE TACKIFIER

The wood chips with the granular polyacrylamide tackifier, TERRA TACK™SC, had vegetative cover results comparable to the compost treatment by producing a 95% vegetative cover on the clay test plot. The sand plot had less satisfactory vegetative cover by producing only 48%. The sediment loss on the sand test plot was 11.27 kg/10m², which was 0.93 kg/10m² less than the maximum allowable loss. The clay plot lost 0.15 kg/10m² of sediment. This was 0.19 kg/10m² less than the maximum allowable sediment loss for 1:3 clay treatment.

WOOD CHIPS WITH THE HYDROPHILIC COLLOID TACKIFIER

The wood chips with the hydrophilic colloid tackifier, RMB Plus, produced only a 50% vegetation cover on sand and only 57% cover on clay. Both results were below the acceptable minimum coverage. The sand plot lost sediment at a rate of 10.97 kg/10m² which is 0.30 kg/10m² less than the granular polyacrylamide tackifier and 7.09 kg/10m² more than the compost on sand plot. The sediment loss for the clay test plot was 0.30 kg/10m² which was twice the amount of sediment lost on the granular polyacrylamide plot and slightly less than the

compost on clay plot. These results for wood chips with hydrophillic colloid tackifier meet the minimum performance standards for sediment loss but, not for vegetation establishment.

All of the wood chips with tackifier test plots kept a consistent depth of material for the length of the slope. The materials did not blow onto adjacent plots and were not transported down slope during rain simulations or natural rain events. The test plots did not show any significant damage from rill formation through the test cycle.

Table K compares the test materials to TxDOT minimum performance standards for vegetation density and sediment loss for erosion control blankets. The shaded areas of the table denote test materials that meet or exceed TxDOT’s standards for the Approved Materials List. A visual survey of the compost plots on sand shows the impressive vegetation establishment. The performance of the materials are shown in Figures 5 - 8.

Table K. Performance Analysis.

Product Evaluated	Year	Slope	Soil	Maximum Allowable Sediment Loss 0.34 kg/10 m²	Minimum Allowable Vegetation Density 80%
Compost	1995	1:3	Clay	0.34	99
Wood Chips with TERRA TACK™SC	1995	1:3	Clay	0.15	95
Wood Chips with RMB Plus	1995	1:3	Clay	0.30	57
Product Evaluated	Year	Slope	Soil	Maximum Allowable Sediment Loss 12.21 kg/10 m²	Minimum Allowable Vegetation Density 70%
Compost	1995	1:3	Sand	3.88	92
Wood Chips with TERRA TACK™SC	1995	1:3	Sand	11.27	48
Wood Chips with RMB Plus	1995	1:3	Sand	10.97	50

COST COMPARISON OF EROSION CONTROL MATERIALS

The cost of the erosion control product currently in the industry varies greatly with product constituents. Using the materials tested at the TxDOT/TTI Hydraulics and Erosion Control Field Laboratory, a comparison of the average cost of the 5 types of erosion control materials are shown in Table L. The material cost of compost is about 20% less than the average organic blanket but approximately three times the cost of the average hydraulically applied mulch. The wood chips, if taken from right-of-way clearing operations, have a minimal cost. Further research into different application methods (mechanical application rather than hand application), equipment and sources will give a better cost evaluation.

Table L. Cost Comparison of Erosion Control Materials.

Material	Average Cost-\$/SM
Synthetic Blanket	3.90
Organic Blanket	1.20
Mulch	0.34
Wood Chips from ROW Clearing Operations	0
Compost	0.97

CONCLUSIONS AND RECOMMENDATIONS

The results were most encouraging. The compost met the minimum requirements for percentage of vegetative cover and was well within the sediment loss standard on sand and clay required by TxDOT for erosion-control blankets (soil retention blankets). The wood chips using both tackifiers met the same sediment loss performance criteria used for erosion control blankets for sand and clay soils. These results strongly suggest a potential cost savings benefit to transportation agencies. However, further research is needed to verify the results. Further examination of the following issues raised by this project is needed: cost effective application method; type and quality of vegetation; and tackifier types and application rates.

The application of the compost and wood chips for this study was labor intensive (wheelbarrows and rakes). This method would not be cost effective for highway construction or maintenance operations. Alternate application methods, including blowing and/or hydro-seeding equipment, should be examined prior to making any recommendations for field application. Review of potential application methods are under preliminary investigation.

While vegetation coverage using compost was well above the minimum acceptable levels, the characteristics of the vegetation warrant further investigation. The compost material used apparently contained weed seed, Palmer amaranth (*Amaranthus palmeris*), which contributed much of the vegetative cover. For this reason the desired seed mix did not compete well with the undesirable weed seed. Germination of the desired seed mix may also have been retarded by placing the compost and wood chips over the seed using the same installation as many erosion control blankets. In an attempt to ensure the germination of the desired vegetation, application of the seed mixture applied on top of or blended in with the compost needs to be investigated. If a water slurry is used, the seed mixture can be blended and applied by blowing, using the hydro-seeding method to ensure proper seed distribution.

Two different tackifiers were used with the wood chips. The granular polyacrylamide tackifier was applied at a rate of 6.72 kg/ha. The colloidal clay-based tackifier was applied at a rate of 56 kg/ha. The test plots using the granular polyacrylamide tackifier produced almost twice as much vegetation as the colloidal clay-based tackifier. Different tackifiers and their application rates to stabilize different soil types and slopes need to be examined to reinforce the capabilities of using wood chips.

The success of compost and wood chips with tackifier on 1:3 slopes suggests that further performance testing on the more demanding 1:2 slopes may be worthwhile. More rigorous tests on the 1:2 slopes will provide a good indication on the limits of each material's effectiveness.

The material cost of using compost and wood chips with tackifier is potentially below the average material cost of synthetic and organic blankets. The cost effectiveness of using these materials will be determined by accessibility of materials and more practical application methods. Debris from right-of-way clearing operations may possibly provide a cost effective

source for wood chips. Organic waste disposal costs may be dramatically reduced while providing on site erosion control material. Compost sources are located throughout the State of Texas with new composting facilities emerging.

With the testing done thus far, compost and wood chips with tackifier have demonstrated remarkable results. Further investigation to replicate results, confirm conclusions, and modify application method needs to be conducted before being recommended for use by the Department as erosion control materials.

GLOSSARY

AERATION - Providing air and oxygen to composting materials to aid in aerobic decomposition.

AEROBIC - Characterized by the presence of oxygen.

AEROBIC COMPOSTING - Decomposition of organic wastes by microorganisms in the presence of oxygen.

ANAEROBIC - Characterized by the absence of oxygen.

BIOSOLIDS - Municipal sewage sludge.

BULKING AGENT - Relatively large materials such as wood chips (or leaves, in sewage sludge co-composting operation) that create air space within compost.

COMPOST - Decomposed, humus-like organic matter produced through composting. Depending on the waste source (feedstock), compost may have some nutrient value and generally improves soil characteristics.

COMPOSTING - A process of accelerated degradation of organic material under controlled conditions.

CURING - The final stage of composting that provides additional biological stabilization.

DECOMPOSITION - The breaking down of dead organic material, such as yard and food wastes, by micro-organisms.

FEEDSTOCK - Waste source used in the composting process.

HUMUS - Commonly used synonym for compost. Complex, highly stable material formed as a result of the breakdown of organic matter.

INORGANIC - Rock, metal, mineral, or other material containing no carbon-to-carbon bonds. These materials will not undergo biological decomposition.

MICROORGANISMS - Microscopic living organisms.

MULCH - Application layer of material, organic or inorganic, spread uniformly over the surface of the soil to provide moisture retention, reduce effects of erosion, weed control, and/or soil temperature control.

MUNICIPAL SOLID WASTE (MSW) - Garbage, refuse, trash, and other solid waste produced within a community from residential, commercial, and industrial activities.

NUTRIENTS - Minerals and organic compounds that provide sustenance for organisms.

ORGANIC - Pertaining to or deriving from living organisms; containing carbon-to-carbon bonds.

ORGANIC WASTE - Waste composed of materials that contain carbon-to-carbon bonds and are biodegradable. Includes paper, wood, food wastes, and yard wastes.

PATHOGEN - Any organism capable of producing disease or infection; often found in waste material. High temperature (above 55°C or 131°F) over a consecutive period (3 days) have been shown to effectively kill pathogens.

PERCOLATION - Downward movement of water through the pores or spaces in rock or soil.

RUN-OFF - Any liquid originating from any part of a composting facility that drains over the land surface.

SCREENING - The process of passing compost through a screen or sieve to remove large organic or inorganic materials and improve the consistency and quality of the end product.

SHREDDER - A mechanical device used to break up waste materials into smaller pieces, usually in the form of irregularly shaped strips. Shredding devices include tub grinders, hammer mills, shears, drum pulverizers, wet pulpers, and rasp mills.

SOIL AMENDMENT/SOIL CONDITIONER - A soil additive that stabilizes the soil, improves its resistance to erosion, increases its permeability to air and water, improves its texture and the resistance of its surface to crushing, makes it easier to cultivate, or otherwise improves its quality.

STABILIZATION - The decomposition of compost to the point where it neither reheats when wetted nor gives off offensive odors. Microbial activity has decreased significantly.

THERMOPHYLIC - Favoring higher temperatures ranging from 45°C - 68°C (113°F - 155°F). Thermophilic microorganisms thrive when the compost heats up.

WINDROW COMPOSTING - A method of composting in elongated piles turned periodically to aerate and mix the material, speeding up the decomposition process and reducing odors.

VM FACTOR - The effectiveness index between 0.10 and 0.01, which is a 90-99% effectiveness rating.

REFERENCES CITED

1. Austin, Deron N., and Toney Driver. Classifying erosion control products. *Erosion Control*. Jan/Feb. 1995, pp. 48-53.
2. Baumann, Jim. *Wisconsin Construction Site Best Management Practice Handbook*. Wisconsin Department of Natural Resources. Bureau of Water Resources Management. Non-point Source and Land Management Section, 1993.
3. Bosschner, Peter J. *Basics Mechanisms of Erosion*. Bureau of Reclamation, Department of the Interior, 1992.
4. Campbell, Stu. *The Mulch Book: A Guide for the Family Food Gardener*. Garden Way Publishing, 1973.
5. Compost use encouraged in federal transportation bill. *Biocycle*. May 1992.
6. Composting Council. Composting Basics. *The Composting Council Fact Sheet*. 1995.
7. Composting Council. Suggested Compost Parameters and Compost Use Guidelines. *The Compost Council Fact Sheet*. May 1994.
8. DeVleeschauwer, D., R. Lal, and M. DeBoodt. The comparative effects of surface applications of organic mulch versus chemical soil conditioners on physical and chemical properties of the soil and on plant growth. *Cantena*. Vol. 5, 1978, pp. 337-349.
9. Doersam, Jim, and Gerald Armstrong. Sludge and yard waste co-composted in Texas. *Biocycle*. Jan. 1992, pp. 62-65.
10. Donahue, R.L., R.W. Miller, and J.C. Shickluna. *Soils-An Introduction to Soils and Plant Growth*. Prentice-Hall, Inc, 1977.
11. Ettlin, Laura, and Bill Stewart. Yard debris compost for erosion control. *Biocycle*. Dec. 1993, pp. 46-47.
12. Frost, Donna I., Barbara L. Toth, and Harry A. Hoitink. Compost stability. *Biocycle*. Nov. 1992, pp. 62-68.
13. Glenn, Jim. The state of garbage in America. *Biocycle*. May 1992, pp. 30-37.
14. Godfrey, S. H., H.C. Landphair, J.P. Long, and J.A. McFalls. *The Performance of Flexible Erosion Control Materials*. Research Report 1914-1. Texas Department of Transportation, Division of Maintenance and Operations, 1993.

15. Godfrey, Sally H, and Jana P. Long. *Temporary Erosion Control Measures Design Guidelines for TxDOT*. Research Report 1379. Texas Department of Transportation and the US Department of Transportation, FHWA, 1994.
16. Grill, J. J., J.P. Canter, and J. Carsouille. The benefits of permanent grass and mulching for limiting runoff and erosion in vineyard: experiments using rainfall-simulation in the Beaujoulais. *Soil Technology Series I*. 1989, pp. 157 - 166.
17. Hagen and Sawyer, and TNRCC. *How to Develop Comprehensive Municipal Composting & Recycling Programs*. Texas Natural Resource Commission, 1993.
18. *International Erosion Control Association Report*. Tame wind and water with spray. Fall. Vol. 25, No. 2, 1993, pp. 4-8.
19. Kashimanian, Richard. Composting and agriculture coverage. *Biocycle*. Sep. 1992, pp. 38-40.
20. Lee, David. Highway landscaping: erosion control and other challenges. *Erosion Control*. Mar/Apr. 1995, pp. 62-67.
21. *Management Strategies for Landscape Waste*. Illinois Department of Energy and Natural Resources, Office of Solid Waste and Renewable Resources, 1989.
22. Metro. *Summary of Projects using Yard Debris Compost for Erosion Prevention and Control, Final Report*, 1994.
23. *Municipal Yard Waste Composting Reference Manual*. Pennsylvania Department of Environmental Resources, Bureau of Waste Management, Division of Waste Minimization & Planning, 1991.
24. Murthy, R. Krishna. *A Manual on Compost and Other Organic Manures*. Department of Agriculture, Tamil Nadu Government Adothorai. Today & Tomorrows Printers and Publishers, 1978.
25. Musick, Mark. Big volume and high quality. *Biocycle*. Sept. 1991, pp. 35-37.
26. North Central Texas Council of Governments. *Storm Water Quality Best Management Practices for Construction Activities*. Feb. 1993.
27. Northcutt, Ben. The role of erosion control in urban landscapes. *Landscape Design*. Vol. 8, No. 2. Feb. 1995, pp. 10 - 13.

28. Roberts, Brian C. Developing erosion control plans for highway construction. *Erosion Control*. May/June. 1994, pp. 36-41.
29. Rodale, J.I. *The Complete Book of Composting*. Rodale Books, Inc., 1975.
30. Roose, E.J. Natural mulch or chemical conditioner for reducing soil erosion in humid tropical areas. *Soil Conditioners*. 1975, pp. 131-138.
31. Saini, G.R., and , D.A. Hugh. Shredded bark as a soil conditioner in potato soils of New Brunswick, Canada. *Soil Conditioners*. The Soil Science Society of America, Inc. 1975, pp. 139-144.
32. Salkever, Alex. Hydroseeding makes its mark in erosion control. *Erosion Control*. May/June 1994, pp. 22-29.
33. Spurr, Stephen H., and Burton V. Barnes. *Forest Ecology*. John Wiley & Sons, 1980.
34. Taylor, Alison C., and Richard M. Kashmanian. *Study and Assessment of Eight Yard Waste Composting Programs Across the United States*. US EPA, 1988.
35. Texas Department of Transportation. *Waste Reduction and Buy Recycled Efforts within North American Departments of Transportation.(Draft)*. General Services Division, Recycling and Recycled Products Program, 1994.
36. TNRCC. *Texas Directory of Recycling Resources & Information*. Pollution Prevention & Recycling/CLEAN TEXAS 2000, 1994.
37. Tyler, Rod. Controlling compost odor. *Lawn & Landscape Maintenance*. Dec. 1994, pp. 12-13.
38. Tyler, Rod. How much is enough? *Lawn & Landscape Maintenance*. Dec. 1994, pp. 14-22.
39. Utilization of municipal solid waste compost: research trials at the Johnson City, Tennessee Facility. *Compost Science & Utilization*. Spring 1993, pp. 42-48.
40. *Virginia Erosion and Sediment Control Handbook*. Virginia Department of Conservation and Recreation. Division of Soil and Water Conservation, 1992.
41. W&H Pacific. *Demonstration Project using Yard Debris Compost for Erosion Control, Final Report*, 1993.

42. Wisconsin Department of Transportation. *Facilities Development Manual*. Chapter 10, Section 10, Subject 11, 1994.
43. Texas Department of Transportation. *Standard Specifications for Construction of Highways, Streets, and Bridges*. Washington, D.C., 1993.
44. *Recycling Market Development Strategic Plan*. Texas Natural Resource Conservation Commission, 1994.
45. Soil Conservation Service. *National Soils Handbook*. Washington, D.C., July 1983.
46. Wischeier, W.H. and D.D. Smith. *Predicting Rainfall Erosion Losses: A Guide to Conservation Planning*. U.S. Department of Agriculture, Agriculture Handbook No. 537, 1978.

APPENDIX A
RECYCLING FACILITIES IN TEXAS

TEXAS RECYCLING PROGRAMS - MUNICIPAL

<i>CITY</i>	<i>AUTO WASTE</i>	<i>BACKYARD COMPOST</i>	<i>BUY BACK CENTERS</i>	<i>CENTRAL COMPOST</i>	<i>CURBSIDE COLLECT</i>	<i>DON'T BAG IT</i>	<i>DROP-OFF CENTERS</i>	<i>OTHER PROGRAMS</i>	<i>WORK-PLACE</i>	<i>CHRISTMAS TREES</i>
<i>Abilene</i>							X			
<i>Addison</i>					X				X	X
<i>Alamo Heights</i>							X			
<i>Allen</i>	X			X	X				X	
<i>Alvin</i>			X		X		X		X	X
<i>Amarillo</i>	X			X			X	X		X
<i>Amherst</i>							X			
<i>Angleton</i>					X		X			
<i>Anson</i>								X		
<i>Anthony</i>			X				X			
<i>Archer City</i>					X		X			X
<i>Arlington</i>					X		X			X
<i>Austin</i>	X	X	X	X	X	X	X	X	X	X
<i>Azle</i>	X									X
<i>Baird</i>	X									X
<i>Balcones</i>					X		X			
<i>Ballinger</i>					X		X			
<i>Bastrop</i>					X		X			
<i>Bay City</i>							X			
<i>Baytown</i>		X		X	X		X		X	X
<i>Beaumont</i>		X		X	X		X		X	X
<i>Beeville</i>			X		X					

TEXAS RECYCLING PROGRAMS - MUNICIPAL

<i>CITY</i>	<i>AUTO WASTE</i>	<i>BACKYARD COMPOST</i>	<i>BUY BACK CENTERS</i>	<i>CENTRAL COMPOST</i>	<i>CURBSIDE COLLECT</i>	<i>DON'T BAG IT</i>	<i>DROP-OFF CENTERS</i>	<i>OTHER PROGRAMS</i>	<i>WORK-PLACE</i>	<i>CHRISTMAS TREES</i>
<i>Bellville</i>							X			
<i>Belton</i>							X			
<i>Benbrook</i>	X				X		X			X
<i>Big Lake</i>									X	
<i>Bishop</i>					X					
<i>Boerne</i>					X					
<i>Borger</i>							X			
<i>Brackettville</i>							X	X		
<i>Breckenridge</i>					X					
<i>Bridge City</i>					X					
<i>Bronte</i>	X						X			
<i>Brownfield</i>					X		X		X	
<i>Brownsville</i>	X		X	X	X		D			X
<i>Bryan</i>	X	X	X	X	X	X	X		X	X
<i>Buda</i>					X					
<i>Bunker Hill Village</i>					X					
<i>Burkburnett</i>							X			X
<i>Burleson</i>						X	X		X	X
<i>Caldwell</i>		X	X							X
<i>Canadian</i>							X			
<i>Carmine</i>							X			
<i>Carrollton</i>				X	X		X		X	X

TEXAS RECYCLING PROGRAMS - MUNICIPAL

<i>CITY</i>	<i>AUTO WASTE</i>	<i>BACKYARD COMPOST</i>	<i>BUY BACK CENTERS</i>	<i>CENTRAL COMPOST</i>	<i>CURBSIDE COLLECT</i>	<i>DON'T BAG IT</i>	<i>DROP-OFF CENTERS</i>	<i>OTHER PROGRAMS</i>	<i>WORK-PLACE</i>	<i>CHRISTMAS TREES</i>
<i>Carthage</i>							X			
<i>Castroville</i>	X			X	X					X
<i>Cedar Hill</i>			X		X	X	X		X	X
<i>Cedar Park</i>	X				X	X	X		X	X
<i>Chandler</i>							X			
<i>Charlotte</i>					X					
<i>Chico</i>					X					
<i>Cleburne</i>		X	X	X		X	X			X
<i>Cleveland</i>			X		X					
<i>Clute</i>	X				X		X		X	X
<i>College Station</i>	X	X	X	X	X	X	X		X	X
<i>Colmesneil</i>			X		X					
<i>Columbus</i>							X			
<i>Comanche</i>				X	X	X				
<i>Conroe</i>			X	X	X		X		X	X
<i>Coppras Cove</i>							X			
<i>Corpus Christi</i>		X			X	X	X		X	X
<i>Corsicana</i>					X		X			X
<i>Cottonwood Shores</i>										X
<i>Crockett</i>					X		X		X	
<i>Crosbyton</i>					X		X		X	
<i>Dangerfield</i>	X									

TEXAS RECYCLING PROGRAMS - MUNICIPAL

<i>CITY</i>	<i>AUTO WASTE</i>	<i>BACKYARD COMPOST</i>	<i>BUY BACK CENTERS</i>	<i>CENTRAL COMPOST</i>	<i>CURBSIDE COLLECT</i>	<i>DON'T BAG IT</i>	<i>DROP-OFF CENTERS</i>	<i>OTHER PROGRAMS</i>	<i>WORK-PLACE</i>	<i>CHRISTMAS TREES</i>
<i>Dalhart</i>	X	X		X					X	X
<i>Dallas</i>					X					
<i>Dayton</i>									X	
<i>Decatur</i>					X		X			X
<i>Deer Park</i>					X		X			X
<i>Del Rio</i>							X			
<i>Denison</i>	X									X
<i>Denton</i>	X	X	X	X	X	X	X		X	X
<i>Diboll</i>					X		X		X	X
<i>Dickens</i>								X		
<i>Dumas</i>							X			
<i>Duncanville</i>	X		X	X	X		X		X	X
<i>Edna</i>	X									
<i>El Lage</i>					X					
<i>El Paso</i>							X			
<i>Electra</i>					X		X			
<i>Eules</i>	X		X		X	X	X		X	X
<i>Everman</i>					X		X		X	
<i>Fairview</i>					X					
<i>Farmers Branch</i>		X			X	X	X		X	X
<i>Floydada</i>							X			
<i>Forney</i>							X			

TEXAS RECYCLING PROGRAMS - MUNICIPAL

<i>CITY</i>	<i>AUTO WASTE</i>	<i>BACKYARD COMPOST</i>	<i>BUY BACK CENTERS</i>	<i>CENTRAL COMPOST</i>	<i>CURBSIDE COLLECT</i>	<i>DON'T BAG IT</i>	<i>DROP-OFF CENTERS</i>	<i>OTHER PROGRAMS</i>	<i>WORK-PLACE</i>	<i>CHRISTMAS TREES</i>
<i>Fort Stockton</i>	X	X				X	X	X	X	X
<i>Frankston</i>					X					
<i>Freer</i>					X					
<i>Friendswood</i>					X		X			
<i>Frisco</i>	X	X		X			X			X
<i>Fritch</i>	X	X		X			X			X
<i>Frost</i>	X		X		X	X	X		X	X
<i>Gainesville</i>			X				X		X	X
<i>Galveston</i>	X	X		X	X	X	X		X	X
<i>Ganado</i>							X			
<i>Garland</i>				X	X	X	X		X	X
<i>Gatesville</i>							X			
<i>Georgetown</i>	X	X			X	X	X		X	X
<i>Gilmer</i>					X	X			X	
<i>Gladewater</i>			X	X		X			X	X
<i>Goliad</i>							X			X
<i>Gonzales</i>			X	X		X			X	X
<i>Grand Prairie</i>			X				X			
<i>Greenville</i>			X				X			
<i>Grey Forest</i>									X	
<i>Groesbeck</i>									X	
<i>Groom</i>							X			

TEXAS RECYCLING PROGRAMS - MUNICIPAL

<i>CITY</i>	<i>AUTO WASTE</i>	<i>BACKYARD COMPOST</i>	<i>BUY BACK CENTERS</i>	<i>CENTRAL COMPOST</i>	<i>CURBSIDE COLLECT</i>	<i>DON'T BAG IT</i>	<i>DROP-OFF CENTERS</i>	<i>OTHER PROGRAMS</i>	<i>WORK-PLACE</i>	<i>CHRISTMAS TREES</i>
<i>Groves</i>		X			X	X	X		X	
<i>Gruver</i>	X						X		X	X
<i>Hallettsville</i>							X			
<i>Haltom City</i>	X	X	X			X	X		X	X
<i>Hamilton</i>								X		
<i>Hamlin</i>	X			X			X			X
<i>Harlingen</i>							X			
<i>Hedley</i>	X			X						X
<i>Hempstead</i>	X			X						X
<i>Hewitt</i>					X		X		X	X
<i>Hico</i>							X			
<i>Highland Park</i>					X				X	X
<i>Holliday</i>							X			
<i>Hollywood Park</i>					X					
<i>Houston</i>	X	X	X	X	X	X	X		X	X
<i>Humble</i>							X			X
<i>Huntington</i>							X			
<i>Huntsville</i>	X		X	X			X	X	X	X
<i>Hurst</i>					X					
<i>Iraan</i>			X							
<i>Irving</i>	X	X	X		X	X	X			X
<i>Jacinto City</i>							X			

TEXAS RECYCLING PROGRAMS - MUNICIPAL

<i>CITY</i>	<i>AUTO WASTE</i>	<i>BACKYARD COMPOST</i>	<i>BUY BACK CENTERS</i>	<i>CENTRAL COMPOST</i>	<i>CURBSIDE COLLECT</i>	<i>DON'T BAG IT</i>	<i>DROP-OFF CENTERS</i>	<i>OTHER PROGRAMS</i>	<i>WORK-PLACE</i>	<i>CHRISTMAS TREES</i>
<i>Jersey Village</i>	X				X		X			
<i>Jonestown</i>							X			X
<i>Jourdanton</i>			X		X		X			X
<i>Justin</i>					X					
<i>Karnes City</i>			X				X			X
<i>Katy</i>			X				X			X
<i>Kerrville</i>				X	X		X	X	X	X
<i>Kilgore</i>							X			
<i>Kingsville</i>							X			X
<i>Kirbyville</i>					X					
<i>Kountze</i>					X					
<i>La Grange</i>	X			X	X		X			X
<i>La Porte</i>	X			X			X			X
<i>Lacy Lakeview</i>	X			X	X		X			
<i>Lago Vista</i>					X					X
<i>Lake Jackson</i>	X	X		X	X	X	X	X	X	X
<i>Lake Worth</i>					X					
<i>Lakeside</i>					X					
<i>Lancaster</i>							X			
<i>Laredo</i>					X		X			X
<i>League City</i>						X				
<i>Leander</i>							X			

TEXAS RECYCLING PROGRAMS - MUNICIPAL

<i>CITY</i>	<i>AUTO WASTE</i>	<i>BACKYARD COMPOST</i>	<i>BUY BACK CENTERS</i>	<i>CENTRAL COMPOST</i>	<i>CURBSIDE COLLECT</i>	<i>DON'T BAG IT</i>	<i>DROP-OFF CENTERS</i>	<i>OTHER PROGRAMS</i>	<i>WORK-PLACE</i>	<i>CHRISTMAS TREES</i>
<i>Leon Valley</i>	X	X	X	X	X	X			X	X
<i>Leroy</i>					X					
<i>Lewisville</i>			X		X		X		X	X
<i>Lexington</i>					X	X	X			X
<i>Littlefield</i>					X	X	X			X
<i>Llano</i>	X	X		X	X		X			
<i>Longview</i>							X			
<i>Lorena</i>			X		X					
<i>Lubbock</i>	X	X		X	X	X	X	X		X
<i>Lufkin</i>	X	X	X	X	X	X	X		X	X
<i>Luling</i>				X	X		X			X
<i>Lyle</i>					X					X
<i>Marshall</i>	X						X			
<i>Mart</i>							X			
<i>Mason</i>							X			
<i>McAllen</i>							X	X	X	X
<i>McCarney</i>							X			
<i>McGregor</i>			X		X				X	
<i>McLean</i>							X			
<i>Meadows</i>	X						X			X
<i>Mercedes</i>	X						X			X
<i>Merkel</i>							X			X

TEXAS RECYCLING PROGRAMS - MUNICIPAL

<i>CITY</i>	<i>AUTO WASTE</i>	<i>BACKYARD COMPOST</i>	<i>BUY BACK CENTERS</i>	<i>CENTRAL COMPOST</i>	<i>CURBSIDE COLLECT</i>	<i>DON'T BAG IT</i>	<i>DROP-OFF CENTERS</i>	<i>OTHER PROGRAMS</i>	<i>WORK-PLACE</i>	<i>CHRISTMAS TREES</i>
<i>Mertzon</i>	X									
<i>Mesquite</i>						X	X			X
<i>Miami</i>							X			
<i>Midland</i>	X	X				X	X		X	X
<i>Midlothian</i>				X	X			X	X	X
<i>Mineola</i>					X		X		X	X
<i>Mineral Wells</i>						X	X		X	X
<i>Mission</i>			X						X	X
<i>Missouri City</i>							X			X
<i>Morgan's Point</i>					X				X	
<i>Morton</i>	X		X				X			
<i>Moulton</i>	X						X			X
<i>Mount Calm</i>								X		
<i>Mount Pleasant</i>							X			
<i>Mount Vernon</i>							X		X	
<i>Muenster</i>			X							
<i>Munday</i>						X				
<i>Murphy</i>					X					X
<i>Nacogdoches</i>	X			X	X		X	X	X	X
<i>Nassau Bay</i>		X		X	X					X
<i>Navasota</i>			X	X	X		X			
<i>Nederlands</i>				X	X					

TEXAS RECYCLING PROGRAMS - MUNICIPAL

<i>CITY</i>	<i>AUTO WASTE</i>	<i>BACKYARD COMPOST</i>	<i>BUY BACK CENTERS</i>	<i>CENTRAL COMPOST</i>	<i>CURBSIDE COLLECT</i>	<i>DON'T BAG IT</i>	<i>DROP-OFF CENTERS</i>	<i>OTHER PROGRAMS</i>	<i>WORK-PLACE</i>	<i>CHRISTMAS TREES</i>
<i>New Braunfels</i>					X					
<i>N. Richland Hills</i>	X		X		X		X		X	X
<i>Odessa</i>	X		X				X		X	X
<i>Olmos Park</i>				X	X		X			X
<i>Olney</i>				X	X		X			X
<i>Olton</i>							X			
<i>Orange Grove</i>					X			X		
<i>Ovilla</i>							X			X
<i>Palestine</i>	X			X	X					
<i>Pampa</i>	X	X				X	X			X
<i>Panhandle</i>	X	X				X	X			X
<i>Pnorama Village</i>							X			
<i>Paris</i>	X			X	X		X		X	X
<i>Pasadena</i>	X			X			X		X	X
<i>Pearland</i>	X	X	X		X	X	X			X
<i>Petersburg</i>							X			
<i>Petrolia</i>					X		X			
<i>Pflugerville</i>					X		X			
<i>Pharr</i>	X	X		X		X	X			X
<i>Pilot Point</i>							X			
<i>Plains</i>							X			
<i>Plano</i>		X	X	X	X	X	X		X	X

TEXAS RECYCLING PROGRAMS - MUNICIPAL

<i>CITY</i>	<i>AUTO WASTE</i>	<i>BACKYARD COMPOST</i>	<i>BUY BACK CENTERS</i>	<i>CENTRAL COMPOST</i>	<i>CURBSIDE COLLECT</i>	<i>DON'T BAG IT</i>	<i>DROP-OFF CENTERS</i>	<i>OTHER PROGRAMS</i>	<i>WORK-PLACE</i>	<i>CHRISTMAS TREES</i>
<i>Pleasanton</i>	X			X	X		X			X
<i>Point Comfort</i>							X			
<i>Port Aransas</i>					X					
<i>Port Arthur</i>				X	X				X	X
<i>Port Isabel</i>							X		X	
<i>Portland</i>							X			X
<i>Post</i>							X			X
<i>Presidio</i>							X			
<i>Ralls</i>	X			X			X			X
<i>Ransom Canyon</i>				X			X			X
<i>Red Oak</i>					X					X
<i>Reno</i>					X					
<i>Richardson</i>	X				X		X	X	X	X
<i>Richland Hills</i>	X		X		X			X	X	X
<i>Richmond</i>					X	X				X
<i>Richwood</i>							X		X	X
<i>Rosenburg</i>					X		X			
<i>Rowlett</i>		X			X	X				
<i>Runaway Bay</i>					X					
<i>Rusk</i>							X			
<i>Sachse</i>					X					X
<i>Saint Jo</i>							X			

TEXAS RECYCLING PROGRAMS - MUNICIPAL

<i>CITY</i>	<i>AUTO WASTE</i>	<i>BACKYARD COMPOST</i>	<i>BUY BACK CENTERS</i>	<i>CENTRAL COMPOST</i>	<i>CURBSIDE COLLECT</i>	<i>DON'T BAG IT</i>	<i>DROP-OFF CENTERS</i>	<i>OTHER PROGRAMS</i>	<i>WORK-PLACE</i>	<i>CHRISTMAS TREES</i>
<i>San Antonio</i>					X		X			X
<i>San Juan</i>					X					
<i>San Marcos</i>	X		X		X		X		X	X
<i>San Saba</i>					X					
<i>Santa Anna</i>									X	
<i>Schertz</i>					X		X			
<i>Schulenburg</i>			X		X		X		X	
<i>Seabrook</i>					X				X	
<i>Seagoville</i>	X	X	X	X	X	X	X	X	X	X
<i>Sealy</i>					X		X			
<i>Shallowater</i>							X			
<i>Shenandoah</i>							X			X
<i>Sherman</i>						X	X			X
<i>Simonton</i>					X					
<i>Smithville</i>		X			X	X	X		X	
<i>Snyder</i>	X					X	X			
<i>Sonora</i>	X		X	X			X	X	X	
<i>Southside Place</i>					X					
<i>Spearman</i>							X		X	
<i>Stephenville</i>			X						X	
<i>Stinnett</i>							X			
<i>Strawn</i>					X					

TEXAS RECYCLING PROGRAMS - MUNICIPAL

<i>CITY</i>	<i>AUTO WASTE</i>	<i>BACKYARD COMPOST</i>	<i>BUY BACK CENTERS</i>	<i>CENTRAL COMPOST</i>	<i>CURBSIDE COLLECT</i>	<i>DON'T BAG IT</i>	<i>DROP-OFF CENTERS</i>	<i>OTHER PROGRAMS</i>	<i>WORK-PLACE</i>	<i>CHRISTMAS TREES</i>
<i>Sugarland</i>	X	X			X				X	X
<i>Sunnyvale</i>			X							
<i>Sunray</i>	X						X		X	
<i>Surfside Beach</i>							X			X
<i>Sweeny</i>	X			X			X			X
<i>Sweetwater</i>			X		X		X		X	X
<i>Taft</i>							X			
<i>Taylor</i>							X			
<i>Temple</i>	X	X	X	X	X	X	X		X	X
<i>Texarkana</i>			X		X				X	
<i>Texas City</i>				X			X			X
<i>The Colony</i>	X				X		X			X
<i>Three Rivers</i>							X			
<i>Throcknorton</i>	X									
<i>Tomball</i>							X			
<i>Toyah</i>							X			
<i>Troy</i>					X					
<i>Tulia</i>			X				X			
<i>Tyler</i>	X	X	X	X			X		X	X
<i>Universal City</i>					X		X			
<i>University Park</i>	X				X				X	X
<i>Victoria</i>					X		X			

TEXAS RECYCLING PROGRAMS - MUNICIPAL

<i>CITY</i>	<i>AUTO WASTE</i>	<i>BACKYARD COMPOST</i>	<i>BUY BACK CENTERS</i>	<i>CENTRAL COMPOST</i>	<i>CURBSIDE COLLECT</i>	<i>DON'T BAG IT</i>	<i>DROP-OFF CENTERS</i>	<i>OTHER PROGRAMS</i>	<i>WORK-PLACE</i>	<i>CHRISTMAS TREES</i>
<i>Waco</i>	X	X	X	X	X	X	X		X	X
<i>Wake Village</i>							X			
<i>Waxahachie</i>					X		X			
<i>Weimer</i>					X		X			
<i>Weslaco</i>							X			X
<i>West Columbia</i>							X			
<i>West Orange</i>					X					X
<i>W. University Place</i>	X			X	X				X	X
<i>Wharton</i>					X		X			
<i>Wheeler</i>	X					X	X			X
<i>White Deer</i>							X			
<i>Willis</i>							X			
<i>Windcrest</i>					X					
<i>Winnboro</i>	X		X		X		X		X	
<i>Winters</i>							X			
<i>Woodcreek</i>					X		X	X		
<i>Woodville</i>					X					
<i>Woodway</i>					X					
<i>Yoakum</i>	X			X	X		X			X

TEXAS RECYCLING PROGRAMS - COUNTY

<i>CITY</i>	<i>AUTO WASTE</i>	<i>BACKYARD COMPOST</i>	<i>BUY BACK CENTERS</i>	<i>CENTRAL COMPOST</i>	<i>CURBSIDE COLLECT</i>	<i>DON'T BAG IT</i>	<i>DROP-OFF CENTERS</i>	<i>OTHER PROGRAMS</i>	<i>WORK-PLACE</i>	<i>CHRISTMAS TREES</i>
<i>Angelina</i>									X	
<i>Bailey</i>							X			
<i>Bandera</i>	X									
<i>Baylor</i>							X			
<i>Bee</i>										X
<i>Bell</i>	X			X	X					X
<i>Brazoria</i>	X		X			X	X	X		X
<i>Calhoun</i>	X		X			X	X	X		X
<i>Cass</i>	X						X		X	
<i>Cochran</i>	X									
<i>Coke</i>							X			
<i>Collin</i>					X					
<i>Crosby</i>							X			
<i>Dallam</i>	X						X	X		X
<i>Dalls</i>	X								X	
<i>Denton</i>									X	
<i>Fayette</i>							X			
<i>Foard</i>							X			
<i>Franklin</i>							X			
<i>Gerza</i>							X			
<i>Goliad</i>							X			
<i>Grayson</i>	X		X				X		X	X

TEXAS RECYCLING PROGRAMS - COUNTY

<i>CITY</i>	<i>AUTO WASTE</i>	<i>BACKYARD COMPOST</i>	<i>BUY BACK CENTERS</i>	<i>CENTRAL COMPOST</i>	<i>CURBSIDE COLLECT</i>	<i>DON'T BAG IT</i>	<i>DROP-OFF CENTERS</i>	<i>OTHER PROGRAMS</i>	<i>WORK-PLACE</i>	<i>CHRISTMAS TREES</i>
<i>Grimes</i>			X				X			
<i>Guadalupe</i>	X						X			
<i>Irion</i>	X						X			
<i>Jackson</i>	X		X				X			X
<i>Kaufman</i>			X		X		X			
<i>Kendall</i>	X		X		X		X			
<i>Kent</i>							X			
<i>Kimble</i>							X			
<i>Lavaca</i>							X			
<i>Leon</i>							X			
<i>Llano</i>	X									
<i>Madison</i>	X									
<i>Matagora</i>	X		X				X		X	
<i>Palo Pinto</i>	X		X	X	X		X			X
<i>Parker</i>							X			
<i>Polk</i>							X			
<i>Reeves</i>							X			
<i>Refugio</i>	X		X				X			
<i>Rusk</i>			X		X		X		X	X
<i>Sabine</i>	X									X
<i>San Jacinto</i>							X			
<i>Somervell</i>					X		X			

TEXAS RECYCLING PROGRAMS - COUNTY

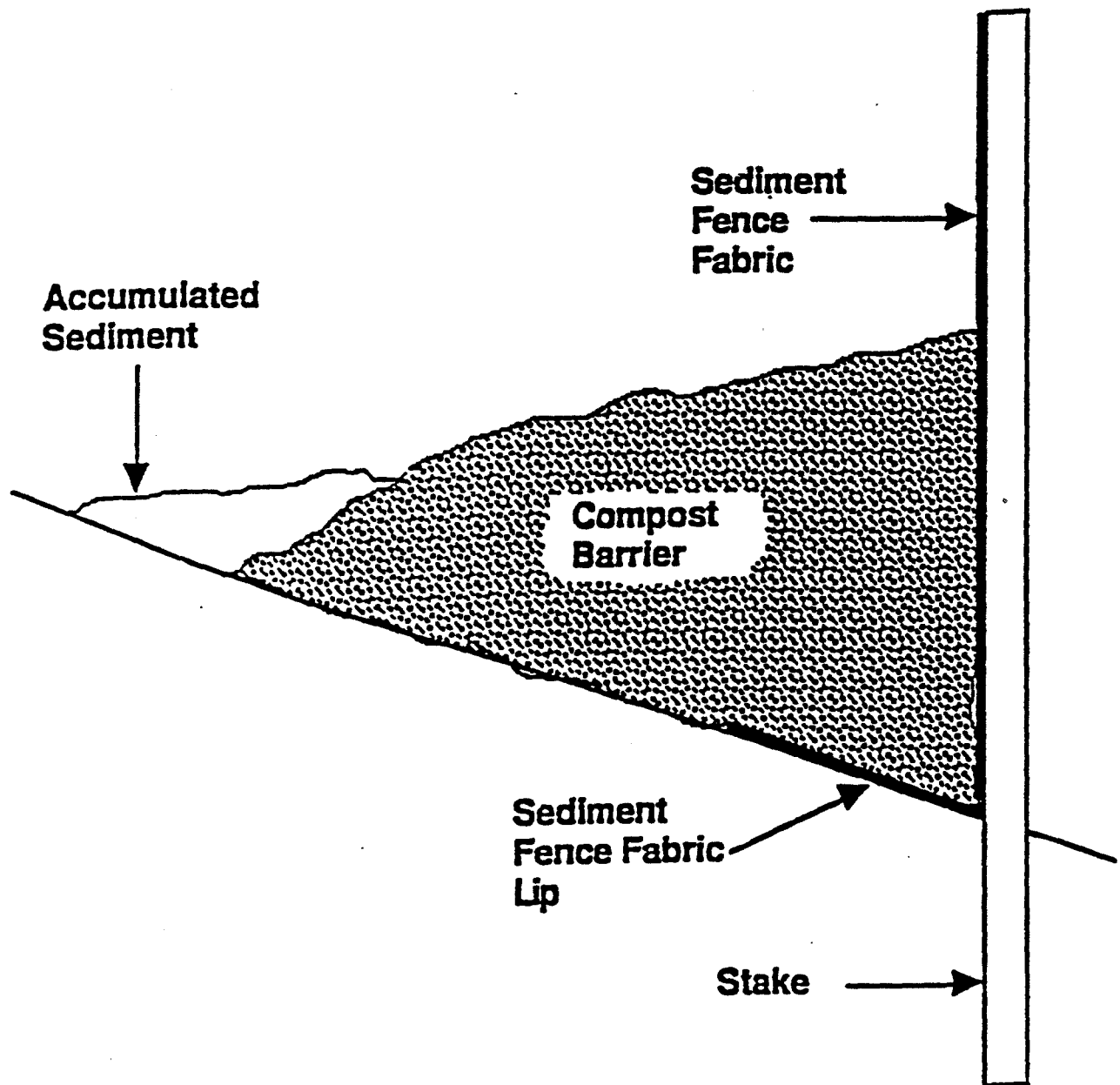
<i>CITY</i>	<i>AUTO WASTE</i>	<i>BACKYARD COMPOST</i>	<i>BUY BACK CENTERS</i>	<i>CENTRAL COMPOST</i>	<i>CURBSIDE COLLECT</i>	<i>DON'T BAG IT</i>	<i>DROP-OFF CENTERS</i>	<i>OTHER PROGRAMS</i>	<i>WORK-PLACE</i>	<i>CHRISTMAS TREES</i>
<i>Tarrant</i>								X	X	
<i>Taylor</i>	X						X			X
<i>Terrell</i>							X			
<i>Victoria</i>			X	X		X	X			X
<i>Walker</i>	X						X			
<i>Waller</i>							X			
<i>Ward</i>	X					X	X		X	
<i>Washington</i>	X		X				X			X
<i>Wharton</i>							X			
<i>Williamson</i>	X						X			
<i>Winkler</i>										X

APPENDIX B

**METRO'S PROPOSED SEDIMENT FENCE/
COMPOST BARRIER CONFIGURATION**

METRO - Compost Erosion Control Project

Proposed Sediment Fence/Compost Barrier Configuration



APPENDIX C

**30 TEXAS ADMINISTRATIVE CODE
CHAPTER 332**

COMPOST RULES FOR THE STATE OF TEXAS

The Texas Natural Resource Conservation Commission (TNRCC or commission) adopts new §§332.1-332.8, 332.21-332.23, 332.31-332.38, 332.41-332.47, 332.51-332.53, 332.61-332.64, 332.71-332.75, concerning composting of materials that might otherwise be placed in landfills. Sections 332.2, 332.3, 332.4, 332.5, 332.7, 332.8, 332.21, 332.22, 332.31, 332.32, 332.33, 332.34, 332.35, 332.37, 332.41, 332.42, 332.43, 332.45, 332.47, 332.52, 332.53, 332.61, 332.71, and 332.72 are adopted with changes to the proposed text as published in the June 20, 1995, issue of the Texas Register (20 TexReg 4464). Sections 332.1, 332.6, 332.23, 332.36, 332.38, 332.44, 332.46, 332.51, 332.62, 332.63, 332.64, 332.73, 332.74, and 332.75 are adopted without changes and will not be republished.

The purpose of the compost rules is to establish a regulatory scheme which will promote the composting and beneficial use of organic materials which traditionally have been landfilled. The statutory basis for the rules is found in Senate Bill (SB) 1340, 72nd Legislature, and SB 1051, 73rd Legislature which amended the Health and Safety Code, Chapter 361, the Solid Waste Disposal Act (SWDA). SB 1340, the Texas Omnibus Recycling Law of 1991, establishes a statewide recycling goal of 40%, and includes composting as an acceptable method of recycling. In addition, the statute directs the TNRCC to establish a composting program capable of achieving at least a 15% reduction in the amount of the municipal solid waste stream that is otherwise deposited in landfills. SB 1051 requires the TNRCC to adopt rules establishing minimum standards and guidelines for the issuance of permits for the composting of mixed municipal solid waste.

The adopted rules address composting, mulching and land application, and beneficial re-use of non-hazardous organic materials. While it is anticipated that the majority of composted materials will be diverted from the municipal waste stream, the proposed rules also address agricultural materials, sludge, and other organic materials diverted from the industrial waste stream. The final rule represents a complete, consolidated rule package which includes facility criteria for

source-separated and mixed waste operations, and which sets forth end-product standards.

The commission accepted public comment on the proposed rules until 5:00 p.m. on July 21, 1995. A public hearing to accept verbal and written comment on the proposed rule was held at TNRCC offices in Austin, Texas on July 21, 1995. The commission received written comment from 25 entities, and seven persons provided verbal comment at the public hearing.

The following entities provided comment on the proposed rules: Allwaste Recovery Systems, City of Amarillo, American Forest & Paper Association, American WasteWater, City of Austin, Bedminster Bioconversion Corp., Black & Veatch, Brazos River Authority, Bill Carter - Recycling & Composting Consultant, Center for Maximum Potential Building Systems, Champion International Corp., Cold Springs Processing, The Composting Council, Gulf Coast Waste Disposal Authority, Henry, Lowerre, Johnson, Hess & Frederick Attorneys at Law, League of Women Voters of Texas, Mesa Processors, The Procter & Gamble Co., Recycling Coalition of Texas, Silver Creek Materials, Inc., Sojo Treatment, Texas Disposal Systems, Inc., Trap Master, Upper Trinity Regional Water District, Wastewater Systems.

A number of typographical errors were identified in the proposed rule. In §332.21(1), the words "for feedstock" have been deleted to be consistent with §332.3(c)(1). In §332.2, the proposed definition of "Mulch" utilized language referring to "wood that has been systematically killed..." The word "systematically" has been replaced with "systemically." In §332.34(9)(B), "and" has been removed from the end of the paragraph because §332.34(10) is not the last paragraph in the section. A catchline has been added to §332.4(11) because it is the only paragraph in that section proposed without one. In §332.45(5), the first sentence reads, "The facility shall be sited and operated in such a manner as to minimize the potential of nuisance conditions..." The term "minimize" has been replaced with "prevent" to be consistent with the statutory requirements and other requirements in the rule to prevent, rather than minimize nuisances. In proposed

§332.47(6)(B)(v), the last sentence reads, "The minimum number of piezometers...for sites of five acres or less, for site greater than..." The term "site" has been changed to "sites." In proposed §332.47(6)(E)(v), the first sentence has been changed to read, "Provide a complete narrative on product distribution to include..." In proposed §332.47(6)(E)(vi), there is a reference to clauses (i)-(iv). The reference to clause (iv) has been changed to (v). In §332.52(2)(A) and (B), the proposed rule references §332.54; however, the reference should be to §332.53, and the change has been made. Proposed §332.61(a) read, "A permittee...have reasonable access household hazardous waste..." The word "to" has been added before household hazardous waste (HHW). In §332.72(c), the proposed last sentence in the subsection states, "Testing of final product...or, in the case of facilities with TNRCC permit, the Quality..." The final rules add "or registration" after TNRCC permit in this sentence.

Several section titles were changed to more accurately reflect the requirements of those sections. The sections with changed titles are listed in this paragraph. The title of §332.31 has been changed to "Definition of and Requirements for Registered Facilities," and the title of §332.32 has been changed to "Certification by Engineer, Approval by Landowner, and Inspection." The title of §332.33 in the final rule is "Required Forms, Applications, Reports, and Request to Use the Sludge Byproduct of Paper Production." The titles of §332.41 and §332.42 have been changed to "Definition, Requirements, and Application Processing for a Permit Facility," and "Certification by Engineer, Ownership or Control of Land, and Inspection," respectively. The title of §332.43 in the final rule is "Required Forms, Applications, and Reports." The title of §332.53 has been changed to "List of Recyclable Materials."

The adoption preamble addresses all comments received by the commission regarding the proposed compost rules. Due to the number of comments received, however, the preamble is very lengthy. So that persons may quickly review the changes to the proposed rules in those sections identified above, the preamble will list those changes below. More detailed descriptions

of the comments and the commission responses are contained in the body of the preamble. The term and definition of "Curing" have been removed from the §332.2. The commission has amended the definition of "Mature compost" in the final rule to replace "sanitized" with "the appropriate level of pathogen reduction (ie. PFRP or PSRP)." The definition of "Nuisance" has been amended to reference the nuisance provisions of the Health and Safety Code, Chapter 341, Texas Water Code, Chapter 26, and 30 TAC §101.4 of the air regulations to eliminate confusion. The definitions for "PFRP" and "PSRP" have been amended to reference United States Environmental Protection Agency (EPA) regulations. The definition of "Semi-mature compost" has been amended to replace "sanitization" with "the appropriate level of pathogen reduction (ie. PFRP or PSRP)." Proposed §332.3(a)(1), has been changed by removing certain language to clarify that mixed municipal solid waste cannot be composted at registered facilities. Proposed §332.3(d)(1)(B) has been amended because the cross-references in the subparagraph to various provisions of §332.4 were incorrect. Proposed §332.4(11) has been changed by moving the following language "any of the materials listed in paragraph (10) of this section which are not managed in accordance with the requirements of this chapter" to the very beginning of the paragraph to make the paragraph clearer. Proposed §332.5 is amended and restructured to provide a more clear process for the application and granting of variances. Proposed §332.7 has been changed by adding language to state "If the wastewater treatment facility has received a water quality permit under the Texas Water Code, Chapter 26 which authorizes compost operations, the compost operation shall be conducted in accordance with the facility permit". Proposed §§332.8(b)(3), (c)(4), (d)(4), and (e)(4) have been modified, as follows: "Except for initial start-up and shut-down, the receiving chamber on all grinders shall be adequately filled prior to commencement ..." Both §§332.31 and 332.41 have been restructured for purposes of clarity and consistency. More clearly defined public notice and processing requirements have been added to proposed §332.22, §332.35, and §332.41 in the final rule. Section 332.35 also now addresses the motion for reconsideration of an executive director's decision on a registration. Proposed §332.32(a) and §332.42(a), which stated that facilities must comply with any future

rules to be in compliance with the registration, have been removed due to concerns that they may not be in compliance with §481.143 of the Government Code. As a result of this change, proposed §332.32(b),(c) have become §332.32(a),(b) and proposed §332.42(b),(c) have become §332.42(a),(b) in the final rule. Proposed §332.32(b) and §332.42(b), now §332.32(a) and §332.42(a) respectively, have been revised to read "...in general compliance with the regulations prior to accepting any feedstock at the facility that requires registration and maintaining that certification on-site available for inspection by the commission." In addition, a new paragraph (c) has been added to §332.32 and §332.42 to require an inspection by TNRCC prior to the acceptance of any feedstocks. Sections 332.33 and 332.43 have been amended to address the requirement for submission of final product testing to be consistent with §332.71. Additionally,

the

paragraphs in §332.33 were rearranged to add clarity. Proposed §332.35(c) has been amended to state that the executive director will base his decision to approve or deny a registration application on whether the application meets the criteria established in §332.4, General Requirements, and Subchapter C. Proposed §332.37(1) and §332.45(1) have been amended to allow leachate to be processed at an authorized facility or as authorized by a National Pollution Discharge Elimination System (NPDES) permit. Proposed §332.37(2) has been modified so that the second sentence reads: "Facilities that compost municipal sewage sludge, grease trap waste, disposable diapers, "and/or" the sludge byproduct of paper mill production shall install and maintain a liner system..." Previously, the sentence utilized "and" rather than "and/or." Proposed §332.37(2) and §332.47(6) (C) (i) have also been amended to allow for alternative designs including concrete. Proposed §332.45(9) has been amended to add a reference to 30 TAC Chapter 305, relating to Consolidated Permits. Proposed §332.47(6) (A) (iv) (II) has been clarified by changing the reference of "TxDOT Circular 80-76" to its generally recognized name of the "Bridge Division Hydraulic Manual" to alleviate confusion. Proposed §332.47(6) (A) (iv) (IV) is the only subclause in clause (iv) with a title; therefore, the title has been removed for consistency. New paragraph (11) has been added to §332.47 to require applicants to submit a list of landowners, residents, and businesses to be consistent with the public notice provisions of §332.41. The list of recyclable materials in proposed §332.53 has been removed and replaced with a statement that the executive director will maintain the list of recyclable materials, and the title of the section has been amended. References to §332.53 in §332.52 have been changed accordingly. Proposed §332.61(a), has added "compost" prior to permittee to clarify that not just any permittee is subject to the household hazardous waste (HHW) collection requirements. Proposed §332.71(d) (1) has been changed to allow for the use of the ROM method (Reduction in Organic Matter) in the Maturity Protocol. Subparagraph 332.71(e) (1) (D) has been removed because the information required by the subparagraph will be provided by subparagraph (C) of that section.

The commission received several general comments on the rule. Five commenters expressed general support for the proposed rules as published. Another commenter expressed strong support for the overall character of the compost regulations with the exception of the source-separated recycling and HHW collection requirements, and the lack of size limits. Three commenters

believe the regulations are daunting and will discourage composting. They noted that the regulations should be a broad and flexible set of operational standards that would accommodate site-specific conditions and variations in feedstocks and market conditions. Another commenter expressed concern that TNRCC's intent to protect natural resources and public health will be frustrated by various exemptions and over-broad standards in the rules as proposed. In response, the commission believes that the proposed rules create an accommodating environment for the processing and beneficial reuse of organic materials. In general, the rules set forth a regulatory environment that is intended to protect human health and the environment while establishing reasonable regulatory requirements. The commission feels strongly that it is appropriate for the registration and permit tier feedstocks to contain design, location, and operational requirements and be subject to final product standards due to the potential contamination from those feedstocks. However, the commission recognizes that many different operational methods exist for compost facilities, and the rules include the variance provision in §332.5 to allow flexibility.

One commenter requested that to the extent possible, reporting requirements should be minimized. The commission believes the reporting requirements provide the necessary information for compliance monitoring while not being overly burdensome. Another commenter noted that the registration and notification tiers are so similar in feedstock and in processing needs that, in the interest of clarity and simplicity, they should be combined. The commission disagrees that the notification and registration tiers should be combined. The notification tier feedstocks are source-separated materials that do not possess the potential for contamination that registration tier feedstocks do. However, pathogens are a concern with the notification tier feedstocks, thus the operational requirements for those facilities require pathogen reduction. Registration tier feedstocks on the other hand, may be contaminated with heavy metals and the requirements on those facilities are generally accepted industry standards.

The commission received a comment that Texas should adopt provisions to allow small-scale experimental composting facilities to get started easily. The commission responds that the rules should allow adequate flexibility for experimental composting at exempt and notification tier facilities. Currently, commission staff are reviewing the 30 TAC 330 municipal solid waste (MSW) rules for experimental sites. If any rule changes are adopted for the MSW rules, the commission will revisit the compost rules to consider adding language that will allow these experimental sites.

A comment was received regarding the issue of land use compatibility. The comment is that land use compatibility issues are inadequately addressed in the proposed rule. The failure of the rules to effectively address odor issues serves to heighten the potential for serious problems resulting from the absence of any meaningful mechanism for reviewing land use compatibility. Regarding land use, the commission believes that the location restrictions in Subchapters C and D for registration and permit tier facilities address certain land use criteria. For all facilities, the provisions of the Health and Safety Code, Chapters 341 and 382, and Texas Water Code, Chapter 26, provide sufficient protection from nuisances. More restrictive land use issues should be addressed by local ordinances.

One comment was received stating that there is no reference to fees in the proposed regulations, nor is there an estimate of cost for the Compost Operator Certification. At this time, the commission does not intend to levy a solid waste fee on compost facilities that receive authorization under this chapter because the primary purpose of these regulations is to promote the composting and beneficial reuse of these materials. Registration and permit tier facilities should be aware that if their final product is a waste grade material, it must be properly disposed. In most cases, this will likely mean disposal at a municipal landfill, and the landfill will probably charge a tipping fee for the disposal. In the event the commission considers charging a fee in the future, all municipal waste fee rules are currently located in 30 TAC Chapter 330, Subchapter P. The operator certification program has not been developed, so the agency cannot provide a fee for that program.

The commission received several comments regarding proposed definitions in §332.2. One commenter believes the proposed definition for "agricultural materials" is too broad. By including "vegetative materials" within that definition, which in turn is defined very broadly, a wide variety of materials from various commercial and industrial operations arguably could be considered to be

"agricultural materials." The commission believes that the inclusion of vegetative materials is appropriate for agricultural operations since farms and other agricultural operations produce fruits, vegetables, and grains. Section 332.4(10) provides a list of appropriate industrial feedstocks for composting under the authority of this chapter. The commission will retain the proposed definition. Another comment concerns the definition of "backyard operations." Because of the inclusion of the undefined terms "non-industrial organic material," "vegetative food material," and "commercial or institutional complex," the commenter is concerned that the definition is overly broad. The commission responds that the intent for including these sources in backyard operations is to encourage stores, schools, and businesses to set up a backyard composting operation. By encouraging persons other than homeowners to compost, TNRCC believes that more of these materials will be beneficially reused. The TNRCC has reviewed the definition and determined the definition is appropriate as proposed. One comment concerned "Beneficial reuse." The commenter stated that it would consider use of compost as cover on a landfill to be a beneficial use. According to the Health and Safety Code, §361.428(b), beneficial reuse does not include landfilling or the use of compost as daily landfill cover. This does not preclude the use of compost as final cover to be considered beneficial reuse. The rules do not exclude daily cover as a reuse; however, a municipal landfill may not count compost used as daily cover toward their composting refund and it will also not count toward the State's 40% recycling goal. The commission will retain the definition as proposed. One commenter suggested revising the definition of "Bulking Agent" to identify paper as a bulking agent. The TNRCC has reviewed the definition for "Bulking Agent" and has determined that the definition does not prohibit the use of paper as a component of a bulking agent and has determined the definition is satisfactory. A comment was received requesting the removal of "Curing" from this section because it is not used anywhere else in rule. The commission agrees that "curing" should be removed. Regarding the definition of "Feedstock," a commenter suggested the reference to land application was not pertinent to this regulation. The commission responds by noting that the exempt tier allows the land application of yard trimmings, clean wood materials, vegetative materials and paper. The

definition for "feedstock" has been retained as proposed.

One commenter wanted the commission to clarify calling mature compost "sanitized" in the definition of "Mature compost," indicating that if sanitized means free of microorganisms, this is not a desirable trait for compost. Sanitized in this context is intended to mean the reduction of pathogens to such an extent as to pose no significant threat to the health and safety of the population that receives the product. However, the commission considers a more appropriate term would be "the appropriate level of pathogen reduction (ie. PFRP or PSRP)" as one commenter suggests for the definition of "Semi-mature compost." The commission has amended the definition of "Mature compost" in the final rule. The commission received several comments relating to the prohibition of nuisances throughout the proposed rules, including a concern that the definition of "Nuisance" in §332.2 related only to air nuisances. The commission responds that the general requirement found in §332.4(2) prohibiting nuisances refers to the Health and Safety Code, Chapters 341 and 382, and the Texas Water Code, Chapter 26. The commission agrees that the definition of "Nuisance" is confusing because it does not address other nuisances. The definition has been amended to reference the nuisance provisions of 30 TAC §101.4 of the air regulations (the proposed definition for Nuisance), the Health and Safety Code, Chapter 341, the Texas Water Code, Chapter 26. One commenter suggested use of the EPA descriptions of the terms "PFRP" and "PSRP". The commission agrees, and the final rule reflects this change. Another commenter objected to allowing yard trimmings and clean wood materials collected with white goods to be considered source-separated materials in the definition of "Source-separated organic material". The TNRCC has reviewed existing projects and determined that the probability of cross contamination is too low to warrant the elimination of this provision. The proposed definition is retained. Two commenters stated that the definition of "Semi-mature compost (SMC)" uses the term "pathogen sanitization" which, to many, implies total disinfection. The commenters indicated the more appropriate term should be "the appropriate level of pathogen reduction (i.e, PSRP or PFRP)" since composting alone cannot achieve disinfection

since temperatures of only 60 to 70 degrees C (Pasteurization) can be reached in the process. Another commenter suggests "met pathogen standards. As with the definition of "Mature compost," the definition of "Semi-mature compost" has been amended to replace "sanitization" with "the appropriate level of pathogen reduction (ie. PFRP or PSRP)." The commission received one comment that the definition of "Voucher" should be called an "information sheet" or some other similar, generic term. The TNRCC believes the term is appropriate as defined. One comment was received noting that the definition of "vegetative materials" is very broad and uncertain and may be susceptible to various interpretations. The TNRCC has reviewed the definition and determined the definition is appropriate as written.

The commission received a comment that the proposed rules should have definitions for "grease trap waste," "organic materials," and "sludge." Grease trap waste is a standard industry term meaning grease caught in a waste trap before entering a sewage system. Sludge is defined as municipal sewage sludge and organic materials is defined by its plain meaning. The commission has not added these definitions to the rule.

Regarding proposed §332.3, Applicability, the commission received many general comments, as well as specific comments on the subsections. One commenter expressed support for the number and types of feedstocks either exempted or with notification-only requirements. Several commenters requested that all tiers should be sized for maximum allowable annual feedstock quantities, and that some maximum quantity be specified for exempt, notification and registration tier facilities. The TNRCC does not agree. Sizing a facility for the maximum allowable annual feedstock quantities would cause the facility to be about four times larger than it needs to be (assuming a three month process). The commission believes the exempt, notification, registration, and permit tier requirements comply with Subchapter N of the SWDA. Another commenter stated that registration, notification, and exempt facilities should not be subject to a public hearing. The commission responds by noting that neither the proposed nor the adopted rules

require public hearings for tiers other than the permit tier. However, the registration tier does include landowner notification, and does provide an opportunity for appeal of the executive director's decision through a motion for reconsideration. Additionally, after review of several comments received addressing public notice throughout Chapter 332, the commission believes that adjacent landowner notification is appropriate at the notification tier, and this has been included as §332.22(b). One comment was received indicating that the proposed §332.3 is unclear as to whether a more regulated tier facility can accept feedstocks identified for a less regulated tier. The TNRCC has reviewed the language in each subsection of §332.3 and believes the agency's intent is clear that a more regulated facility can accept feedstocks identified for less regulated facilities. For example the applicability section for the permit tier states, "Operations that add any amount of mixed municipal solid waste as a feedstock in the composting process," which the TNRCC feels clearly indicates that less regulated material can be used as a feedstock for a permitted facility.

With regard to 332.3(a), the commission received two general comments. One commenter objects to allowing mixed municipal solid waste composting because Texas does not have the infrastructure to ensure the quality control necessary. Another commenter believes the TNRCC is not in favor of municipal solid waste (MSW) composting since that is the only category that requires a full permit under the proposed regulations. The commission responds the Health and Safety Code, §361.428(b), requires the commission to adopt rules establishing minimum standards and guidelines for the issuance of permits for processes or facilities that produce compost from the typical mixed municipal solid waste stream. The commission believes the proposed rules provide necessary safeguards for the protection of health and the environment, while providing reasonable standards that are consistent with other municipal solid waste processing permits. The rules retain the requirements for mixed MSW composting. Regarding §332.3(a)(1), a comment was received stating that the paragraph is confusing because it suggests that mixed municipal solid waste may be composted at registered facilities under some

circumstances. The commission agrees with the comment and the paragraph has been changed to delete the confusing language.

The commission received several comments regarding §332.3(b) which identifies those feedstocks eligible for the registration tier. One comment indicated that this level of authorization initially seems to be not as burdensome, but is actually not much different than the permit tier. The commission disagrees that the registration requirements are almost as stringent as those set forth for permitted facilities. The registration is not subject to a public hearing, and does not require a geologic/hydrogeologic assessment. Both of these requirements add a substantial cost and technical element to the permit facilities that are not encumbered by those seeking a registration. A technical review is appropriate for the registration tier, and the rules retain this tier of regulation. Several commenters requested that TNRCC should define grease trap waste as mixed municipal solid waste and allow the composting of grease trap waste only at the permit tier. Two other commenters expressed support for grease trap waste at the registration tier. The TNRCC does not consider grease trap waste to be a mixed solid waste, and further believes there are adequate safeguards at the registration tier. The commission keeps grease trap waste as a registration tier feedstock. One comment received suggested allowing septage at the registration tier, and another suggested allowing sludge generated at Type V grease trap processing facilities to be composted. Domestic septage is contained in the definition for "Municipal Sewage Sludge," and is, therefore, an acceptable feedstock for the registration tier. The TNRCC feels grease trap sludge is covered by the inclusion of grease trap waste.

Several commenters requested adding certain materials as feedstocks to §332.3(b) including: grit trap wastes, petroleum contaminated soils, and water treatment sludges (not waste water treatment sludges). The final rule does not include any of these materials as acceptable feedstocks. The commission did not propose grit trap wastes as a compost feedstock because the majority of grit trap waste is non-compostable. Regarding petroleum contaminated soils, soils

that are hazardous are not appropriate for composting at facilities covered by Chapter 332. At this time, the commission does not believe that contaminated non-hazardous soils are appropriate either for these facilities. In the future, the commission may consider adding water treatment sludges as a feedstock, but only after careful review and analysis of the feedstock.

The commission also received several comments regarding specific provisions in §332.3(b)(1). A comment noted that §332.3(b)(1) should be clarified to state that facilities composting municipal sewage sludge with mixed municipal solid waste are subject to §332.3(a). The commission disagrees that §332.3(b)(1) should be clarified as the commenter suggests. Section 332.2(a)(2) makes clear that if mixed MSW is added to any feedstock, including municipal sewage sludge, the operation must receive a permit. The language has not been changed in the final rule. Another comment indicated that §332.3(b)(2) appears to be overbroad because it allows any "positively-sorted organic material," which is in turn defined without limitation, to be composted at a registered facility. This provision or the definition of "positively-sorted organic material" should include a limitation on the materials allowed to be included. Another commenter suggests that "Positively-sorted organic materials" as a feedstock should fall within the permit tier since there is a high probability of contamination from the mixed municipal solid waste stream. The commission responds that consistent with other feedstocks, there are no limits on the amount of positively-sorted organic material accepted at a registered operation. Additionally, the definition sets forth a list of materials that are considered to be organic materials. Regarding contamination, the commission believes that there is less chance of contamination from positively-sorted feedstocks as opposed to mixed municipal solid waste, and, therefore, believes the registration tier is an appropriate level of regulation for these feedstocks. The commission retains the proposed language. Two comments were received regarding §332.3(b)(5). One commenter stated that disposable diapers should only be an acceptable feedstock in the permit tier and another commenter supports disposable diapers at the registration tier. The commission responds that as long as the diapers are source-separated or positively-sorted, the TNRCC believes the safeguards

at the registration tier are adequate to protect the public health and environment.

Section 332.3(d) lists the appropriate feedstocks for those facilities that are exempt from notification, registration, and permitting. The proposed exemptions generated many comments. One comment suggested that agricultural and industrial operations should not be exempt and should be subject to end-product standards and final product grades. The commission responds that compost feedstocks at agricultural operations should be source-separated, and not contaminated with heavy metals and polychlorinated biphenyl (PCB). Consistent with other source-separated feedstocks, end-product testing is, therefore, not required. The final rule continues to exempt agricultural operations. Regarding industrial operations, specific nonhazardous industrial feedstocks are listed in §332.4(10) for composting at exempt and notification operations. These feedstocks are source-separated which the commission believes should be treated the same as municipal or commercial source-separated materials. Concerning the exemption provided by §332.3(d)(6) for on-site industrial facilities, "on-site" is set forth in §335.2(d) as meaning land owned or effectively controlled by the owner or operator of the facility within 50 miles. This exemption is limited to the composting of materials where the composting takes place on-site, and the final product is utilized or disposed on-site. The commission believes such an exemption is consistent with the Health and Safety Code, Chapter 361, and the exemption from permitting provided by §335.2(d). The commission emphasizes that this exemption does not apply to final product that is taken off-site for distribution, application, disposal, or any other purpose. The commission retains the exemptions for industrial on-site facilities and the allowance of industrial feedstocks identified in §332.4(10).

A comment was received that the TNRCC lacks authority to provide for exemptions, since composting facilities are not included among the types of facilities exempted from permit requirements in the Health and Safety Code. Further, that §361.111 lists certain facilities that are to be exempted from permit requirements and no longer provides discretionary authority to

exempt others. Accordingly, composting facilities are subject to the requirements of the Health & Safety Code, §361.088, and authorization must be preceded by notice and the opportunity to request a contested case hearing. The commission agrees that Health and Safety Code, §361.111, requires the commission to exempt certain facilities listed in the section from permit requirements. However, §361.111 does not limit the commission from exempting facilities not listed in §361.111. Furthermore, §361.061 states that the commission may require permits authorizing the construction, operation and maintenance of solid waste facilities to store, process or dispose of the solid waste. The exception for municipal waste facilities is found in the Health and Safety Code, §361.428(b), which requires the commission to adopt rules establishing a permit program for mixed municipal solid waste composting operations. The TNRCC has complied with this provision in the Chapter 332 rules.

Another general comment regarding §332.3(d) was the concern that exempt operations will not necessarily meet the requirements of §332.4, General Requirements, and §332.8, Air Quality Requirements, because they will not have the means to know of these requirements. The commission will disseminate the rules to interested parties and others it believes may have an interest in composting. Furthermore, most of the requirements in §332.4 represent general statutory provisions that each person and activity in the state is required to comply with. Another comment notes that the categories of operations included within proposed §332.3 (d) are overbroad. The commission disagrees and will retain the operations in §332.3(d) as proposed.

The commission also received several comments targeted at specific paragraphs in §332.3(d). With regard to §332.3(d)(1)(B), the commenter noted the cross-references in §332.3(d)(1)(B) to various provisions of §332.4 are all incorrect, and there is not a §332.4(j) in the proposed regulation. The TNRCC agrees and has changed §332.3(d)(1)(B) to read "Source-separated industrial materials listed in §332.4(10) of this title (relating to General Requirements) excluding those items listed in subparagraphs (A),(F),(G),(H), and (J)." With regard to §332.3(d)(2), a

comment suggests the paragraph is overbroad because of the definitions of "agricultural operations" and "agricultural materials" which may allow numerous industrial and commercial operations to fall within the scope of this provision. The Industrial and Hazardous Waste program at the TNRCC determines when agricultural operations become industrial operations. As an example, cotton is an agricultural product until entering a cotton gin. It then becomes an industrial product. The commission believes that safeguards exist to make accurate determinations as to whether an operation is an agricultural operation or an industrial operation. In addition, §332.4(10) identifies specific industrial non-hazardous feedstocks that are acceptable at this tier. The proposed exemption for agricultural operations is retained. Concerning §332.3(d)(4), a comment was received that the allowance of "land application" is overbroad and is inconsistent with the proposed definition of "land application," and could allow the land application of industrial waste. Again, the commission believes that industrial source-separated materials should be treated the same as municipal or commercial source-separated materials. A comment was received addressing §332.3(d)(5). The commenter states that the paragraph appears to allow any quantity of "paper," which is defined as "a material made from plant fibers," to be applied to land at any location as an erosion control or soil amendment. An incredible variety of materials are made from plant fibers, e.g. cotton cloth, lumber. The commission responds that source-separated paper is not a solid waste, and it has effectively been beneficially reused in land application as a measure against erosion and as a soil amendment. The commission believes it is appropriate to allow land application of paper for these reasons at the exempt tier. The exemption is retained. Finally, a comment states that §332.3(d)(6) also is incredibly overbroad. It appears to allow the on-site "composting" of any type of industrial solid waste from industrial plants, manufacturing plants, mining operations, or agricultural operations. For reasons discussed earlier in the preamble, the commission will retain the exemption for on-site composting.

With regard to proposed §332.4, General Requirements, the commission received two general

comments. One commenter noted that there does not seem to be a general requirement in the rules that non-compostable materials be excluded from feedstock. The commission replies that allowable feedstocks are contained in §332.3 "Applicability," and the commission believes this is sufficient to keep prohibited materials out of processing. Another general comment was that many of the provisions in §332.4 are worded so broadly that they may have no practical value in terms of enforcement. The TNRCC does not agree. In general, the provisions that are worded broadly are referring to other laws and regulations that are enforceable.

Concerning §332.4(1) which prohibits pollution of waters in the state, the commission received a comment that the provision does not stand as a clear prohibition of discharges except as expressly authorized by a Chapter 26 permit. The commission disagrees. There is nothing in this regulation that allows a discharge of pollutants into waters in the state and Chapter 26 clearly prohibits it. A comment received regarding §332.4(2), which addresses nuisances, stated that this general requirement is only related to air emissions and does not appear to include any generally applicable provision directly requiring prevention of conditions such as high levels of flies or other insects, rodents, insect vectors, or wind-blown materials. As discussed earlier, the definition of "Nuisance" has been changed. The TNRCC also believes that the language in the nuisance rule allows for adequate enforcement against windblown material leaving the property of any composting facility. Concerning proposed §332.4(3), the commission received two comments. One comment noted that although this statement may be useful as a general reminder, it does not appear to be specific enough to serve as an unambiguous statement that discharges to waters in the state are prohibited. The second comment stated that §332.4(1) and §332.4(3) say the same thing in different words. The commission disagrees with the first commenter, and believes the performance standard to not pollute waters in the state is enforceable. In response to the second comment, the two paragraphs address different issues. Paragraph (1) refers to discharges and pollution of ground-water or surface-water from the compost operation and is targeted at the operator. Paragraph (3) refers to discharges and pollution caused by use and application of final

product and is targeted at end-users.

With regard to §332.4(8), a comment was received that the requirement that unauthorized materials be disposed of in a "timely manner" is extremely ambiguous, and enforcement could be very difficult. The commission wishes to retain some flexibility because disposal time may be variable depending upon the problem that the unauthorized materials present. The term "timely manner" remains in the rule. Several persons commented on §332.4(9). One comment suggests that it is inappropriate to allow landfill leachate to be used as feedstock at permitted composting sites, while two other commenters supported the use of landfill leachate at exempt, notification, and registration tier facilities. The commission believes use of landfill leachate is appropriate at the permit tier, but only at the permit tier. The feedstock at the permit tier is mixed municipal solid waste which is the material that generates landfill leachate. In turn, the use of landfill leachate as make-up water in non-permitted facilities would increase the probability of end-product contamination without adequate testing.

One comment was received regarding §332.4(10) stating that the provision should be completely rewritten because it appears that it may be intended to provide that only the listed nonhazardous industrial solid wastes may be accepted for composting, mulching, or land application at facilities authorized under this Chapter. However, the reference to the 30 TAC §335.2(d) exemption further confuses the issue. The language might be interpreted as allowing any nonhazardous industrial solid waste to be composted at a facility qualifying for the 30 TAC §335.2(d) exemption which would be inappropriate. The commission does not agree. The provisions contained in the applicability section indicate what may be processed at a facility. This provision indicates that industrial wastes are not prohibited from process or disposal provisions of 30 TAC §335.2(d). As stated earlier, the exemption for on-site industrial facilities is consistent with existing TNRCC rules in 30 TAC Chapter 335 and the Health and Safety Code, Chapter 361. No public comments were received on proposed §332.4(11); however, in reviewing the proposed language, the

commission believes a change is necessary to make the paragraph clearer. The proposed rule has been changed by moving the following language "any of the materials listed in paragraph (10) of this section which are not managed in accordance with the requirements of this chapter" to the very beginning of the paragraph.

The commission retains §§332.4(1)-332.4(10) as proposed. Section 332.4(11) has been changed as discussed.

One comment was received regarding §332.5 suggesting that the provision does not provide an adequate standard for determining when the granting of a variance is appropriate, and that no variance should be granted unless the person granting the variance expressly finds, in writing, that the applicant has demonstrated that the new standard is no less protective of human health, welfare, physical property, and the environment than the standard from which a variance is sought. The commission responds that there are many different methods utilized for composting, especially for composting processes for the registration and permit tier feedstocks. It is the intent of the TNRCC to be flexible by encouraging the most appropriate technology for each operation. It is for this reason that the variance provision was included in the proposed rule. The commission believes the standards set forth in §332.5 are adequate for determining whether a variance is appropriate. However, the commission does believe §332.5, as proposed, did not provide clear guidance on the process for submitting a variance request and did not clearly identify the entity at TNRCC responsible for approving or denying a variance request. Section 332.5 has been amended in the final rule to address these issues.

The commission received several comments discussing proposed §332.6. One comment stated that the reference to "materials considered to be exempt, notification or registered facilities" in the first sentence of §332.6 (a) is unclear, and that the types of changes to a solid waste permit authorized by §332.6 (a) and (b) require permit amendments and are not appropriately authorized

as permit modifications. The commission does not agree. The provisions of §332.6 are consistent with existing commission procedures established in Chapter 305. Another commenter believes the proposed regulation should clearly indicate the process an existing MSW facility with permit provisions for composting exempt tier materials, would need to follow if the facility wanted to process material listed in a more regulated tier. Additionally, the commenter does not feel the proposed regulation clearly indicates whether an existing MSW facility would be inspected in accordance with the existing permit or the proposed regulation. The commission believes §332.6 directs a permit holder to the appropriate sections in Chapter 305 for processing a modification or amendment to the permit. The commission emphasizes that this Chapter is not intended to affect existing MSW permits unless modified under Chapter 332. If a permit is amended or modified in accordance with the provisions of this chapter, the amended or modified permit governs. One commenter was concerned about which division will review applications. The commission reserves the right to allocate staff resources as appropriate. The commission will retain §332.6 as proposed.

Two comments were received on §332.7. One commenter indicated that §332.7 is not clear on how it applies to existing wastewater treatment facilities operating under a permit. They request that the proposed rules allow variances for composting operations at existing wastewater treatment facilities because the design of operations occurred prior to rules development. The commenter suggests using the following language "If the wastewater treatment facility has received a water quality permit under the Texas Water Code, Chapter 26 which authorizes compost operations, the compost operation shall be conducted in accordance with the facility permit". The commission agrees with the commenter and the proposed wording will be added to §332.7. The second comment stated that the TNRCC's modification practice with respect to solid waste facilities is not applicable to water quality permits. This type of change requires a permit amendment. The commission responds that the term "modification" in §332.7 is appropriate because the placement of a composting operation at a water quality permitted facility issued under

the Texas Water Code, Chapter 26 requires a permit to be "modified" by an amendment in accordance with 30 TAC Chapter 305.

Proposed §332.8 allows compost operators the opportunity to obtain a standard air quality permit as an alternative to a regular air quality permit to create a one-stop permitting program. The standard permit sets forth basic requirements that the operator must meet, and by doing so the operator will not be required to go through a separate air quality review and public hearing. The commission received a number of comments regarding the standard air quality permit. One general comment stated the provisions in §332.8 are wholly inadequate to address air emissions issues associated with these types of facilities because the requirements simply do not address the primary causes of air contaminants concerns at composting facilities: odors and volatile organic compounds (VOC). Of the limited control measures mentioned in the rules, many are simply too general to be readily enforceable. An example is the requirement for "an adequate volume of bulking material to blend with/cover the material" prior to receiving material with high odor potential. This requirement is too general. The commenter states that the rules must be written in a manner that provides adequate directive and guidance to assure that nuisance conditions never develop. The TNRCC does not believe that it is necessary to list every possible control measure for composting facilities to have adequate protection against nuisance conditions. As minimum requirements, the TNRCC has included certain specific design and operational criteria in these rules. However, to meet the standard of not creating a nuisance, the rules are written to provide the operators with flexibility. For example, proposed §332.8(c)(3) requires that an "adequate volume of bulking material" must be used; what an "adequate volume" is depends on a variety of factors, such as climatic conditions, type of feedstocks, type of bulking material, etc. Prescribing specific volumes of bulking or cover material may be too restrictive given the variety of feedstocks and methods for processing and may not be economically reasonable. Also, any compost operation which is operating under the notification or permitted tiers must provide certain information to the agency and those operators will be held to the representations made in

their notification and application forms. The operator's incentive to avoid creation of a nuisance is to avoid enforcement action by the agency. As a comparison, specific design or operational criteria in the rules promulgated under the Texas Clean Air Act (TCAA) for other sources of air contaminants also provide operational flexibility for compliance with the nuisance rule. Given the nature of these operations, the TNRCC does not believe that it is technically practicable and economically reasonable to require additional controls for facilities covered by this chapter, including controls for the emission of VOCs.

Another general comment regarding §332.8 is that the statutory prerequisites for standard air quality permits have not been met. Prior to issuing any such permit, TNRCC must comply with the mandates of Section 382.0518 of the Health & Safety Code. However, the provisions in the proposed rules are not adequate to assure that facilities will use best available control technology (BACT) or that emissions from facilities will not contravene the intent of Chapter 382 of the Health & Safety Code, particularly as it relates to aesthetics. The commenter further notes that the provisions in the rules relating to air issues address certain limited aspects of operations at facilities, e.g., grinding operations and dust from vehicle traffic, but fail to address the actual composting process, a major aspect of operations related to odor emissions and VOCs from stockpiles or leachate retention facilities. The TNRCC believes that these proposed rules are adequate for the finding that BACT will be used and that the emissions from the facilities will not contravene the intent of the TCAA. In drafting these rules, technical practicability and economic reasonableness of reducing or eliminating the emissions from these facilities was considered. The actual composting process is addressed in requirements throughout these rules, such as §§332.8(b)(1), (c)(1) and (3), and 8(e)(6). Emissions from materials stockpiles must not cause a nuisance. Further, if the facilities operate in accordance with the requirements of these rules, the TNRCC believes that there will be protection of aesthetic enjoyment of air resources by the public. Leachate retention facilities are not typically sources of odors at municipal landfills and are not expected to be sources of odor emissions at compost facilities. Likewise emissions of

certain gases such as VOCs, from these are expected to be minimal if present at all.

Specifically, regarding §§332.8(b)(3), 332.8(c)(4), 332.8(d)(4), and 332.8(e)(4), a comment was received that the requirement can be met by simply parking a water truck or having a garden hose available next to the grinding operation. The commenter suggests that no restrictions should be required on a grinder unless a problem is identified at a later time. The TNRCC recognizes that grinders are sources of particulate emissions and the operators should be prepared to control these emissions if and when they occur. The rules do not require use of water at all times because the amount of water needed depends on various factors, including climatic conditions, type of feed stock and location, thereby providing the operator with flexibility in how to maintain compliance with the rule. Continuous use of dust suppressants is not required, but is an option for the operator as a control measure. Regarding §332.8(d)(1), two commenters believe it is unnecessary to require a speed limit of 10 mph on roads already treated for dust suppression. The commission believes that dust emissions generated from vehicular traffic can be controlled by various measures as listed in the proposed rule. Measures such as watering or treating with dust suppressants are only temporary methods compared to paving which is considered a more permanent control measure. Paved and clean roads have an inherently lower potential for emissions. Relaxation of the 10 mph speed limit is appropriate for those facilities which choose to pave traffic areas. In addition, the TNRCC believes that vehicular speeds on unpaved roads should be limited to 10 mph because increased speeds on unpaved roads will reduce the long-term effectiveness of dust suppressants and require more frequent application of these suppressants to maintain the same control efficiency.

Concerning proposed §332.8(d)(3),(e)(3), the requirement for venting through a fabric filter, a commenter expressed concern that this is an inflexible technology standard. A suggestion was made that if odor is the concern here, other states have used a limit of seven dilutions to threshold at facility boundary lines. The commission responds that the requirement for use of a fabric filter

is due to the concern of particulate emissions. If an operation wants to use an alternative technology for the control of particulate emissions from conveying air, they may apply for a permit under Chapter 116 of this Title (Control of Air Pollution by Permits for New Construction or Modification). Regarding proposed §332.8(d)(4)-(5), one commenter believed the requirements are overly restrictive and limit the use of alternative or innovative technologies. The commenter acknowledges particulate matter control is important, but the specific requirements are excessive. The TNRCC believes that these requirements are necessary for BACT while providing the operator with flexibility. For facilities that cannot meet the requirements of this chapter, they may apply for a permit under Chapter 116 of this Title (Control of Air Pollution by Permits for New Construction or Modification) to use alternative or innovative technologies.

One commenter requested modifying the term "entitled to an air quality standard permit" to "will be issued an air quality standard permit," in proposed §332.8(e). The TNRCC responds that the proposed language is consistent with other standard permits available under the TCAA, Texas Health & Safety Code Chapter 382, found in 30 T.A.C. Chapter 116, Subchapter F.

A general comment concerning §332.8(d),(e) was that the two sections are almost identical and they should be combined. This commenter is correct in pointing out that §332.8(d) and §332.8(e) are almost identical. However, these will not be consolidated in order to maintain consistency with the remainder of the format of these proposed rules which list requirements for four different types of compost facilities, each with different design and operational criteria.

After reviewing the proposed language in §§332.8(b)(3), 332.8(c)(4), 332.8(d)(4), and 332.8(e)(4), the commission believes that these paragraphs should be modified, although no specific comments were received regarding this concern. Due to the design of most tub grinders, the requirement to maintain a full receiving hopper during all grinding operations is unduly burdensome and technically unfeasible. For start-up, a pre-filled hopper could cause the grinder to remain in a locked condition. For grinder shut-down, maintaining a full hopper would require

that the tub be manually emptied after shut-down. The proposed revision below should not significantly affect emissions and does not represent an additional restriction for the composting industry. The TNRCC recommends that §§332.8(b)(3), (c)(4), (d)(4), and (e)(4) be modified, as follows: "Except for initial start-up and shut-down, the receiving chamber on all grinders shall be adequately filled prior to commencement ..."

The commission will retain the proposed language in §332.8 with the exception of the changes in §§332.8(b)(3), 332.8(c)(4), 332.8(d)(4), and 332.8(e)(4) discussed above.

Subchapter B, §§332.21-332.23, addresses composting operations requiring a notification. The commission received several comments concerning this subchapter. Two commenters suggested deleting §332.21 because this section is identical to §332.3(c). The commission believes that the feedstocks should be repeated at the beginning of each subchapter for clarity. The section has been retained. Consistent with changes to the notification requirements in the rule for registered and permitted facilities, the commission has amended §332.22 to clarify the notification procedures to adjacent landowners.

Concerning §332.23, one commenter suggested that it would be better if this section were simply entitled "Suggested Operational Standards." The commission does not agree. These are operational requirements and if problems arise and are brought to the attention of the commission, enforcement action may be appropriate. One comment on §332.23(1) stated that it is extremely inappropriate to authorize the intentional use of an anaerobic composting phase. Such a phase greatly increases the potential for odor generation. The commission disagrees with the comment. There are appropriate processes that rely on an anaerobic phase that decrease the potential for odor generation. Several comments were received discussing §332.23(2)(A),(B). One comment suggests clarifying paragraphs (A) and (B) by providing that the listed temperatures are to be maintained for continuous periods of 72 hours or longer and 360 hours or longer, rather than

days. The commission does not agree with the suggested changes because the language in these provisions was borrowed from federal regulations and has functioned effectively for several years. Two commenters requested that pathogen reduction required at this tier be removed. Pathogen reduction is required at this tier because of the potential for pathogens to be present in the feedstocks associated with this tier. Pathogen reduction is required in the registration tier for municipal sewage sludge composting in accordance with the provisions of 30 TAC Chapter 312 pertaining to Sludge Use, Disposal, and Transportation. The commission further notes that pathogen testing is required for permitted and registered facilities. The commission received one comment on proposed §332.23(3) stating that trace amounts of many different hazardous substances are found throughout the environment. If the standard is zero as the language indicates by its exclusion of pesticides, herbicides, fungicides, and insecticides that contain hazardous constituents, then almost nothing could be composted. The commission believes the intent of the provision is clear; the prohibited substances shall not be applied or incorporated into the feedstock, in-process or processed material. The commission retains the language in §332.23 as proposed.

Subchapter C, §§332.31-332.38, contains the requirements for registered facilities, and the commission received many comments regarding the provisions of this subchapter. One commenter suggested that the effect of the site restrictions and operational requirements of this subchapter will be to force these operations indoors, and the result will be that most available feedstock material will be disposed of by other means. The commission believes that the proposed rules create an accommodating environment for the processing and beneficial reuse of organic materials. The commission feels strongly that it is appropriate for the registration and permit tier feedstocks to contain design, location, and operational requirements and be subject to final product standards due to the potential contamination from those feedstocks. The requirements for these facilities are consistent with other municipal solid waste registrations and permits. One commenter suggested deleting §332.31 because it is identical to §332.3(b). The

commission believes that the feedstocks should be repeated at the beginning of each subchapter; however, for clarity, the structure of proposed §332.31 has been modified.

Concerning §332.32(a), the commission received a comment that this provision, which states that facilities must comply with any future rules to be in compliance with the registration, is not in compliance with the Health and Safety Code, §481.143. The commission assumes the commenter is actually referring to the Government Code rather than the Health and Safety Code. Section 481.143 of the Government Code, "Uniformity of Requirements," essentially requires that a permit application shall be considered by a regulatory agency under the rules that are effective at the time the application is filed. The commission has removed this requirement, and believes that the existing program requirements provide sufficient protection for human health and environmental protection. As a result of this change, proposed §332.32(b),(c) have become §332.32(a),(b) in the final rule. The commission received two comments regarding proposed §332.32(b). One commenter suggested that certification by a professional engineer should also be required for the design of the facility, and that such certification should be required to be included with the registration application. The comment also suggests that the requirement for a certification that a facility "is in general compliance" is simply too open-ended to be meaningful. Another comment states that there are many low-tech composting methods which can be accomplished with little or no design. Requiring certification by an engineer in such cases only elevates costs. The commission responds that the regulations only require engineer certification for general compliance, and do not require submittal of documents requiring an engineers seal or certification because it cannot and should not perform quality control and proof reading for professionals. Requiring the applicant to submit the required engineers certification with the application would require construction of the facility prior to submitting the application which the commission feels would be inappropriate. Additionally, certification of general compliance with the regulations is a standard practice of the commission. The commission does agree that a time limit for obtaining the engineers certification is appropriate; therefore, proposed §332.32(a)

(§332.32(b) in the proposed rule) has been revised to read "...in general compliance with the regulations prior to accepting any feedstock at the facility that requires registration and maintaining that certification on-site available for inspection by the commission; and..." In addition, the commission believes that it is appropriate for registered facilities to be inspected by the TNRCC prior to accepting feedstocks. The inspection requirement has been added to §332.32.

The commission received one comment regarding §332.33. Concerning §332.33(1), two commenters recommend that existing Annual Reports being submitted by composters of biosolids be accepted in place of TNRCC Form #3. The commission believes this is not appropriate to address in the regulations, but is an operational implementation issue. It is likely that another report could be attached to Compost Form #3 if it provided the information required by the annual reporting form. Operators should understand that Form #3 is not planned to be a lengthy form that will take a lot of time to fill out. The commission is not interested in creating a paperwork burden on operators. The commission retains the language of §332.33(1) as proposed. For clarity and consistency, though, the structure of §332.33 in the final rule has been changed. In addition, the catchline of proposed §332.33(4) has been changed to "Final product testing report," and the last sentence of the paragraph has been deleted because it referred to permits rather than registrations.

The commission received several comments on proposed §332.34 which discusses the registration application. One commenter requested that specific designs for odor control processes must be required as part of the application. Those designs must be based on appropriate air dispersion modeling. The commission does not believe odor dispersion models are necessary in light of the prohibition of nuisance conditions that exists as a general requirement. Another commenter felt the application requirements are much too extensive, and all that should be required is name, address, legal authority, and a brief description of the anticipated process including types of

feedstocks, and a statement the facility will be constructed and operated to meet the requirements of §332.4 and §332.8. The commission disagrees with the comment. The material processed at the registration tier can be problematic and the commission will retain oversight. Specifically regarding §332.34(11), the commission received a comment requesting guidance for identification of potentially affected landowners, residents, and businesses because of the high potential for generation of significant odors. Several factors may determine who is an affected party including distance to the operation, location to the entrance, prevailing wind direction, etc. The commission anticipates that determination will be on a site-specific basis, and the final rule clarifies that it is the executive director's discretion to determine who may be affected. For the registration tier, the final rules require notification of landowners. It is left to the discretion of the landowners to notify residents and businesses on their property. The commission received two comments concerning proposed §332.34(12). One comment stated that the rules need specifically to provide that a registered facility is limited to the quantities and types of feedstocks and the process identified in the registration application, unless specific approval is granted. The commission responds that §332.37(9) requires the applicant to receive written permission from the commission for significant changes. Another commenter believes that the language infers that the facility was or will be designed by a Texas Registered Professional Engineer knowledgeable in the management and operation of a composting facility. The commenter believes that if the engineer is to develop the operating plan, the engineer should also be a certified compost operator or the rules should allow the operating plan to be developed by a Certified Compost Operator. The commission does not agree. The Texas Engineering Practice Act requires an engineer to be qualified by education or experience before the engineer accepts an assignment, a certified compost operator may not be qualified to design facilities. The commission will retain §332.34(12) as proposed.

A comment received by the commission discussing §332.34(13) requested a provision that plans and specifications should be required to comply with all applicable provisions of the chapter. If

compliance is not possible, the applicant should be required to submit a request for a variance pursuant to §332.5. The commission does not agree because the engineer is required to provide a certification that the site is in general compliance with the regulations. Regarding §332.34(14), a commenter noted that the provision for a closure plan needs more specificity including a closure cost estimate. Additionally, some financial assurance mechanism is needed. The commission believes that the closure plan for registered facilities should be site-specific. These are not municipal landfills. The major concern is the disposition of waste if the facility closes, and the applicant is required to provide this information according to §332.34(14). The commission also believes financial assurance should not be required of registered facilities. If, after a period of time, there appear to be several closures that become problems, the commission may revisit the financial assurance issue in the future. The commission will retain the language in proposed §332.34(13) and §332.34(14) as proposed.

Regarding §332.35, the commission received a comment that the proposed rules would have the effect of depriving the public of the opportunity for public hearings on matters for which they currently are entitled to that opportunity. Legislation limiting such opportunities did not pass the state legislature. The TNRCC should not, and does not have legal authority to, deprive the public of that right through the adoption of rules. The commission responds that the registration tier does not eliminate the opportunity for public participation in the process. The rules require public notice and provide the opportunity for a motion for reconsideration of an executive director's action on a registration. Furthermore, the commission believes the technical requirements required of registered facilities provide the necessary protection of human health and the environment. Another comment suggested that a groundwater characterization is needed for registered facilities because the authorized wastes could include numerous contaminants. Further, the commenter states that because of the potential for contamination, registered facilities should not be allowed in areas with shallow groundwater. The commission believes the liner requirements are adequate to protect the groundwater, and does not believe a characterization is

necessary in all cases, nor is a prohibition of registered facilities necessary in areas with shallow groundwater. One commenter noted that the application processing in §332.35 is missing in the permit tier. Most requirements for application processing for permits are contained in 30 TAC Chapters 281 and 305; however, public notice requirements have been added to the permit tier in §332.41. The requirements for application processing for registrations were included in Chapter 332 because Chapter 281 and 305 do not address registration processing for compost facilities. The commission received a comment specific to §332.35(a). The comment notes that subsection (a) requires a notice suitable for publication or mailing, but there does not appear to be any requirement that the notice be published or mailed to anyone. The commission agrees and the rules are amended to clarify the public notice procedures. Additionally, the final rule includes an appeal process of the executive director's decision on a registration through a motion for reconsideration. Applicants, the public interest council, or other persons may file a motion for reconsideration pursuant to §332.35(e), if the party wishes to have the commission review the executive director's action. Regarding proposed §332.35(c), the commission received a comment stating that subsection (c) fails to provide any guidance on the factors to be considered by the executive director in determining whether to approve or deny an application. The commission agrees that rules should establish a decision criteria for the executive director. The final rules have been changed to state that the executive director will base his decision on whether the application meets the criteria established in §332.4, General Requirements and Subchapter C. The structure of §332.35 was altered to accommodate the changes in the final rule.

Regarding §332.36, the commission received several comments. One commenter stated that it is unclear what is meant in §332.36 (1) by preventing "washout." If a facility is located within the 100 year floodplain, it should be designed and maintained, with dikes or similar structures, to prevent flooding during a 100-year event. The commission responds that preventing "washout" is clear criteria and it is a design function to determine how it is best accomplished. The 50 foot set back is consistent with existing MSW requirements. Concerning §332.36(2), a commenter

suggested that a facility designed to prevent run-on and run-off must significantly alter natural drainage patterns. The commission does not agree. Several programs at the commission have that as a requirement and have issued permits and registrations. A comment suggested that the 100 foot setback requirement in §332.36(5) should be extended to include aquifer recharge features. The set back is intended to help prevent wash-out which is not a problem with recharge features. A comment again suggested it is extremely inappropriate to authorize the intentional use of an anaerobic composting phase in §332.36(6). There are appropriate processes that rely on an anaerobic phase and the commission does not intend to dictate operational criteria. The commission will retain the proposed language in §332.36.

A number of comments were received concerning §332.37 which sets forth operational requirements for registered facilities. One comment noted that the only provision addressing vehicular access for facilities requiring registration is one requiring that the access road be an "all-weather road," which is inadequate. The commission also needs to consider traffic on access roads. The commission responds that traffic safety is not a commission function. Limitations on roadway use is best left to the local jurisdiction responsible for maintaining the roadways, or with the Department of Transportation in the case of a state highway.

Another commenter suggests there is no reasonable basis for not requiring information equivalent to that required pursuant to §332.47(6) relating to facility information. Without that level of information, the TNRCC will not have the information it needs to adequately evaluate these types of facilities. Further, the commenter notes that no facility should be authorized to accept sewage treatment sludges without this level of review. The commission does not agree. Very careful consideration was given to the information required for the commission to make a decision on a registration tier facility. The commission believes the requirements set forth in Subchapter C for registered facilities provide an acceptable level of regulation to protect human health and the environment while retaining the necessary flexibility to promote composting. The commission emphasizes that these facilities must still undergo a review by the agency prior to operation.

Another comment regarding §332.37 states that there are no consistent pathogen reduction requirements for registered facilities, although there are for "exempt" operations. There are no pathogen reduction requirements for exempt tier facilities, but there are clear pathogen reduction requirements for notification tier facilities. There are also clear (30 TAC Chapter 312) requirements for the registration tier facilities that compost wastewater treatment sludges, and all other registered and permitted operations must test final product for pathogens. One commenter believes the entire §332.37 is redundant and is adequately covered by the general requirements of §332.4. In response, §332.4 represents general requirements that all facilities must follow, while §332.37 presents specific operational requirements tailored for registration tier feedstocks.

Specifically concerning §332.37(1), a commenter believes that it is unclear what is intended by the requirement that the facility be constructed, maintained, operated to "manage" run-on and run-off during a 25-year, 24-hour rainfall event. Additional clarification is needed. At a minimum, language should be added to make the provision consistent with the requirements of 30 TAC §330.55(b)(1),(2) & (3). The commission believes the provisions of §332.37(1) are clear and are adequate to protect surface waters. The use of a 25 year 25 hour storm is standard. The commission will retain the proposed language. With regard to proposed §332.37(2), a commenter suggested the second sentence should be modified to read: "Facilities that compost municipal sewage sludge, grease trap waste, disposable diapers, "or" the sludge byproduct" As currently drafted, only facilities with all of those feedstocks would be covered by this requirement. The commenter also notes the reference in the third sentence to areas where "receiving, mixing, composting, post-processing, screening and storage areas would be in contact with the ground ..." is ambiguous, and that a liner should be required under all areas regardless of processing method. Furthermore, some form of leak detection and/or groundwater monitoring system is needed in order to determine if the liner system is intact. Another commenter stated that it is unreasonable to restrict receiving and processing of yard waste and wood to lined areas if

materials are processed and removed from the unlined area within a short time. Another commenter recommends allowing concrete as an acceptable surface in addition to clay and synthetic liners. Two commenters believe that liners should not be required for registration tier facilities, rather sufficient run-on and run-off controls with a suitable working surface for the composting pad should be minimum requirements. The commission agrees that "and" should be changed to "and/or" to clarify that any of these feedstocks alone or combined is required to install a liner system. The change has been made. The commission disagrees that a liner is necessary in all instances. As an example, requiring a liner for many within-vessel composting systems would be expensive while not affording much more environmental protection for that part of the operation. The commission will retain the proposed language. To address the comment on yard trimmings and clean wood materials, the rules only require lining areas that are for municipal sewage sludge, grease trap waste, disposable diapers, and/or the sludge byproduct of paper. Yard trimmings and clean wood materials waiting to be processed with these materials are not required to be on a liner. Regarding other surfaces, it was not the intent of the commission in the proposed rule to limit liners to clay or synthetic materials. The commission agrees that other materials such as concrete are effective, and the rule has been changed to provide for alternative designs including concrete. The commission disagrees with the comment that liners should not be required. It is appropriate to require liners for the identified feedstocks due to potential contamination. The commission retains the requirement for liners.

Regarding §332.37(4), a commenter suggests fences should be required to be adequate to prevent, or at least minimize, access by domestic pets. The commission believes that the requirement for a fence, as proposed, is adequate to control access to the facility, and a requirement to prevent access by domestic animals would be difficult to enforce. The requirement is retained as proposed. Concerning §332.37(5), a comment states that the definition of "nuisance" found in §332.2 needs to be rephrased to address broader issues related to pests, disease vectors, and the like. As discussed earlier, the definition of "Nuisance" has been changed.

A comment was received on §332.37(6) that again states that it is extremely inappropriate to authorize the intentional use of an anaerobic composting phase. As noted previously, there are appropriate processes that rely on an anaerobic phase and the commission does not intend to dictate process criteria. The proposed language is kept in the final rule. The commission received one comment discussing the proposed language in §332.37(9) which is the authorization for significant changes. The comment requested more specificity for this provision including a procedure for obtaining the authorizations. The commission believes it has the authority to require reasonable support documentation without additional verbiage. Section 332.37(9) is retained as proposed. The commission received two comments concerning §332.37(11)(A). One commenter requests language should be included in rules assuring operators that the application of biosolids compost meeting Grade 2 Compost standards remains unrestricted. The second commenter requests that end-product standards in Chapter 332 be applicable to any registered facility that composts municipal sewage sludge. Composters of municipal sewage sludge are not required to comply with the end-product standards of Subchapter G with the exception of the foreign matter requirements. Instead, those facilities must comply with the requirements of 30 TAC Chapter 312 which does not classify processed sludge as Grade 1 or Grade 2. The Grade 2 standards in the compost rules are equivalent to the Class A sludge standards in the Chapter 312 rules; and final product meeting the Class A standards does not have a restricted use. Although the commission understands the commenters concern, the commission believes that adding such language will only serve to add more confusion to the rules because it will appear that those facilities are subject to both the Chapter 332 and Chapter 312 standards. Regarding the second comment, it is the intent of the commission to not duplicate requirements. There are existing federal and state standards for municipal sewage sludge in 40 CFR Part 503 and 30 TAC Chapter 312, respectively, including end-product standards for municipal sewage sludge. The commission retains the proposed language. The commission also received two comments on proposed §332.37(12) which requires a compost facility to employ at least one TNRCC certified compost operator. One commenter had very specific questions about the certification program. The other

commenter stated that once certification is available, no composting facility of significant size or accepting materials other than yard trimmings should be allowed to operate without a certified operator on-site. Furthermore, the reference to requiring that a certified operator "routinely be available on site" is unduly ambiguous. Currently, the TNRCC does not have an established certification program for composting. The proposed rules were written to only require a certified compost operator when the program became available. At this time, the commission cannot

speculate as to the specific requirements of the certification program, but it would probably be similar to the multi-level landfill certification program. Operators will be notified when the program comes into existence. The commission disagrees that a facility should not be allowed to operate without a certified operator. If this were the case, an operation could be held up for months before starting because the agency will probably provide a limited number of trainings. Furthermore, it may be impossible to have a certified operator on site at all times, so the commission believes that "available on site" is appropriate. The proposed language has been kept without change in the final rule.

The commission received one comment concerning proposed §332.38. The comment requests that a facility also should be required to maintain records of any complaints received, discharges to surface waters, the results of periodic water balance calculations to determine if leachate may be seeping into groundwater, and records of any repairs to liners, and records of types and quantities of wastes received. The commission gave careful consideration to the records it would require and does not intend to require a facility to expend resources toward recordkeeping beyond what the commission believes is reasonable. The final rules retain §332.38 as proposed.

Subchapter D of the rules addresses the requirements for permitted facilities. The commission received several comments on the requirements for this tier; however, many of them are duplicative of comments received for the registration tier. Regarding §332.41, one commenter suggested deleting the section because it is identical to §332.3(a). The rules retain §332.41, but public notice requirements have been added to the section, and the section has been restructured.

Concerning §332.42(a), a comment received believes that this provision seems entirely appropriate, but does not comply with the Government Code, §481.143. The commission has removed this requirement, and believes that the existing program requirements provide sufficient protection for human health and environmental protection. As a result of this change, proposed §332.42(b)-(c) have become §332.42(a)-(b) in the final rule.

Concerning §332.42(b), a commenter recommends that certification by a professional engineer should also be required for the design of the facility. Also, the requirement for a certification that a facility "is in general compliance" is simply too open-ended to be meaningful. A certification of construction in compliance with all applicable design requirements should be required to be submitted to the TNRCC prior to commencement of operations at the facility. The commission disagrees. The regulations do not require submittal of documents requiring an engineers seal or certification because it cannot and should not preform quality control and proof reading for professionals. Requiring the applicant to submit the required engineers certification with the application would require construction of the facility prior to submitting the application which the commission feels would be

inappropriate. Certification of general compliance with the regulations is a standard practice of the commission. The commission does agree that a time limit for obtaining the engineers certification is appropriate; therefore, §332.42(b) has been revised to read "...in general compliance with the regulations prior to accepting any feedstock at the facility that requires a permit and maintaining that certification on-site available for inspection by the commission; and..." In addition, the commission believes that it is appropriate for permitted facilities to be inspected by the TNRC prior to accepting feedstocks. The inspection requirement has been added to §332.42.

In §332.43, the commission amended the catchline of paragraph (3), which now is "Final product testing report."

Concerning §332.44(1), the commenter states that it is unclear what is meant by preventing "washout." If a facility is located within the 100 year floodplain, it should be designed and maintained, with dikes or similar structures, to prevent flooding during a 100-year event. The commission believes that preventing "washout" is clear criteria and it is a design function to determine how it is best accomplished. The 50 foot set back is consistent with existing MSW requirements. With regard to §332.44(6), a commenter suggests the 100 foot setback requirement should be extended to include aquifer recharge features. The commission responds that the set back is intended to help prevent washout which is not a problem with recharge features. The commission retains §332.44 as proposed.

Regarding §332.45, the commission received a general comment that the entire section is redundant and is adequately covered by the general requirements of §332.4. The commission does not agree that the general requirements of §332.4 adequately address concerns with these facilities. The material processed at permit tier can be extremely problematic and the commission will retain oversight. With regard to §332.45(1), a comment stated that it is unclear what is intended by the requirement that the facility be constructed, maintained, and operated to "manage" run-on and run-off during a 25-year, 24-hour rainfall event. Additional clarification is needed. At a minimum, language should be added to make the provision consistent with the requirements of 30 TAC §330.55(b)(1),(2) & (3). The language should be amended to clarify that the discharge of feedstock, in-process, processed materials, and leachate is prohibited regardless of the storm event. In addition, some provision should be made for requiring operators

to dispose of leachate at a facility permitted pursuant to the Texas Water Code, Chapter 26, if retention capacity is not adequate to contain the leachate expected from processing and rainfall events. The rules also need to require the use of a water balance in order to assure adequate leachate and contaminated water containment capacity. The commission believes the provisions of §332.45(1) are clear and adequate to protect surface waters. The use of a 25 year, 24 hour storm is standard. Proposed §332.45(1) is retained as proposed.

With regard to §332.45(4), the commission received a comment that fences should be required to be adequate to prevent, or at least minimize, access by domestic pets. Again, the commission believes that the requirement for a fence, as proposed, is adequate to control access to the facility, and a requirement to prevent access by domestic animals would be difficult to enforce. The proposed language has been kept. Concerning proposed §332.45(5), a comment notes that although this provision is intended to address a broader definition of nuisance, it is limited to air issues by the definition of "nuisance" found in Section 332.2. Accordingly, this language needs to be rephrased to address broader issues related to pests, disease vectors, and the like. As discussed earlier, the definition of "Nuisance" has been amended. Regarding §332.45(6), a commenter stated that it is inappropriate to authorize the intentional use of an anaerobic composting phase. The commission again responds that there are appropriate processes that rely on an anaerobic phase and the commission does not intend to dictate process criteria. The proposed language is retained. Concerning §332.45(9), a commenter suggests a reference to a specific procedure to be followed in obtaining permit amendments. The commission agrees that the paragraph should incorporate a reference to 30 TAC Chapter 305, relating to Consolidated Permits, and the change has been made. The commission received one comment on §332.45(12). The comment stated that the provision appears to allow a facility to operate for six months without a certified compost operator on staff, even if the operation commences a year after the certification program has been established and after these rules have been adopted. That result is indefensible. Once certification is available, no composting facility of significant size or accepting

materials other than yard trimmings should be allowed to operate without a certified operator on-site. Also, the reference to requiring that a certified operator "routinely be available on site" is unduly ambiguous. As stated earlier, the TNRCC does not have an established certification program for composting. The proposed rules were written to only require a certified compost operator when the program became available. The commission disagrees that a facility should not be allowed to operate without a certified operator. The frequency of the program may be such that an operation is held up for months before starting because the agency may only provide a limited number of trainings. Furthermore, it may be impossible to have a certified operator on site at all times, so the commission believes that "available on site" is appropriate. The proposed language has been kept without change in the final rule.

With respect to §332.46, a commenter requests that a facility also should be required to maintain records of any complaints received, discharges to surface waters, the results of periodic water balance calculations to determine if leachate may be seeping into groundwater, and records of any repairs to liners, and records of types and quantities of wastes received. The commission gave careful consideration to the records it would require and does not intend to require a facility to expend a lot of resources toward recordkeeping other than that which is absolutely necessary. The language in §332.46 is retained as proposed.

Concerning §332.47, the commission received one comment that the permit application requirements for a mixed municipal solid waste composting facility are unnecessary, completely ridiculous, and complete overkill. The commission does not agree. The feedstock for the permit tier can be problematic and should receive no less oversight than other MSW facilities. The commission believes the application requirements are wholly appropriate. Furthermore, the SWDA requires a permit for mixed municipal solid waste composting. Although no official comment was received, agency staff in reviewing the proposed rule determined that §332.47(6)(A)(iv)(II) should be clarified by changing the reference of "TxDOT Circular 80-76" to

its generally recognized name of the "Bridge Division Hydraulic Manual" to alleviate confusion. The proposed language has been amended to incorporate this change. Proposed §332.47(6)(A)(iv)(IV) is the only subclause in clause (iv) with a title; therefore, the title has been removed for consistency. As with the registration tier, the commission has amended proposed language regarding liners in §332.47(6)(C)(i) to allow for alternative designs. With these exceptions and those changes identified as typographical errors earlier in the preamble, the commission retains the language in §332.47 as proposed. Paragraph (11) has been added to §332.47 to require that applicants submit a list of landowners.

Subchapters E (§§332.51-332.53) and F (§§332.61-332.64) set forth requirements for source-separated recycling and HHW collection respectively. The commission received several comments on both subchapters.

Regarding §332.51(a), one commenter supported the reasonable access provisions of Subchapter E. Another commenter stated that the rules for source-separated recycling have no basis to be called "source separated recycling". Two commenters requested removal of Subchapter E from the rules. The commission responds that the requirement for reasonable access to source-separated recycling is a statutory requirement specified in §361.428 of the SWDA. The rules retain the requirement. The commission disagrees that these rules do not provide reasonable access. In developing standards for source-separated recycling programs, the commission has been very cognizant of establishing realistic requirements so that recycling is encouraged without discouraging mixed waste composting. Concerning §332.51(b), a comment stated that the provision could be interpreted to imply that a permitted composting facility could not accept mixed municipal solid waste for composting. The commission disagrees that §332.51(b) forbids a permitted composting facility from receiving mixed MSW. The materials "collected pursuant to this subchapter" are source-separated cans, bottles, etc. The section is simply pointing out that the source-separated recyclable materials cannot be mixed with the solid waste that will be

composted. The proposed language is retained.

With respect to §332.52(1), two commenters stated that Option 1 can in no way be considered reasonable access. One commenter further suggest the following should be required: one center at the composting facility; a center at each transfer station in the service area; at least one center in each municipality or subdivision of 5,000 or more population; and additional centers for 15,000 population served or at least 80% of the population in area served is within five miles of a recycling center. There should also be some minimum set of materials to accept. The commission believes the proposed Option 1 provides reasonable access by requiring a collection station at each MSW composting operation and each transfer station. Regarding §332.52(2), one commenter states that curbside recycling should be an option to that basic minimum. The commission believes that in providing four options, the rules establish minimum criteria for each including allowing curbside recycling as a basic minimum in §334.52(2). Concerning §332.52(3), a commenter suggests this option should not be allowed to substitute for the basic requirement of recycling centers unless it involves at least an equivalent convenience of access by the public. The commission disagrees with the comment, and considers this option reasonable access. One comment was received discussing proposed §332.52(4). The commenter recommends that any alternative method should at least meet the 10% recovery standard. Additionally, there is no guidance for the TNRCC to make the determination of whether reasonable access will be achieved. The alternative plan was included to provide applicants flexibility in developing a tailored plan for their specific circumstances. The rule does require the permittee to address certain criteria to show reasonable access. Setting forth specific standards already established as options for establishing reasonable access, as in the 10% requirement of Option 3, is in conflict with the goal of allowing alternative designs. The commission retains the proposed language in §332.52 with the exception of typographical errors previously identified.

Concerning §332.53, the commission believes the executive director should maintain the list of

recyclable materials rather than specifying materials by rule, and the section has been changed accordingly. The title of the section has been amended to reflect this change, and corresponding changes have been made to §332.52 where §332.53 is referenced.

With regard to Subchapter F, the commission received several comments. Concerning §332.61(a), one commenter supports the proposed rule as providing reasonable access, two commenters suggest removal of these requirements, and one commenter recommends clarification in the rules that this requirement applies to a "compost" permittee. The commission agrees that the rule should specify that a "compost" permittee is subject to the HHW collection requirements, and the change is made in the final rule. However, the commission disagrees that this subchapter should not be part of the compost rules package. The requirement for reasonable access to HHW collection is a statutory requirement specified in the SWDA, §361.428, as part of the establishment of a composting program; therefore, it is appropriate to include this subchapter in Chapter 332. The general requirement for a HHW collection program is retained. The commission received one comment regarding proposed §332.62. The commenter is concerned that the only one location for HHW collections is required even in the largest cities, which would not provide reasonable access for large metropolitan areas. Each option should include a provision such that 80% of the population is within 10 miles of one of the collection locations. The commission responds that in developing standards for HHW collection programs, the commission has been very cognizant of establishing realistic requirements. After a review of existing programs in the state, the commission believes that one permanent collection center or a series of events provides reasonable access. The commission retains the requirements as proposed.

Subchapter G includes §§332.71-332.75, and relates to end-product testing, end-product grades and allowable uses, and labelling. Regarding §332.71, one commenter requested that rules allow leachate to be treated by a wastewater treatment plant and discharged. The commission agrees

that leachate can be processed at an authorized facility or as authorized by a NPDES permit as is the case with leachate from municipal waste landfills. Language allowing this has been added to the rules in §332.37(1) pertaining to operational requirements for registered operations and §332.45(1) pertaining to operational requirements for permitted facilities.

With respect to §332.71(a), one commenter recommends that all facilities, not just registered and permitted operations, should be subject to some end-product testing. Another comment objects to the exemption from the end-product requirements of Subchapter G for final product derived from municipal sewage sludge. The commenter also suggests Subchapter G should include a restriction on the growing of food crops on land where composted sewage sludge is applied. Another commenter stated that composted municipal sewage sludge should be acceptable for growing food crops. The commission believes that testing only product from registered and permitted facilities is adequate, and there is no evidence that indicates testing of products from the lower tiers is justified. With regard to sewage sludge, it is the intent of the commission to not duplicate requirements. There are existing federal and state standards for municipal sewage sludge in 40 CFR Part 503 and 30 TAC Chapter 312, respectively. In these rules, there are end-product standards for municipal sewage sludge. Because the Part 503 and Chapter 312 rules do not prohibit the application of municipal sewage sludge on land for growing food crops, the commission will not consider adding this provision to the composting rules.

The commission received a comment regarding proposed §332.71(b) stating that all analytical methods should be EPA approved. Inclusion of "off the wall" methodology such as some of those listed will only result in unproven, uncontrolled and non-verifiable answers. The commission responds that EPA does not regulate compost or compost facilities; therefore, not all the tests required for compost or compost facilities have been examined by the EPA. The commission has carefully chosen standard tests so that a meaningful cost-effective testing program could be established. Regarding §332.71(b)(6), one commenter requested clarity if the addition of large

amounts of material with low volatile solids as an operating strategy to lower the organic content would be allowed. The maturity testing proposed in this regulation is intended to give the operator significant flexibility while providing the state with reliable bench marks that allow comparative testing for non-mature compost. The protocol presented is intended to test the feedstocks the facility is processing. If large amounts of material with low volatile solids is representative of the feedstock stream then it would be allowed, if not then the provision for changing the feedstock would apply and the protocol for the new feedstock would have to be established. The commission received one comment concerning §332.71(d). The commenter notes that the maturity testing protocol outlined is a comparison of the simple reduction of organic matter (ROM) method versus certain test procedures that are much more complex, and many of the tests in this section are complex and expensive. A simple volatile solids determination is much more cost-effective. Furthermore, it seems the rules could be interpreted to require a new maturity analysis upon the slightest change in compost composition. The commission responds that the maturity testing protocol is intended to give an operator flexibility to provide for distribution of semi-mature product and still give the state assurance the metals limits are not exceeded. However, if no correlation is found between the ROM and the physical/chemical/respiratory tests, it is appropriate for the operator to utilize the ROM method. Proposed §332.71(d)(1) is amended to allow for the ROM method in the Maturity Protocol. One comment was received discussing §332.71(d)(5). The commenter noted that the requirement that the maturity test not be repeated unless a "significantly" new compost feedstock recipe is utilized seems vague and open to wide-ranging interpretations. The protocol is established for the feedstock then the testing is performed in accordance with the established protocol. The commission recognizes that operators are constantly trying new recipes and may alter the recipe depending on climatic conditions or for other reasons. It is not the TNRCC's intent to require a new maturity protocol every time a recipe is changed, but only for major changes in the recipe. Examples of a significant change would be the inclusion of a higher tier feedstock for any tier facility, or another registration tier feedstock at a registered facility. Another example might be a

situation where the net volatile solids change. The commission will retain the term "significantly" in §332.71(d)(5), and emphasizes that it will generally rely on the professional judgement of the compost operator to determine when a change is significant. The commission encourages operators to contact agency staff for guidance in this matter as it arises at a facility.

One commenter complained about the documentation requirements in §332.71(e). The commenter also pointed out that the meaning of subparagraph (D) in this section is very confusing. The commission believes the documentation and record-keeping requirements are reasonable and not overly burdensome, and represent standard analytical documentation. The commission agrees that §332.71(e)(1)(D) is ambiguous and does not provide any additional information over subparagraph (E) of that subsection. Subparagraph (D) has been removed and proposed subparagraphs §332.71(e)(1)(E) and (F) have been changed to §332.71(e)(1)(D) and (E).

With regard to proposed §332.71(f), the commission received several comments. One commenter expressed support for the proposed sampling frequencies. Two commenters stated that the sampling frequencies could become rather onerous for large volume producers, and recommended frequent testing during the first six months or year, but only every 10,000 to 20,000 cubic yards after that. Two commenters believe the sampling frequencies should be more frequent. The commission received one comment recommending that yard waste should be tested every quarter for the first two years of operation, and then once a year if the compost falls within the metals limits during the first two years. The commission believes the high testing frequency is necessary to characterize, rather than monitor, the final product and represents a reasonable requirement on compost facilities. Furthermore, the commission considers the proposed testing frequency to be acceptable toward this goal. The commission recognizes that less frequent monitoring may be appropriate after a facility has tested final product for one year, and included §332.71(f)(3) in the proposed rule to allow for an alternative testing plan. Concerning yard

trimmings, the commission does not believe it is necessary to test the final product from these materials. The final rule remains unchanged from the proposed rule.

One comment expressed general concern that the analytical requirements for final product samples in §332.71(h) are very extensive. Additionally, foreign matter by weight is required but this parameter requires further information from the TNRCC given the nature of the material. One commenter specifically questioned the need for salinity testing in §332.71(h)(5). Another commenter requested that registered facilities be required to test for PCBs in addition to permitted facilities. The commission responds that the metals to be tested are the same metals required to be tested for in the federal 503 rules. Salmonella, fecal coliform, pH, and salinity are also generally accepted testing parameters. The rules do allow a substantial range for salinity and pH; thus the commission does not believe requiring these is burdensome. Testing for the metals, pH, salinity, salmonella, and fecal coliform continues to be required in the final rule. Final product testing of compost derived from mixed municipal solid waste in Minnesota has shown PCBs in the final product, and the commission feels it is appropriate for this reason to require testing for PCBs for permitted facilities. The commission does not believe that registration tier feedstocks present the same potential for PCB contamination that permit tier feedstocks do because PCBs are not likely to contaminate feedstocks when the waste is not coprocessed. The proposed requirement is unchanged for the final rule. The foreign matter requirements are generally accepted industry standards. The commission retains the proposed foreign matter requirements.

Regarding proposed §332.71(j)(1), one comment notes that §332.33 and §332.43 require annual reports only, including the results of all analysis. Proposed §332.71(j) is in conflict with §332.33 and §332.43. The commission has amended §332.33 and §332.43 to address the requirement for submission of final product testing to be consistent with §332.71. Specifically in §332.33, paragraph (4) now requires submission of end-product testing. For purposes of clarity, proposed paragraphs (2) and (3) are paragraphs (1) and (2) in the final rule, proposed paragraph (1) is now

paragraph (3), and proposed paragraph (4) is now paragraph (5). In §332.43, paragraph (3) now requires submission of end-product testing, and proposed paragraph (3) has been renumbered paragraph (4).

Proposed §332.72 establishes the end-product standards for the constituents that are required to be tested in §332.71. The commission received a number of comments regarding these final product standards. Four commenters expressed their belief that proposed Grade I metals limits are not technically defensible and should be eliminated. In addition, several commenters wanted to know if the TNRCC performed a risk assessment to generate the Grade I compost limits as the EPA did to generate their numerical limits in 40 CFR Part 503. The TNRCC addressed the methodology and reasoning employed to derive the Grade 1 and Grade 2 limits in the proposed rule; however, the commission believes it is appropriate, in light of these comments, to again discuss the agency staff's methodology. The commission also emphasizes that the preamble noted that the TNRCC's justification document regarding the risk assessment was available for review by the public. The TNRCC staff performed a risk assessment to generate both the Grade 1 and Grade 2 final product standards for metals and PCBs. Staff of the Toxicology and Risk Assessment (TARA) Section reviewed the EPA standards for the Use or Disposal of Sewage Sludge (40 CFR, 1993), Technical Support Document for Land Application of Sewage Sludge (EPA, 1992), and other states' and international compost regulations. A literature search was also conducted to determine the chemical concentrations that are currently measured in different types of compost. The approach used to determine end-product standards for chemicals in compost followed the methodology in the Sewage Sludge Rules (EPA, 1992), with slight modifications. Ten inorganic chemicals (arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, and zinc) that are present in compost were identified as chemicals of concern. These inorganic chemicals were selected because the EPA has identified them as, "pollutants that may pose health or environmental hazards when sewage sludge is used or disposed (EPA, 1992)." A limited review of the literature to-date (MDEP, 1992; Johnson and Crawford, 1993; Glenn,

1994; Tisdell, 1993; Lisk *et al.*, 1992; Walker and O'Donnell, 1991) indicates that the same inorganic chemicals have been detected at significant concentrations in compost derived from MSW. Thus, the same inorganic chemicals that are regulated in sewage sludge were selected to be regulated in compost. The potentially exposed populations (i.e., humans, domestic animals, and plants) and potential exposure pathways (e.g., human ingestion of compost) were identified for the residential (Grade 1) and non-residential (Grade 2) usage patterns of compost. Exposure limits (i.e., maximum allowable concentrations in compost which are not expected to adversely affect the receptor) were determined for each potential exposure pathway, for both grades of compost.

The end-product standards for Grade 1 compost were determined by using the lowest value of: 1) the lowest exposure limit for each chemical, 2) the 99th percentile of the chemical's concentration range currently measured in MSW compost, and 3) the standards listed in the Sewage Sludge Rules (EPA, 1992). For Grade 1 compost, the lowest exposure limit for arsenic, based on carcinogenic endpoints, is below the levels detected in compost and in soil. Because it is virtually impossible to have arsenic concentrations in compost at levels lower than those found naturally, it was decided that the level currently measured in compost, which is also within the range of background soil arsenic concentrations measured in the State of Texas, would be an appropriate end-product standard. The end-product standards for Grade 2 compost were determined by using the lowest value of: the lowest exposure limit for each chemical, and the standards listed in the Sewage Sludge Rules (EPA, 1992). No data was identified for MSW compost that provided concentrations of molybdenum and selenium in MSW compost so the standards determined in the Sewage Sludge Rules (EPA, 1992) were used as end-product standards for both grades of compost. Because most of the Grade 1 end-product standards are based on the 99th percentile chemical concentration currently measured in MSW compost, it is believed that the majority of MSW compost produced in the State of Texas will meet Grade 1 end-product standards. Furthermore, the 99th percentile methodology is consistent with the

methodology used to develop the federal 503 limits for sludge. The compost end-product standards may be subject to change as more data become available; however, any change would be subject to proposal.

Another commenter believes that a system with only two grades is simplistic, and notes the TARA report, "End Product Standards for Compost" issued July 12, 1995 states repeatedly that "data on the actual concentrations of potentially toxic organic chemicals in compost was very limited or unavailable altogether, particularly for MSW compost generated in Texas"(p.1). TARA staff also recommend that "...adequate data be collected to determine the concentrations of potentially toxic organic compounds in MSW." The commission believes that two grades of compost are adequate, and that both grades are protective of human health and the environment. The TARA report does acknowledge that there is a limited amount of data on compost quality in Texas; however, the commission believes the TNRCC should be the entity to establish a testing program that would test for substances other than those already required. Additionally, the agency would incur the costs of doing so.

Another comment regarding §332.72 recommends that every registration and permit tier facility should be required to submit testing data of their end product prior to obtaining permission to market material to the public, either as Grade 1 or Grade 2. The commission responds that the requirement to label final product and identify the grade effectively requires that product be tested before distribution. Another commenter stated that a producer of compost at registered or notification type facilities would still be required to monitor for PCBs to effectively produce a compost that could be marketed back to the general public. The commenter also recommended PCB limits of 50 ppm which is consistent with the federal 503 rules. The commission disagrees that registered facilities will be required to monitor their product for PCBs to competitively market their product. PCB testing is only required for permitted facilities because analytical results from facilities in Minnesota have shown PCBs in final product. The commission believes

that registration tier feedstocks do not present the same potential for PCB contamination as mixed municipal solid waste; therefore, PCB testing is not required. However, registered facilities may choose to test for PCBs for their own information, but the results are not required to be submitted to the agency. The exposure limits for PCBs in Grade 1 and Grade 2 compost were based on the lowest federal regulatory limits for residential and non-residential land use scenarios, respectively. The regulatory limits for PCBs have been based on carcinogenic endpoints.

With regard to §332.72(d)(1)(A)(C), one comment stated that the prohibitions against foreign material need much better definition and development. The commission responds that these are standard industry requirements for foreign matter. The proposed Grade 1 and Grade 2 final product grades are retained in §332.72.

Concerning proposed §332.72(d)(1)(B) and §332.72(d)(2)(B), one commenter noted that these sections make reference to the "MAXIMUM ALLOWABLE CONCENTRATIONS" in Table 1, but Table 1 was not included in the rules. Table 1 appeared in the June 20, 1995, issue of the Texas Register (20 TexReg 4991) in the Tables and Graphics section. The commission retains the proposed language in §332.72 with exception of typographical errors previously identified.

Concerning proposed §332.73, the commission received one comment that two grades are inconsistent with the 30 TAC Chapter 312 Sludge Rules which allow biosolids meeting the metals limits listed in the Grade 2 criteria to be used in a totally unrestricted manner. As stated earlier, the commission believes that two grades of compost and the restricted use on Grade 2 are appropriate. It is important to also note that consistent with federal programs, compost from municipal sewage sludge must only comply with the 503 standards (except for foreign matter) and as such does not have a restricted use. The language in proposed §332.73 remains unchanged.

Regarding proposed §332.74, one commenter believes the label requirements should not impose a

burden on the producer. Three commenters believe it is appropriate to require label information, but not to specify feedstocks, as required by §332.74(b)(2)(B). The requirement should be eliminated. The commission believes that it is appropriate to identify feedstocks on the label as a consumer information measure. The commission retains the requirement for declaring feedstocks on labels.

Concerning §332.75, one comment was received questioning the TNRCC's ability to enforce the requirement that out-of-state products comply with the label requirements. The commission believes that a state may regulate out-of-state products so long as the standards that these products must meet do not place a burden on the out-of-state producers that is not borne by the in-state producers. The staff does not believe that the requirements in §332.74, relating to Compost Labelling Requirements place an unreasonable burden on producers of out-of-state compost.

The new rules are adopted under the Texas Water Code, §5.103, which gives the TNRCC the authority to adopt rules necessary to carry out its powers, duties, and responsibilities; and Health and Safety Code, Chapter 361, SWDA, which provides TNRCC with the authority to adopt and promulgate rules consistent with the general intent and purposes of the Act.

SUBCHAPTER A : GENERAL INFORMATION

§332.1. Purpose.

The purpose of this chapter is to establish regulations that will divert organic materials from the typical municipal solid waste stream, and promote the beneficial reuse of those materials while maintaining standards for human health and safety and environmental protection.

§332.2. Definitions.

The following words and terms, when used in this subchapter, shall have the following meanings unless the context clearly indicates otherwise.

Agricultural materials - Litter, manure, bedding, feed material, vegetative material, and dead animal carcasses from agricultural operations.

Agricultural operations - Operations involved in the production of agricultural materials.

Air contaminant - Particulate matter, radioactive material, dust, fumes, gas, mist, smoke, vapor, or odor or any combination thereof produced by processes other than natural. Water vapor shall not be considered an air contaminant.

All-weather roads - A roadway that has been designed to withstand the maximum load imposed by vehicles entering and exiting the facility during all types of weather conditions.

Anaerobic composting - The controlled biological decomposition of organic materials through microbial activity which occurs in the absence of free oxygen. Anaerobic composting does not include the stockpiling of organic materials.

paints, varnishes, wood preservatives, or other chemical products. Clean wood material also does not include demolition material, where the material is contaminated by materials such as but not limited to paint or other chemicals, glass, electrical wiring, metal and sheetrock.

Commission - The Texas Natural Resource Conservation Commission and its successors.

Compost - The stabilized product of the decomposition process that is used or distributed for use as a soil amendment, artificial top soil, growing medium amendment, or other similar uses.

Composting or functionally aerobic composting - The controlled, biological decomposition of organic materials through microbial activity which occurs in the presence of free oxygen. Composting or functionally aerobic composting does not include the stockpiling of organic materials.

Cured compost (CC) - A highly stabilized product which results from exposing mature compost to a prolonged period of humification and mineralization.

Dairy material - Products which have a Standard of Identity defined in the Code of Federal Regulations, Title 21 §131.

Distribute - To sell, offer for sale, expose for sale, consign for sale, barter, exchange, transfer possession or title, or otherwise supply.

Executive director - The Executive Director of the Texas Natural Resource Conservation Commission or his duly authorized representative.

Facility - All structures, other appurtenances, and improvements within the property

Backyard operations - The composting, land application and mulching of non-industrial organic material, such as grass clippings, leaves, brush, clean wood material or vegetative food material, generated by a homeowner, tenant of a single or multi-family residential or apartment complex, or a commercial or institutional complex where the composting, land application or mulching occurs on the dwelling property and the final product is utilized on the same property. Backyard operations includes neighborhood composting demonstration sites which generate less than 50 cubic yards of final product per year.

Batch (or Sampling batch) - The lot of produced compost represented by one analytical sample (3000 cubic yards or 5000 cubic yards depending on facility type).

Beneficial reuse - Any agricultural, horticultural, reclamation, or similar use of compost as a soil amendment, mulch, or component of a medium for plant growth, when used in accordance with generally accepted practice and where applicable is in compliance with the final product standards established by this chapter. Simply offering a product for use does not constitute beneficial reuse. Beneficial reuse does not include placement in a disposal facility, use as daily cover in a disposal facility, or utilization for energy recovery.

Bulking Agent - An ingredient in a mixture of composting materials included to improve structure and porosity (which improve convective air flow and reduce settling and compaction) and/or to lower moisture content. Bulking agents may include but are not limited to: compost, straw, wood chips, saw dust or shredded brush.

Clean wood material - Wood or wood materials, including stumps, roots, or vegetation with intact rootball, sawdust, pallets and manufacturing rejects. Clean wood material does not include wood that has been treated, coated or painted by materials such as, but not limited to,

Leachate - Liquid which has come in contact with or percolated through materials being stockpiled, processed, or awaiting removal and which has extracted, dissolved or suspended materials. Leachate also includes condensate from gases resulting from the composting process.

Manure - Animal excreta and residual materials that have been used for bedding, sanitary or feeding purposes for such animals.

Mature compost - Mature compost is the stabilized product of composting which has achieved the appropriate level of pathogen reduction (ie. PFRP or PSRP) and is beneficial to plant growth, and meets the requirements of Table 2 of §332.72 of this title (relating to Final Product Grades)

Maturity - A measure of the lack of biological activity in freshly aerated materials, resulting from the decomposition of the incoming feedstock during the active composting period.

Meat feedstocks - Meat and meat by-products whether raw, processed, or cooked including whole animal carcasses, poultry and eggs. Meat feedstocks does not include oils and/or greases that are derived from these same materials.

Mixed municipal solid waste - Garbage, refuse, and other solid waste from residential, commercial, industrial non-hazardous, and community activities which is generated and collected in aggregate.

Mulch - Ground, coarse, woody yard trimmings and clean wood material. Mulch is normally used around plants and trees to retain moisture and suppress weed growth, and is intended for use on top of soil or other growing media rather than being incorporated into the soil or growing media. Mulch does not include wood that has been systemically killed using

boundaries used for receiving and storage of organic materials and processing them into useable final products.

Feedstock - Any material used for land application or as a basis for the manufacture of compost, mulch or other useable final product.

Final product - Composted material meeting testing requirements of §332.71 of this title (relating to Sampling and Analysis Requirements for Final Product) and awaiting distribution or disposal.

Fish feedstocks - Fish, shellfish, or seafood and by-products of these materials whether raw, processed, or cooked. Fish feedstocks does not include oils and/or greases that are derived from these same materials.

Foreign matter - Inorganic and organic constituents which are not readily decomposed, including metals, glass, plastics and rubber, but not including sand, dirt, and other similar materials.

Grab sample - A single sample collected from one identifiable location.

Grease - See the definition of Oil in this section.

Hours of operation - Those hours which the facility is open to receive feedstock, incorporate feedstock into the process, retrieve product from the process, and/or ship product.

Land application - The spreading of yard trimmings, manure, clean wood material and/or vegetative food materials onto the surface of the land or the incorporation of these materials within 3 feet of the surface.

that may be substituted for the QAQC plan.

Paper - A material made from plant fibers (such as but not limited to wood pulp, rice hulls, and kenaf). The sludge byproduct resulting from the production of paper may be approved as a feedstock pursuant to §332.33(4) of this title (relating to Required Forms, Applications, Reports, and Request to Use the Sludge Byproduct of Paper Production).

Permit - A written document issued by the commission that, by its conditions, may authorize the owner or operator to construct, install, modify, or operate a facility or operation in accordance with specific limitations.

Person - Any individual, partnership, corporation, association, governmental subdivision, or public or private organization of any character.

PFRP - The process to further reduce pathogens as described in 40 Code of Federal Regulations Part 503, Appendix B.

PSRP - The process to significantly reduce pathogens as described in 40 Code of Federal Regulations Part 503, Appendix B.

Positively-sorted organic material - Positively-sorted organic material includes materials such as, but not limited to, yard trimmings, clean wood materials, manure, vegetative material, paper, meat and fish feedstocks that are sorted or pulled out as targeted compostable organic materials from mixed municipal solid waste prior to the initiation of processing.

Processing - Actions that are taken to land apply feedstocks or convert feedstock materials into finished compost, mulch or a useable final product. Processing does not include the stockpiling of materials.

herbicides.

Municipal sewage sludge - Solid, semi-solid, or liquid residue generated during the treatment of domestic sewage in treatment works. Sewage sludge includes, but is not limited to, domestic septage; scum or solids removed in primary, secondary, or advanced wastewater treatment processes; and material derived from sewage sludge. Sewage sludge does not include ash generated during the firing of sewage sludge in a sewage sludge incinerator or grit and screening generated during preliminary treatment of domestic sewage in a treatment works.

Nuisance - Nuisances as set forth in the Texas Health and Safety Code, Chapter 341, the Texas Water Code, Chapter 26, and §101.4 of this title (relating to Nuisance).

Oil - Any material rendered from vegetative material, dairy material, meat and fish feedstocks, that is soluble in trichlorotrifluoroethane. It includes other material extracted by the solvent from an acidified sample and not volatilized during the test. Oil and greases do not include grease trap waste.

One hundred-year floodplain - Any land area which is subject to a 1.0% or greater chance of flooding in any given year from any source.

Operator - The person(s) responsible for operating the facility or part of a facility.

Quality Assurance/Quality Control (QAQC) plan - A written plan to describe standard operating procedures used to sample, prepare, store, and test final product, and report test results. The plan outlines quality assurance criteria, as well as quality control procedures, needed to meet the operational specifications of 30 TAC Chapter 332.

Quality Assurance Program Plan (QAPP) - A QAQC plan prepared by the TNRCC

stage and achieved the appropriate level of pathogen reduction (ie. PFRP or PSRP). It has undergone partial decomposition but it is not yet stabilized into mature compost. Semi-mature compost shall not be packaged, as uncontrolled microbial transformations will occur.

Solid waste - Garbage; rubbish; refuse; sludge from a wastewater treatment plant, water supply treatment plant, or air pollution control facility; and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, municipal, commercial, mining and agricultural operations from community and institutional activities.

Source-separated - Set apart from waste after use or consumption by the user or consumer.

Source-separated organic material - Organic materials from residential, commercial, industrial, and other community activities, that at the point of generation have been separated, collected and transported separately from non-organic materials, or transported in the same vehicle as non-organic materials but in separate compartments. Source-separated organic material may include materials such as, but not limited to, yard trimmings, clean wood materials, manure, vegetative material, and paper. Yard trimmings and clean wood material collected with whitegoods, as in brush and bulky item collections, will be considered source-separated organic materials for the purposes of these rules.

Stockpile - A collection of materials that is either awaiting processing or removal.

Unauthorized material - Material which is not authorized to be processed in a particular type of composting, mulching or land application facility.

Vegetative material - Fruit, vegetable or grain material whether raw, processed, liquid, solid, or cooked. Vegetative material does not include oils and/or greases that are derived from

Recyclable material - For purposes of this chapter, a recyclable material is a material that has been recovered or diverted from the solid waste stream for purposes of reuse, recycling, or reclamation, a substantial portion of which is consistently used in the manufacture of products which may otherwise be produced from raw or virgin materials. Recyclable material is not solid waste unless the material is deemed to be hazardous solid waste by the administrator of the United States Environmental Protection Agency, whereupon it shall be regulated accordingly unless it is otherwise exempted in whole or in part from regulation under the federal Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Protection Act. If, however, recyclable materials may become solid waste at such time, if any, as it is abandoned or disposed of rather than recycled, whereupon it will be solid waste with respect only to the party actually abandoning or disposing of the material.

Recycling - A process by which materials that have served their intended use or are scrapped, discarded, used, surplus, or obsolete are collected, separated, or processed and returned to use in the form of raw materials in the production of new products. Recycling includes the composting process if the compost material is put to beneficial reuse as defined in this section.

Residence - A single-family or multi-family dwelling.

Run-off - Any rainwater, leachate, or other liquid that drains over land from any part of a facility.

Run-on - Any rainwater, leachate, or other liquid that drains over land onto any part of a facility.

Semi-mature compost (SMC) - Organic matter that has been through the thermophilic

these same materials.

Vector - An agent, such as an insect, snake, rodent, bird, or animal capable of mechanically or biologically transferring a pathogen from one organism to another.

Voucher - Provides the same information as required on a label to persons receiving compost distributed in bulk.

Wetlands - Those areas defined as wetlands in the Texas Water Code, Chapter 26.

Wet weight - The weight of the material as used, not a weight that has been adjusted by subtracting the weight of water within the feedstock.

White goods - Discarded large household appliances such as refrigerators, stoves, washing machines or dishwashers.

Yard trimmings - Leaves, grass clippings, yard and garden debris, and brush, including clean woody vegetative material not greater than six inches in diameter, that results from landscaping maintenance and land-clearing operations. Yard trimmings does not include stumps, roots, or shrubs with intact root balls.

§332.3. Applicability.

(a) Permit required. The following compost operations are subject to the general requirements found in §332.4 of this title (relating to General Requirements), and the requirements set forth in Subchapters D, E, F, and G of this title (relating to Operations Requiring a Permit; Source-Separated Recycle; and Household Hazardous Waste Collection; End-Product

Standards), and the air quality requirements in §332.8 of this title (relating to Air Quality Requirements). These facilities are required to obtain a permit from the commission pursuant to Chapters 305 of this title (relating to Consolidated Permits) and 281 of this title (relating to Application Processing).

(1) Operations that compost mixed municipal solid waste.

(2) Operations that add any amount of mixed municipal solid waste as a feedstock in the composting process.

(b) Registration required. The following compost operations are subject to the requirements of the General Requirements found in §332.4 of this title (relating to General Requirements), the requirements set forth in Subchapters C and G of this title (relating to Operations Requiring a Registration; and End-Product Standards), and the air quality requirements in §332.8 of this title (relating to Air Quality Requirements).

(1) Operations that compost municipal sewage sludge, except those facilities that compost municipal sewage sludge with mixed municipal solid waste.

(2) Operations that compost positively-sorted organic materials from the municipal solid waste stream.

(3) Operations that compost source-separated organic materials not exempted under subsection (d) of this section.

(4) Operations that compost grease trap waste.

(5) Operations that compost disposable diapers or paper products soiled by human excreta.

(6) Operations that compost the sludge byproduct generated from the production of paper if the executive director determines that the feedstock is appropriate pursuant to §332.33 of this title (relating to Required Forms, Applications, Reports, and Request to Use the Sludge Byproduct of Paper Production).

(7) Operations that incorporate any of the materials set forth in paragraphs (1)-(6) of this subsection with source-separated yard trimmings, clean wood material, vegetative material, paper, manure, meat, fish, dairy, oil, grease materials or dead animal carcasses.

(c) Operations requiring notification. The following operations are subject to all requirements set forth in Subchapter B of this title (relating to Operations Requiring Notification), the general requirements found in §332.4 of this title (relating to General Requirements), and the air quality requirements in §332.8 of this title (relating to Air Quality Requirements):

(1) Operations that compost any source-separated meat, fish, dead animal carcasses, oils, greases, or dairy materials.

(2) Operations that incorporate any of the materials set forth in paragraph (1) of this subsection with source-separated yard trimmings, clean wood material, vegetative material, paper, or manure.

(d) Operations exempt from facility notification, registration, and permit requirements. The following operations are subject to the general requirements found in §332.4 of this title (relating to General Requirements) and the air quality requirements in §332.8 of this title (relating to Air Quality Requirements), and exempt from notification, registration and permit requirements

found in Subchapter B of this title (relating to Operations Requiring Notification), Subchapter C of this title (relating to Requirements for Registered Facilities), and Subchapter D of this title (relating to Permit Required).

(1) Operations that compost only materials listed in subparagraphs (A) and (B) of this paragraph.

(A) Source-separated yard trimmings, clean wood material, vegetative material, paper, and manure.

(B) Source-separated industrial materials listed in §332.4(10) of this title (relating to General Requirements) excluding those items listed in subparagraphs (A),(F),(G),(H), and (J).

(2) Agricultural operations that generate and compost agricultural materials on-site.

(3) Mulching operations.

(4) Land application of yard trimmings, clean wood materials, vegetative materials, and manure at rates below or equal to agronomic rates as determined by the Texas Agricultural Extension Service.

(5) Application of paper that is applied to land for use as an erosion control or a soil amendment.

(6) On-site composting of industrial solid waste at a facility that is in compliance

with §335.2 of this title (relating to Permit Required) and §335.6 of this title (relating to Notification Requirements).

§332.4. General Requirements.

All composting facilities and backyard operations shall comply with all of the following general requirements.

(1) Compliance with Texas Water Code. The activities which are subject to this chapter shall be conducted in a manner which prevents the discharge of material to or the pollution of surface or groundwater in accordance with the provisions of the Texas Water Code, Chapter 26.

(2) Nuisance conditions. The composting, mulching, and land application of material shall be conducted in a sanitary manner which shall prevent the creation of nuisance conditions as mandated by the Texas Health and Safety Code, Chapters 341 and 382 and the Texas Water Code, Chapter 26 as defined in these regulations, and any other applicable regulations or statutes.

(3) Discharge to surface or groundwater. The discharge of material or the pollution of surface or groundwater resulting from the beneficial reuse and recycling of material is subject to enforcement by the commission and may result in the assessment of civil penalties.

(4) Compliance with federal laws. Facility operations shall be conducted in accordance with all applicable Federal laws and regulations.

(5) Compliance with State laws. Facility operations shall be conducted in

accordance with all applicable laws and regulations of the State of Texas.

(6) Facility operations. Facility operations shall not be conducted in a manner which causes endangerment of human health and welfare, or the environment.

(7) Operations on a municipal solid waste landfill unit. No composting activities shall be conducted on the cap of a municipal solid waste landfill without prior approval by the commission on a case by case basis.

(8) Operational requirement. Operations shall be conducted in such a manner to ensure that no unauthorized or prohibited materials are processed at the facility. All unauthorized or prohibited materials received by the facility shall be disposed of at an authorized facility in a timely manner.

(9) Leachate. Leachate from landfills and mixed municipal solid waste composting operations shall not be used on any composting process, except mixed municipal solid waste composting, and shall not be added subsequent to the designation of an end-product grade unless the product is reanalyzed to determine end-product quality.

(10) Nonhazardous industrial solid waste. This chapter applies to the composting, mulching, and land application of only the following nonhazardous industrial solid waste when the composting occurs on property which does not qualify for the exemption from the requirement of an industrial solid waste permit pursuant to §335.2(d) of this title (relating to Permit Required).

(A) dead animal carcasses;

(B) clean wood material;

(C) vegetative material;

(D) paper;

(E) manure (including paunch manure);

(F) meat feedstocks;

(G) fish feedstocks;

(H) dairy material feedstocks;

(I) yard trimmings; and

(J) oils and greases;

(11) **Industrial and hazardous waste.** Any of the materials listed in paragraph (10) of this section which are not managed in accordance with the requirements of this chapter, all hazardous wastes, and any nonhazardous industrial solid wastes not listed in paragraph (10) of this section shall be managed in accordance with Chapter 335 of this title (relating to Industrial Solid Waste and Municipal Hazardous Waste).

§332.5. Variances.

(a) In specific cases the executive director may approve a variance from the requirements of this chapter if the variance is not contrary to the public health and safety and, due to special conditions, a literal enforcement of this chapter would result in unnecessary hardship, and so that

the spirit of the chapter is observed. A variance may not be approved concerning the procedural requirements of this chapter, including application procedures and the filing of reports, or concerning the provisions of §332.8 of this title (relating to Air Quality Requirements).

(b) A request for a variance must be submitted in writing to the executive director. The request may be made in an application for a registration or permit. Any approval of a variance must be in writing by the executive director.

(c) If the variance is requested for a facility permitted under this chapter, the commission must approve the variance.

§332.6. Compost and Mulch Operations Located at Municipal Solid Waste Facilities.

(a) Facilities that compost or mulch materials considered to be exempt, notification or registered facilities in §332.3 of this title (relating to Applicability) may be located at municipal solid waste permitted facilities. The owner shall prepare and submit a modification request in accordance with the provisions of §305.70 of this title (relating to Municipal-Solid Waste Class 1 Modifications) unless the municipal solid waste facility permit authorizes compost or mulch operations. If the municipal solid waste facility permit authorizes compost operations, the compost operation shall be conducted in accordance with the facility permit.

(b) Facilities considered to be permitted facilities in §332.3 of this title (relating to Applicability) may be located at municipal solid waste permitted facilities. The owner shall prepare and submit an application for a major permit amendment in accordance with the provisions of §305.62 of this title (relating to Amendment) and shall submit the information required by §332.47 of this title (relating to Permit Application Preparation) and shall fully comply with the provisions of §332.41 of this title (relating to Definition, Requirements, and

Application Processing for a Permit Facility).

§332.7. Compost Operations Located at Waste Water Treatment Facilities.

Municipal sewage sludge composting facilities considered to be registered facilities in §332.3 of this title (relating to Applicability) may be located at waste water treatment facilities that have received a water quality permit under the Texas Water Code, Chapter 26. The owner shall prepare and submit a modification to amend the water quality permit in accordance with the provisions of Chapter 305 of this title (relating to Consolidated Permits). The applicant shall comply with the provisions of §332.4 of this title (relating to General Requirements) and §332.31 of this title (relating to Definition of and Requirements for Registered Facilities) except where those provisions conflict with the provisions of the water quality permit. If the wastewater treatment facility has received a water quality permit under the Texas Water Code, Chapter 26 which authorizes compost operations, the compost operation shall be conducted in accordance with the facility permit.

§332.8. Air Quality Requirements.

(a) General requirements.

(1) Any composting or mulching operation which has existing authority under the Texas Clean Air Act does not have to meet the air quality criteria of this subchapter. Pursuant to the Texas Clean Air Act, §382.051, any new composting or mulching operation which meets all of the applicable requirements of this subchapter is hereby entitled to an air quality standard permit authorization under this subchapter in lieu of the requirement to obtain an air quality permit under Chapter 116 of this title (relating to Control of Air Pollution by Permits for New Construction or Modification).

(2) Those composting or mulching operations which would otherwise be required to obtain air quality authorization under Chapter 116 of this title (relating to Control of Air Pollution by Permits for New Construction or Modification), which cannot satisfy all of the requirements of this subchapter, shall apply for and obtain air quality authorization pursuant to Chapter 116 of this title (relating to Control of Air Pollution by Permits for New Construction or Modification) in addition to any notification, registration, or permit required in this subchapter.

(3) Any composting or mulching operation authorized under this chapter which is a new major source or any modification which constitutes a major modification under nonattainment review or Prevention of Significant Deterioration review as amended by the Federal Clean Air Act amendments of 1990, and regulations promulgation thereunder, shall be subject to the requirements of Chapter 116 of this title (relating to Control of Air Pollution by Permits for New Construction or Modification), in addition to any notification, registration or permit required in this chapter.

(4) Composting facilities that do not wish to comply with the requirements of this section, are required to apply for and obtain air quality authorization under Chapter 116 of this title (relating to Control of Air Pollution by Permits for New Construction or Modification). Once a person has applied for and obtained air quality authorization under Chapter 116 of this title (relating to Control of Air Pollution by Permits for New Construction or Modification), the person is exempt from the air quality requirements of this chapter.

(5) No person may concurrently hold an air quality permit issued under Chapter 116 of this title (relating to Control of Air Pollution by Permits for New Construction or Modification) and an air quality standard permit authorized under this chapter for composting or mulching operations at the same site.

(6) Composting or mulching operations which have authorization under this chapter shall comply with the general requirements in §332.4 of this title (relating to General Requirements), and subsections (b), (c), (d) or (e) of this section; and

(7) The operator of a composting or mulching operation operating under an air quality standard permit shall maintain on file at all times and make immediately available documentation which shows compliance with this section.

(b) Exempt operations. Composting and mulching operations that are considered exempt operations pursuant to §332.3(d) of this title (relating to Applicability), and that meet the following requirements are hereby entitled to an air quality standard permit.

(1) If the total volume of materials to be mulched and/or composted, including in-process and processed materials at any time is greater than 2000 cubic yards, the setback distance from all property boundaries to the edge of the area receiving, processing or storing feedstock or finished product shall be at least 50 feet.

(2) All permanent in-plant roads and vehicle work areas shall be watered, treated with dust-suppressant chemicals, or paved and cleaned as necessary to achieve maximum control of dust emissions. Vehicular speeds on non-paved roads shall not exceed 10 Mph.

(3) Except for initial start-up and shut-down, the receiving chamber on all grinders shall be adequately filled prior to commencement of grinding and remain filled during grinding operations to minimize emissions from the receiving chamber or grinding operations shall occur inside an enclosed structure. In addition, all grinders not enclosed inside a building shall be equipped with low-velocity fog nozzles spaced to create a continuous fog curtain or the operator shall have portable watering equipment available during the grinding operation. These controls

shall be utilized as necessary for maximum control of dust when stockpiling ground material.

(4) All conveyors which off-load materials from grinders at a point which is not enclosed inside a building shall have available a water or mechanical dust suppression system. These controls shall be utilized as necessary for maximum control of dust when stockpiling ground material.

(5) If there are any changes to the composting or mulching operation that would reclassify it from an exempt operation to a notification, registration, or permit facility as authorized under §332.3 of this title (relating to Applicability), the operation shall obtain an air quality standard permit for a notification, registered, or permitted composting operation.

(c) Notification operations. Composting operations required to notify pursuant to §332.3(c) of this title (relating to Applicability) which meet the following requirements are hereby entitled to an air quality standard permit.

(1) The setback distance from all property boundaries to the edge of the area receiving, processing or storing feedstock or finished product shall be at least 50 feet.

(2) All permanent in-plant roads and vehicle work areas shall be watered, treated with dust-suppressant chemicals, or paved and cleaned as necessary to achieve maximum control of dust emissions. Vehicular speeds on non-paved roads shall not exceed 10 mph.

(3) Prior to receiving any material with a high odor potential such as, but not limited to dairy material feedstocks, meat, fish, oil and grease feedstocks, the operator shall insure that there is an adequate volume of bulking material to blend with/cover the material, and shall begin processing the material in a manner that prevents nuisances.

(4) Except for initial start-up and shut-down, the receiving chamber on all grinders shall be adequately filled prior to commencement of grinding and remain filled during grinding operations to minimize emissions from the receiving chamber or grinding operations shall occur inside an enclosed structure. In addition, all grinders not enclosed inside a building shall be equipped with low-velocity fog nozzles spaced to create a continuous fog curtain or the operator shall have portable watering equipment available during the grinding operation. These controls shall be utilized as necessary for maximum control of dust when stockpiling ground material.

(5) All conveyors which off-load materials from grinders at a point which is not enclosed inside a building shall have available a water or mechanical dust suppression system. These controls shall be utilized as necessary for maximum control of dust when stockpiling ground material.

(6) If there are any changes to the composting or mulching operation that would reclassify it from a notification operation to a registration or permit operation as authorized under §332.3 of this title (relating to Applicability), the operation shall obtain an air quality standard permit for a registered or permitted composting operation.

(d) Registered operations. Composting operations required to obtain a registration pursuant to §332.3(b) of this title (relating to Applicability) which meet the following requirements are hereby entitled to an air quality standard permit.

(1) All permanent in-plant roads and vehicle work areas shall be watered, treated with dust-suppressant chemicals, or paved and cleaned as necessary to achieve maximum control of dust emissions. Vehicular speeds on non-paved roads shall not exceed 10 mph.

(2) Prior to receiving any material with a high odor potential such as, but not limited to dairy material feedstocks, sewage sludge, meat, fish, oil and grease feedstocks, and grease trap waste, the operator shall insure that there is an adequate volume of bulking material to blend with/cover the material, and shall begin processing the material in a manner that prevent nuisances.

(3) All material shall be conveyed mechanically, or if conveyed pneumatically, the conveying air shall be vented to the atmosphere through a fabric filter(s) having a maximum filtering velocity of 4.0 ft/min with mechanical cleaning or 7.0 ft/min with air cleaning.

(4) Except for initial start-up and shut-down, the receiving chamber on all grinders shall be adequately filled prior to commencement of grinding and remain filled during grinding operations to minimize emissions from the receiving chamber or grinding operations shall occur inside an enclosed structure. In addition, all grinders not enclosed inside a building shall be equipped with low-velocity fog nozzles spaced to create a continuous fog curtain or the operator shall have portable watering equipment available during the grinding operation. These controls shall be utilized as necessary for maximum control of dust when stockpiling ground material.

(5) All conveyors which off-load materials from grinders at a point which is not enclosed inside a building shall have available a water or mechanical dust suppression system. These controls shall be utilized as necessary for maximum control of dust when stockpiling ground material.

(6) If there are any changes to the composting or mulching operation that would reclassify it from a registration operation to a permit operation as authorized under §332.3 of this title (relating to Applicability), the operation shall obtain an air quality standard permit for a permitted composting operation.

(e) Permit operations. Composting operations required to obtain a permit pursuant to §332.3(a) of this title (relating to Applicability) which meet the following requirements are hereby entitled to an air quality standard permit.

(1) All permanent in-plant roads and vehicle work areas shall be watered, treated with dust-suppressant chemicals, or paved and cleaned as necessary to achieve maximum control of dust emissions. Vehicular speeds on non-paved roads shall not exceed 10 mph.

(2) Prior to receiving any material with a high odor potential such as, but not limited to dairy material feedstocks, sewage sludge, meat, fish, oil and grease feedstocks, and municipal solid waste, the operator shall insure that there is an adequate volume of bulking material to blend with/cover the material, and shall begin processing the material in a manner that prevents nuisances.

(3) All material shall be conveyed mechanically, or if conveyed pneumatically, the conveying air shall be vented to the atmosphere through a fabric filter(s) having a maximum filtering velocity of 4.0 ft/min with mechanical cleaning or 7.0 ft/min with air cleaning.

(4) Except for initial start-up and shut-down, the receiving chamber on all grinders shall be adequately filled prior to commencement of grinding and remain filled during grinding operations to minimize emissions from the receiving chamber or grinding operations shall occur inside an enclosed structure. In addition, all grinders not enclosed inside a building shall be equipped with low-velocity fog nozzles spaced to create a continuous fog curtain or the operator shall have portable watering equipment available during the grinding operation. These controls shall be utilized as necessary for maximum control of dust when stockpiling ground material.

(5) All conveyors which off-load materials from grinders at a point which is not enclosed inside a building shall have available a water or mechanical dust suppression system. These controls shall be utilized as necessary for maximum control of dust when stockpiling ground material.

(6) All activities which could result in increased odor emissions such as turning of compost piles shall be conducted in a manner that does not create nuisance conditions or shall only be conducted inside a building maintained under negative pressure and controlled with a chemical oxidation scrubbing system or bio filter system.

This agency hereby certifies that the rule as adopted has been reviewed by legal counsel and found to be a valid exercise of the agency's authority.

Issued in Austin, Texas, on

SUBCHAPTER B : OPERATIONS REQUIRING NOTIFICATION

The new rules are adopted under the Texas Water Code, §5.103, which gives the Texas Natural Resource Conservation Commission (TNRCC) the authority to adopt rules necessary to carry out its powers, duties, and responsibilities, and Health and Safety Code, Chapter 361, Solid Waste Disposal Act, which provides the TNRCC with the authority to adopt and promulgate rules consistent with the general intent and purposes of the Act.

§332.21. Operations Requiring Notification.

The following operations are subject to all the requirements of this subchapter, the General Requirements found in §332.4 of this title (relating to General Requirements), and the air quality requirements of §332.8 of this title (relating to Air Quality Requirements).

(1) Operations that compost any source-separated meat, fish, dead animal carcasses, oils, greases, or dairy materials.

(2) Operations that incorporate any of the materials set forth in paragraph (1) of this section with source-separated yard trimmings, clean wood material, vegetative material, paper, or manure.

§332.22. Notification.

(a) The operator shall notify the executive director in writing of the existence of the facility 30 days prior to construction by completing TNRCC Compost Form Number 1, "Notice of Intent to Operate a Compost Facility," available from the commission.

(b) The applicant shall include a list of adjacent and landowners and their addresses.

Upon receipt of the notification, the chief clerk shall mail notice of the planned facility to the affected landowners. The chief clerk shall also mail notice to other affected landowners as directed by the executive director.

§332.23. Operational Requirements.

Operation of the facility shall comply with all of the following operational requirements:

(1) **Aerobic composting required.** The facility shall utilize functionally aerobic composting methods, although an anaerobic composting phase may be utilized in the early stages of processing, if it is followed by a period of functionally aerobic composting;

(2) **Pathogen reduction.** One of the following protocols shall be used to reduce pathogens during composting:

(A) Using either the within-vessel composting method or the static aerated pile composting method, the temperature of the composting materials shall be maintained at 55 degrees Centigrade or higher for three days; or

(B) Using the windrow composting method, the temperature of the composting materials shall be maintained at 55 degrees Centigrade or higher for 15 days or longer. During the period when the composting materials are maintained at 55 degrees Centigrade or higher, there shall be a minimum of five turnings of the windrow.

(3) **Prohibited substances.** Fungicides, herbicides, insecticides or other pesticides that contain constituents listed in 40 CFR Part 261, Appendix VIII - Hazardous Constituents or

on the Hazardous Substance List as defined in the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) shall not be applied to or incorporated into feedstocks, in-process materials, or processed materials.

This agency hereby certifies that the rule as adopted has been reviewed by legal counsel and found to be a valid exercise of the agency's authority.

Issued in Austin, Texas, on

SUBCHAPTER C : OPERATIONS REQUIRING A REGISTRATION

The new rules are adopted under the Texas Water Code, §5.103, which gives the Texas Natural Resource Conservation Commission (TNRCC) the authority to adopt rules necessary to carry out its powers, duties, and responsibilities, and Health and Safety Code, Chapter 361, Solid Waste Disposal Act, which provides the TNRCC with the authority to adopt and promulgate rules consistent with the general intent and purposes of the Act.

§332.31. Definition of and Requirements for Registered Facilities.

(a) **Definition of registered facilities.** The following operations are subject to the requirements of this subchapter:

(1) Operations that compost municipal sewage sludge, except those facilities that compost municipal sewage sludge with mixed municipal solid waste.

(2) Operations that compost positively-sorted organic materials from the municipal solid waste stream.

(3) Operations that compost source-separated organic materials not exempted under §332.3(d) of this title (relating to Applicability).

(4) Operations that compost grease trap waste.

(5) Operations that compost disposable diapers or paper products soiled by human excreta.

(6) Operations that compost the sludge byproduct generated from the production

of paper if the executive director determines that the feedstock is appropriate pursuant to §332.33 of this title (relating to Required Forms, Applications, Reports, and Request to Use the Sludge Byproduct of Paper Production).

(7) Operations that incorporate any of the materials set forth in paragraphs (1)-(6) of this section with source-separated yard trimmings, clean wood material, vegetative material, paper, manure, meat, fish, dairy, oil, grease materials or dead animal carcasses.

(b) Requirements for registered facilities. The operations listed in subsection (a) of this section are subject to the requirements of the General Requirements found in §332.4 of this title (relating to General Requirements), the requirements set forth in this subchapter, the requirements set forth in Subchapter G of this title (relating to End-Product Standards) and the air quality requirements set forth in §332.8 of this title (relating to Air Quality Requirements).

§332.32. Certification by Engineer, Approval by Land Owner, and Inspection.

(a) Certification by registered professional engineer. The operator shall obtain certification by a Texas-Registered Professional Engineer that the facility has been constructed as designed and is in general compliance with the regulations prior to accepting any feedstock at the facility that requires registration and maintaining that certification on-site for inspection by the commission.

(b) Ownership or control of property. The facility shall be located on property owned by the operator or the operator shall establish, using an affidavit form provided by the commission, signed by the owner and notarized, that the owner is aware of and consents to the operation prior to any receipt of feedstock or processing activities. A copy of the affidavit shall be kept on-site at all times.

(c) Inspection of facility. Prior to the initial acceptance of any feedstocks, the facility shall be inspected by the TNRCC to determine compliance with the registration.

§332.33. Required Forms, Applications, Reports, and Request to Use the Sludge Byproduct of Paper Production

(a) The operator of the compost facility shall submit the following:

(1) TNRCC Form Number 2. The operator shall submit TNRCC Form Number 2, "Notice of Intent to Apply for a Compost Facility Registration or Permit," available from the commission; and

(2) Registration application. The registration application described in §332.34 of this title (relating to Registration Application).

(3) Annual report. The operator shall submit annual written reports using TNRCC Form No. 3, "Annual Report Form for Compost Facilities Requiring Registration or Permit," available from the commission. These reports shall at a minimum include input and output quantities, a description of the end-product distribution, and all results of any required laboratory testing. A copy of the annual report shall be kept on-site for a period of five years.

(4) Final product testing report. Facilities requiring registration must submit reports on final product testing to the executive director in compliance with §332.71(j)(1) of this title (relating to Sampling and Analysis Requirements for Final Product) on a semi-annual basis.

(b) In order to use the sludge byproduct of paper production as a composting feedstock, the operator must first receive permission from the executive director.

(A) The operator shall submit a request to the executive director to use the sludge byproduct as a feedstock. The request may also be submitted with a registration application.

(B) At a minimum, the request shall present all of the following:

(i) identification of the source of the sludge byproduct;

(ii) a general description of the process that produces the sludge byproduct including the use of any elemental chlorine bleaches used in the process;

(iii) analytical results that identify concentrations for polychlorinated dibenzo-p-dioxins (CCDs) and polychlorinated dibenzofurans (CDFs); and

(iv) a demonstration that the final product will not be harmful to human health or the environment.

(C) The executive director or his designee shall, after review of the request, determine if he will approve or deny the request.

(D) An operator that receives approval from the executive director to include the sludge byproduct of paper production as a composting feedstock, shall submit a new request to the executive director in accordance with this subsection if a significant change, such as a new source for the feedstock, is planned.

§332.34. Registration Application.

Registration applications for composting must include:

(1) Title page. The title page shall show the name of the project, the name of the applicant, the location by city and county.

(2) Signature of the applicant. The signature of the applicant(s), checked against agency requirements, in accordance with §305.44 of this title (relating to Signatories to Applications);

(3) Affidavit. A notarized affidavit from the applicant(s) verifying land ownership and landowner agreement to the proposed activity;

(4) Table of contents. The table of contents shall list and give the page numbers for the main sections of the application.

(5) Legal authority. The applicant shall provide verification of his/her legal status. Normally, this is a one-page certificate of incorporation issued by the Secretary of State.

(6) Evidence of competency. The applicant shall provide the following:

(A) The names of the principals and supervisors of the applicant's organization relative to the proposed compost operation; and

(B) The name, location, and permit or registration number of any compost operations or solid waste operations that it is operating or has operated in Texas.

(7) Notice of Appointment. The applicant shall provide a notice of appointment

identifying the applicant's engineer.

(8) Notice of coordination. The applicant shall provide notice of coordination with all local, state, and federal government officials and agencies.

(9) Legal description. The applicant shall provide the following:

(A) A legal description of the property and the county, book, and page number of the current ownership record from the county deed records; and

(B) a boundary metes and bounds drawing and description of the site signed and sealed by a Registered Professional Land Surveyor;

(10) Location description.

(A) Map. The applicant shall clearly show the boundaries of the planned facility on a map that is all or a portion of a county map prepared by Texas Department of Transportation (TxDOT). At a minimum, the map shall be at a scale of one-half inch equals one mile.

(B) Geographic coordinates. The applicant shall supply geographic coordinates for the southeast corner of the facility.

(11) Landowner list. The applicant shall include a list of adjacent landowners and their addresses along with an appropriately scaled map locating the property owned by these persons.

(12) Site operating plan. The applicant shall submit a site operating plan. This document

is to provide guidance from the design engineer to site management and operating personnel in sufficient detail to enable them to conduct day to day operations in a manner consistent with the engineer's design. At a minimum, the site operating plan shall include specific guidance or instructions on all of the following:

(A) Process description. The process description shall be composed of a descriptive narrative along with a process diagram. The process description shall include:

(i) Feedstock identification. The applicant shall prepare a list of the materials intended for processing along with the anticipated volume to be processed. This section shall also contain an estimate of the daily quantity of material to be processed at the facility along with a description of the proposed process of screening for unauthorized and prohibited materials.

(ii) Tipping process. Indicate what happens to the feedstock material from the point it enters the gate. Indicate how the material is handled in the tipping area, how long it remains in the tipping area, what equipment is used, how the material is evacuated from the tipping area, at what interval the tipping area is cleaned, the process used to clean the tipping area.

(iii) Process. Indicate what happens to the material as it leaves the tipping area. Indicate how the material is incorporated into the process and what process or processes are used until it goes to the post-processing area. The narrative shall include: water addition, processing rates, equipment, energy and mass balance calculations, and process monitoring method.

(iv) Post-processing. Provide a complete narrative on the post-processing process, include post-processing times, identification and segregation of product,

(H) Vector control.

(I) Quality assurance and quality control.

(i) Municipal sewage sludge compost facilities. The operator shall comply with the provisions of Chapter 312 of this title (relating to Sludge Use, Disposal, and Transportation).

(ii) All other registered facilities. As a minimum the applicant shall provide testing and assurance in accordance with the provisions of §332.71 of this title (relating to Sampling and Analysis Requirements for Final Product).

(J) Equipment failures including alternative plans in the event of an equipment failure.

(K) A description of the anticipated final grade of the materials.

(13) Construction plans and specifications. The applicant shall submit facility construction plans and specifications. The facility plans and specification shall reflect the provisions of this chapter to the maximum extent possible.

(14) Closure plan. The applicant shall provide a plan for proper closure of the facility including disposition of any remaining feedstocks, in-process, and processed materials.

§332.35. Registration Application Processing.

storage of product, quality assurance and quality control.

(v) Product distribution. Provide a complete narrative on product distribution including items such as: end-product quantities, anticipated final grades, packaging, labeling, loading, and tracking bulk material.

(vi) Process diagram. Present a process diagram that displays graphically, the narrative generated in response to clauses (i)-(v) of this paragraph.

(B) The minimum number of personnel and their functions to be provided by the site operator in order to have adequate capability to conduct the operation in conformance with the design and operational standards.

(C) The minimum number and operational capacity of each type of equipment to be provided by the site operator in order to have adequate capability to conduct the operation in conformance with the design and operational standards.

(D) Security, site access control, traffic control and safety.

(E) Control of dumping within designated areas, screening for unprocessable, prohibited, and unauthorized material.

(F) A fire prevention and suppression plan that shall comply with provisions of the local fire code, which shall also be sent to the local fire protection entity responsible for responding to a fire at the facility.

(G) Control of windblown material.

(a) An application shall be submitted to the executive director. When an application is administratively complete, the executive director shall assign the application an identification number.

(b) Public Notice.

(1) When an application is administratively complete the chief clerk shall mail notice to adjacent landowners. The chief clerk also shall mail notice to other affected landowners as directed by the executive director.

(2) When an application is technically complete the chief clerk shall mail notice to adjacent landowners. The chief clerk shall also mail notice to other affected landowners as directed by the executive director. The applicant shall publish notice in the county in which the facility is located, and in adjacent counties. The published notice shall be published once a week for three weeks. The applicant should attempt to obtain publication in a Sunday edition of a newspaper. The notice shall explain the method for submitting a motion for reconsideration.

(3) Notice issued under paragraphs (1) or (2) shall contain the following information:

(A) the identifying number given the application by the executive director;

(B) the type of registration sought under the application;

(C) the name and address of the applicant(s);

(D) the date on which the application was submitted; and

(E) a brief summary of the information included in the application.

(c) The executive director or his designee shall, after review of any application for registration of a compost facility determine if he will approve or deny an application in whole or in part. The executive director shall base his decision on whether the application meets the requirements of this subchapter and the requirements of §332.4 of this title (relating to General Requirements).

(d) At the same time that the executive director's decision is mailed to the applicant, a copy or copies of this decision shall also be mailed to all adjacent and affected landowners, residents, and businesses.

(e) Motion for Reconsideration.

(1) The applicant or a person affected may file with the chief clerk a motion for reconsideration of the executive director's final approval of an application.

(2) A motion for reconsideration must be filed with the chief clerk not later than the 20th day after the date on which the chief clerk mailed to the applicant the signed registration or other approval.

(3) A decision by the executive director, including a registration issued by the executive director, is not affected by the filing of a motion for reconsideration under this section unless expressly so ordered by the commissioners. If a motion for reconsideration is not acted on by the commissioners within 45 days after the date on which chief clerk mailed the signed registration to the applicant, the motion shall be deemed overruled. When a motion for

reconsideration is overruled by commission action or pursuant to this subsection, the Texas Government Code, §2001.146, regarding motions for rehearing in contested cases is inapplicable and no motions for rehearing shall be filed. To the extent applicable, the commission decision may be subject to judicial review pursuant to Texas Water Code, §5.351 or the Texas Health & Safety Code, §361.321.

§332.36. Location Standards.

Facilities shall meet all of the following locational criteria.

(1) **One-hundred year flood-plain.** The facility shall be located outside of the one hundred-year floodplain unless the applicant can demonstrate that the facility is designed and will operate to prevent washout during a 100-year storm event, or obtains a Conditional Letter of Map Amendment (CLOMA) from the Federal Emergency Management Administration (FEMA) Administrator.

(2) **Drainage.** The facility shall not significantly alter existing-drainage patterns.

(3) **Wetlands.** The facility shall not be located in wetlands.

(4) **Water wells.** The facility shall be located at least 500 feet from all public water wells and at least 150 feet from private water wells.

(5) **Surface water.** The facility shall be located at least 100 feet from creeks, rivers, intermittent streams, lakes, bayous, bays, estuaries, or other surface waters in the state.

(6) **Set back distance from facility boundary.** The set back distance from the

facility boundary to the areas for receiving, processing, or storing feedstock or final product shall be at least 50 feet.

(7) Edwards aquifer recharge zone. If located over the Recharge Zone of the Edwards Aquifer, a facility is subject to Chapter 313 of this title (relating to Edwards Aquifer). The Edwards Aquifer Recharge Zone is specifically that area delineated on maps in the office of the executive director.

§332.37. Operational Requirements.

The operation of the facility shall comply with all of the following operational requirements:

(1) Protection of surface water. The facility shall be constructed, maintained and operated to manage run-on and run-off during a 25-year, 24-hour rainfall event and shall prevent discharge into waters in the state of feedstock material, including but not limited to, in-process and/or processed materials. Any waters coming into contact with feedstock, in-process, and processed materials shall be considered leachate. Leachate shall be contained in retention facilities until reapplied on piles of feedstock, in-process, or unprocessed materials. The retention facilities shall be lined and the liner shall be constructed in compliance with paragraph (2) of this section. Leachate may be treated and processed at an authorized facility or as authorized by an NPDES permit. The use of leachate in any processing shall be conducted in a manner that does not contaminate the final product;

(2) Protection of groundwater. The facility shall be designed, constructed, maintained and operated to protect groundwater. Facilities that compost municipal sewage sludge, grease trap waste, disposable diapers, and/or the sludge byproduct of paper mill production shall install and maintain a liner system complying with the provisions of subparagraph

(A), (B), or (C) of this paragraph. The liner system shall be provided where receiving, mixing, composting, post-processing, screening and storage areas would be in contact with the ground or in areas where leachate, contaminated materials, contaminated product or contaminated water is stored or retained. The application shall demonstrate the facility is designed so as not to contaminate the groundwater and so as to protect the existing groundwater quality from degradation. For the purposes of these sections, protection of the groundwater includes the protection of perched water or shallow surface infiltration. The lined surface shall be covered with a material designed to withstand normal traffic from the composting operations. At a minimum the lined surface shall consist of soil, synthetic, or an alternative material that is equivalent to two feet of compacted clay with a hydraulic conductivity of 1×10^{-7} centimeters per second or less.

(A) Soil liners shall have more than 30% passing a number 200 sieve, have a liquid limit greater than 30% and a plasticity index greater than 15;

(B) Synthetic liners shall be a membrane with a minimum thickness of 20 mils;

(C) An alternative design that utilizes an impermeable liner (such as concrete).

(3) Unauthorized and prohibited materials. The operator shall operate the facility in a manner that will preclude the entry of any unauthorized or prohibited materials from entering the composting process.

(4) Access. Access to the facility shall be controlled to prevent unauthorized disposal of unauthorized or prohibited material and scavenging. The facility shall be completely fenced with a gate that is locked when the facility is closed.

(5) Nuisance conditions. The facility shall be sited and operated in such a manner as to prevent the potential of nuisance conditions and fire hazards. Where nuisance conditions or fire hazards exist, the operator will immediately take action to abate such nuisances.

(6) Aerobic composting required. The facility shall utilize functionally aerobic composting methods, although an anaerobic composting phase may be utilized in the early stages of processing, if it is followed by a period of functionally aerobic composting.

(7) Site sign. The facility shall have a sign at the entrance indicating the type of facility, the registration number, hours of operation and the allowable feedstocks.

(8) Access road. The facility access road shall be an all-weather road.

(9) Authorization required for significant changes. The operator shall obtain written permission from the commission before changing the processing method or other significant changes to the original registration application.

(10) Prohibited substances. Fungicides, herbicides, insecticides or other pesticides that contain constituents listed in 40 CFR Part 261, Appendix VIII - Hazardous Constituents or on the Hazardous Substance List as defined in the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) shall not be applied to or incorporated into feedstocks, in-process materials or processed materials.

(11) End-product standards.

(A) Facilities that compost municipal sewage sludge. For facilities that

compost only municipal sewage sludge or compost municipal sewage sludge with any source-separated materials, the operator shall comply with the provisions of Chapter 312 of this title (relating to Sludge Use, Disposal, and Transportation) and shall not exceed the foreign matter criteria contained §332.72(d)(2)(A) and (D), of this title (relating to Final Product Grades).

(B) All other registered facilities. The operator shall meet compost testing requirements set forth in §332.71 of this title (relating to Sampling and Analysis Requirements for Final Product), final product grades set forth in §332.72 of this title (relating to Final Product Grades), and label all materials which are sold or distributed as set forth in §332.74 of this title (relating to Final Product Labelling Requirements).

(12) The operator shall employ at least one TNRCC-certified compost operator within six months from the adoption of this title, the initiation of operations at the compost facility, or the establishment of the compost certification program which ever occurs later and a TNRCC-certified compost operator shall routinely be available on site during the hours of operation.

§332.38. Records Requirements.

(a) Facilities that compost municipal sewage sludge. For facilities that compost only municipal sewage sludge or compost municipal sewage sludge with any source-separated materials, the operator shall comply with the provisions of Chapter 312 of this title (relating to Sludge Use, Disposal, and Transportation).

(b) All other registered facilities.

(1) The operator shall maintain records on-site, available for inspection by the commission, for a period consisting of the two most recent calendar years. The records shall consist of the following:

(A) the facility registration obtained from the commission;

(B) a log of abnormal events at the facility, including but not limited to, process disruptions, extended equipment failures, injuries, and weather damage; and

(C) Results of final product testing required by §332.71(j) of this title (relating to Sampling and Analysis Requirements for Final Product).

(2) The operator shall maintain copies of the annual report on-site for the five most recent calendar years.

This agency hereby certifies that the rule as adopted has been reviewed by legal counsel and found to be a valid exercise of the agency's authority.

Issued in Austin, Texas, on

SUBCHAPTER D : OPERATIONS REQUIRING A PERMIT

The new rules are adopted under the Texas Water Code, §5.103, which gives the Texas Natural Resource Conservation Commission (TNRCC) the authority to adopt rules necessary to carry out its powers, duties, and responsibilities, and Health and Safety Code, Chapter 361, Solid Waste Disposal Act, which provides the TNRCC with the authority to adopt and promulgate rules consistent with the general intent and purposes of the Act.

§332.41. Definition, Requirements, and Application Processing for a Permit Facility.

(a) **Definition of permitted facilities.** The following operations are subject to the requirements of this subchapter:

(1) Operations that compost mixed municipal solid waste not in accordance with §332.31 of this title (relating to Definition of and Requirements for Registered Facilities).

(2) Operations that add any amount of mixed municipal solid waste as a feedstock in the composting process.

(b) **Requirements for permitted facilities.** The operations listed in subsection (a) of this section are subject to the general requirements found in §332.4 of this title (relating to General Requirements), and the requirements set forth in this subchapter, the requirements set forth in Subchapters E, F, and G of this title (relating to Source-Separated Recycling; and Household Hazardous Waste Collection; and End-Product Standards), and the air quality requirements set forth in §332.8 of this title (relating to Air Quality Requirements).

(c) **Processing of Application for Permit Facility.**

(1) Public Notice.

(A) When an application is administratively complete the chief clerk shall mail notice to adjacent landowners, residents, and businesses. The chief clerk also shall mail notice to other-affected landowners, residents, and businesses, as directed by the executive director.

(B) When an application is technically complete the chief clerk shall mail notice to adjacent landowners, residents, and businesses. The chief clerk shall also mail notice to other affected landowners, residents, and businesses, as directed by the executive director. The applicant shall publish notice in the county in which the facility is located, and in adjacent counties. The published notice shall be published once a week for three weeks, with the first publication occurring no earlier than 30 days before any hearing. The applicant should attempt to obtain publication in a Sunday edition of a newspaper. The notice shall explain the method for submitting a request for hearing or a protest.

(C) Notice issued under paragraphs (1) or (2) shall contain the following information:

(i) the identifying number given the application by the executive director;

(ii) the type of registration sought under the application;

(iii) the name and address of the applicant(s);

(iv) the date on which the application was submitted; and

(v) a brief summary of the information included in the application.

(d) Other chapters. A facility must obtain a permit from the commission pursuant to Chapters 305 of this title (relating to Consolidated Permits) and 281 of this title (relating to Application Processing). A permit may be issued under Chapter 263, Subchapter A (relating to Final Approval by the Executive Director). The public notice requirements of Chapters 305, 281, and 263 apply to the extent consistent with this subchapter.

§332.42. Certification by Engineer, Ownership or Control of Land, and Inspection.

(a) Certification by registered professional engineer. The operator shall obtain certification by a Texas-Registered Professional Engineer that the facility has been constructed as designed and in general compliance with the regulations prior to accepting any feedstock at the facility that requires a permit and maintaining that certification on-site available for inspection by the commission; and

(b) Ownership or control of property. The facility shall be located on property owned by the operator or the operator shall establish, using an affidavit form provided by the commission, signed by the owner and notarized, that the owner is aware of and consents to the operation prior to any receipt of feedstock or processing activities. A copy of the affidavit shall be kept on-site at all times.

(c) Inspection of facility. Prior to the initial acceptance of any feedstocks, the facility shall be inspected by the TNRCC to determine compliance with the permit.

§332.43. Required Forms, Applications, and Reports

The operator shall submit all of the following:

(1) TNRCC Compost Form Number 2. The operator shall submit TNRCC Compost Form Number 2, "Notice of Intent to Apply for a Compost Facility Registration or Permit," and a permit application prepared in accordance with the requirements of §332.47 of this title (relating to Permit Application Preparation).

(2) Annual report. The operator shall submit annual written reports using TNRCC Form Number 3, "Annual Report Form for Composting Facilities Requiring Registration or Permit," available from the commission. These reports shall at a minimum include input and output quantities, a description of the end-product distribution, and all results of any required laboratory testing. A copy of the annual report shall be kept on-site for a period of five years.

(3) Final product testing report. Facilities requiring registration must submit reports on final product testing to the executive director in compliance with §332.71(j)(1) of this title (relating to Sampling and Analysis Requirements for Final Product) on a monthly basis.

(4) Engineer's appointment. An engineer's appointment which consists of a letter from the applicant to the Executive Director identifying the engineer responsible for the submission of the plan, specifications and any other technical data to be evaluated by the commission regarding the project.

§332.44. Location Standards.

Facilities shall meet all of the following locational criteria:

(1) One-hundred year floodplain. The facility shall be located outside of the one

hundred-year floodplain unless the applicant can demonstrate that the facility is designed and will operate to prevent washout during a 100-year storm event, or obtains a Conditional Letter of Map Amendment (CLOMA) from the Federal Emergency Management Administration (FEMA) Administrator.

(2) **Drainage.** The facility shall not significantly alter existing drainage patterns.

(3) **Wetlands.** The facility shall not be located in wetlands.

(4) **Water wells.** The facility shall be located at least 500 feet from all public water wells and at least 150 feet from private water wells.

(5) **Surface water.** The facility shall be located at least 100 feet from creeks, rivers, intermittent streams, lakes, bayous, bays, estuaries, or other surface waters in the state.

(6) **Set back distance from facility boundary.** The set back distance from the facility boundary to the areas for receiving, processing, or storing feedstock or final product shall be at least 50 feet.

(7) **Edwards Aquifer Recharge Zone.** If located over the Recharge Zone of the Edwards Aquifer, a facility is subject to Chapter 313 of this title (relating to Edwards Aquifer). The Edwards Aquifer Recharge Zone is specifically that area delineated on maps in the office of the executive director.

§332.45. Operational Requirements.

The operation of the facility shall comply with all of the following operational

requirements:

(1) Protection of surface water. The facility shall be constructed, maintained and operated to manage run-on and run-off during a 25-year, 24-hour rainfall event and shall prevent discharge into waters in the state of feedstock material, including but not limited to, in-process and/or processed materials. Any waters coming into contact with feedstock, in-process, and processed materials shall be considered leachate. Leachate shall be contained in retention facilities until it is reapplied on piles of feedstock, in-process, or unprocessed materials, or it is disposed or treated. The retention facilities shall be lined and the liner shall be constructed in compliance with §332.47(6)(C) of this title (relating to Permit Application Preparation). Leachate may be treated and processed at an authorized facility or as authorized by an NPDES permit. The use of leachate in any processing shall be conducted in a manner that does not contaminate the final product.

(2) Protection of groundwater. The facility shall be constructed, maintained and operated to protect groundwater. As a minimum, groundwater protection shall be in accordance with the provisions of §332.47(6)(C) of this title.

(3) Unauthorized and prohibited materials. Delivery of unauthorized or prohibited materials shall be prevented. As a minimum there shall be one employee on-site at all times inspecting each delivery of feedstock to insure there is no unauthorized or prohibited material incorporated into the feed-stock.

(4) Access. Access to the facility shall be controlled to prevent unauthorized disposal of unauthorized and prohibited materials, and scavenging. The facility shall be completely fenced with a gate that is locked when the facility is closed.

(5) Nuisance conditions. The facility shall be sited and operated in such a manner as to prevent the potential of nuisance conditions and fire hazards. Where nuisance conditions or fire hazards exist, the operator will immediately take action to abate such nuisances.

(6) Aerobic composting required. The facility shall utilize functionally aerobic composting methods, although an anaerobic composting phase may be utilized in the early stages of processing, if it is followed by a period of functionally aerobic composting.

(7) Site sign. The facility shall have a sign at the entrance indicating the type of facility, the permit number, hours of operation and the allowable feedstocks.

(8) Access road. The facility access road shall be an all-weather road;

(9) Amendment required for significant changes. The operator shall submit and obtain a permit amendment from the commission in compliance with Chapter 305 of this title (relating to Consolidated Permits) before changing the processing method or other significant changes to the original permit application.

(10) Prohibited substances. Fungicides, herbicides, insecticides or other pesticides that contain constituents listed in 40 CFR Part 261, Appendix VIII - Hazardous Constituents or on the Hazardous Substance List as defined in the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) shall not be applied to or incorporated into feedstocks, in-process materials or processed materials.

(11) End-product standards. The operator shall meet compost testing requirements set forth in §332.71 of this title (relating to Sampling and Analysis Requirements for Final Product), final product grades set forth in §332.72 of this title (relating to Final Product

Grades), and label all materials which are sold or distributed as set forth in §332.74 of this title (relating to Final Product Labelling Requirements).

(12) Certified compost operator. The operator shall employ at least one TNRCC-certified compost operator within six months from the adoption of this title, or the initiation of operations at the facility, or the establishment of the compost certification program which ever occurs later and a TNRCC-certified compost operator shall routinely be on-site during the hours of operation.

§332.46. Records Requirements.

(a) Records. The operator shall maintain records on-site, available for inspection by the commission, for a period consisting of the two most recent calendar years. The records shall consist of the following:

(1) the facility operating permit obtained from the commission;

(2) a log of abnormal events at the facility, including but not limited to, process disruptions, extended equipment failures, injuries, and weather damage; and

(3) results of final product testing required by §332.71(j) of this title (relating to Sampling and Analysis Requirements for Final Product).

(b) Copies. The operator shall maintain copies of the annual report on-site for the five most recent calendar years.

§332.47. Permit Application Preparation.

To assist the commission in evaluating the technical merits of a compost facility, a site development plan shall be prepared and submitted to the commission along with Compost Form Number 3. The site development plan shall be sealed by a registered professional engineer in accordance with the provisions of 22 TAC §131.138. If the site development plan is submitted in a three ring binder or in a format that allows the removal or insertion of individual pages, it shall not be considered a bound document. The site development plan shall contain all of the following information.

(1) Title page. A title page shall show the name of the project, the county (and city if applicable) in which the proposed project is located, the name of the applicant, the name of the engineer, the date the application was prepared and the latest date the application was revised.

(2) Table of contents. A table of contents shall be included which lists the main sections of the plan, any requested variances and includes page numbers.

(3) Engineer's appointment. An engineer's appointment which consists of a letter from the applicant to the executive director identifying the consulting engineering firm responsible for the submission of the plan, specifications and any other technical data to be evaluated by the commission regarding the project.

(4) Land Use. To assist the executive director in evaluating the impact of the facility on the surrounding area, the applicant shall provide the following:

(A) a description of the zoning at the facility and within one mile of the facility. If the facility requires approval as a nonconforming use or a special use permit from the

local government having jurisdiction, a copy of such approval shall be submitted with the application;

(B) a description of the character of the surrounding land uses within one mile of the proposed facility;

(C) proximity to residences and other uses (e.g. schools, churches, cemeteries, historic structures, historic sites, archaeologically significant sites, sites having exceptional aesthetic quality, parks, recreational sites, recreational facilities, licensed day care etc.). Give the approximate number of residences and business establishments within one mile of the proposed facility including the distances and directions to the nearest residences and businesses;

(D) a discussion that shows the facility is compatible with the surrounding land uses; and

(E) a constructed land use map showing the land use, zoning, residences, businesses, schools, churches, cemeteries, historic structures, historic sites, archaeologically significant sites, sites having exceptional aesthetic quality, licensed day care centers, parks, recreational sites and recreational facilities within one mile of the facility and wells within 500 feet of the facility.

(5) Access. To assist the executive director in evaluating the impact of the facility on the surrounding roadway system, the applicant shall provide the following:

(A) Data on the roadways, within one mile of the facility, used to access the facility. The data shall include dimensions, surfacing, general condition, capacity and load

limits;

(B) Data on the volume of vehicular traffic on access roads within one mile of the proposed facility. The applicant shall include both existing and projected traffic during the life of the facility (for projected include both traffic generated by the facility and anticipated increase without the facility);

(C) An analysis of the impact the facility will have on the area roadway system, including a discussion on any mitigating measures (turning lanes, roadway improvements, intersection improvements, etc.) proposed with the project; and

(D) An access roadway map showing all area roadways within a mile of the facility. The data and analysis required in subparagraphs (A), (B), and (C) of this paragraph shall be keyed to this map.

(6) Facility Development: To assist the executive director in evaluating the impact of the facility on the environment, the applicant shall provide the following.

(A) Surface water protection plan. The surface water protection plan shall be prepared by a registered professional engineer. At a minimum the applicant shall provide all of the following.

(i) Present a design for a run-on control system capable of preventing flow onto the facility during the peak discharge from at least a 25-year, 24-hour rainfall event.

(ii) Present a design for a run-off management system to collect

and control at least the peak discharge from the facility generated by a 25-year 24-hour rainfall event.

(iii) Present a design for a contaminated water collection system to collect and contain all leachate. If the design uses leachate for any processing, the applicant shall clearly demonstrate that such use will not result in contamination of the final product.

(iv) Present drainage calculations as follows.

(I) Calculations for areas of 200 acres or less shall follow the rational method as specified in the Texas Department of Transportation Bridge Division Hydraulic Manual.

(II) Calculations for discharges from areas greater than 200 acres shall be computed by using USGS/DHT hydraulic equations compiled by the United States Geological Survey and the Texas Department of Transportation Bridge Division Hydraulic Manual, the HEC-1 and HEC-2 computer programs developed through the Hydrologic Engineering Center of the United States Army Corps of Engineers, or an equivalent or better method approved by the executive director.

(III) Calculations for sizing containment facilities for leachate shall be determined by a mass balance based on the facilities proposed leachate disposal method.

(IV) Temporary and permanent erosion control measures shall be discussed.

(v) Drainage Maps and Drainage Plans shall be provided as follows.

(I) An off-site topographic drainage map showing all areas which contribute to the facilities run-on. The map shall delineate the drainage basins and sub-basins, show the direction of flow, time of concentration, basin area, rainfall intensity and flow rate. This map shall also show all creeks, rivers, intermittent streams, lakes, bayous, bays, estuaries, arroyos, and other surface waters in the state.

(II) A pre-construction on-site drainage map. The map shall delineate the drainage basins and sub-basins, show the direction of flow, time of concentration, basin area, rainfall intensity and flow rate.

(III) A post-construction on-site drainage map. The map shall delineate the drainage basins and sub-basins, show the direction of flow, time of concentration, basin area, rainfall intensity and flow rate.

(IV) A Drainage facilities map. The map shall show all proposed drainage facilities (ditches, ponds, piping, inlets, outfalls, structures, etc.) and design parameters (velocities, cross-section areas, grades, flowline elevations, etc.). Complete cross sections of all ditches and ponds shall be included.

(V) A profile drawing. The drawing shall include profiles of all ditches and pipes. Profiles shall include top of bank, flowline, hydraulic grade and existing groundline. Ditches and swells shall have a minimum of one foot of freeboard.

(VI) A floodplain and wetlands map. The map shall show the location and lateral extent of all floodplains and wetlands on the site and on lands within 500 feet of the site.

(VII) An erosion control map which indicates placement of erosion control features on the site.

(B) Geologic/Hydrogeologic report. The geologic/hydrogeologic report shall be prepared by an engineer or qualified geologist/hydrogeologist. The applicant shall include discussion and information on all of the following:

(i) a description of the regional geology of the area. This section shall include:

(I) a geologic map of the region with text describing the stratigraphy and lithology of the map units. An appropriate section of a published map series such as the Geologic Atlas of Texas prepared by the Bureau of Economic Geology is acceptable;

(II) a description of the generalized stratigraphic column in the facility area from the base of the lowermost aquifer capable of providing usable ground water, or from a depth of 1,000 feet, whichever is less, to the land surface. The geologic age, lithology, variation in lithology, thickness, depth geometry, hydraulic conductivity, and depositional history of each geologic unit should be described based upon available geologic information.

(ii) A description of the geologic processes active in the vicinity of the facility. This description shall include an identification of any faults and/or subsidence in the area of the facility.

(iii) a description of the regional aquifers in the vicinity of the facility based upon published and open-file sources. The section shall provide:

(I) aquifer names and their association with geologic units described in clause (i) of this subparagraph;

(II) a description of the composition of the aquifer(s);

(III) a description of the hydraulic properties of the aquifer(s);

(IV) identification of areas of recharge to the aquifers within five miles of the site; and

(V) the present use of ground water withdrawn from aquifers in the vicinity of the facility.

(iv) Subsurface investigation report. This report shall describe all borings drilled on-site to test soils and characterize ground water and shall include a site map drawn to scale showing the surveyed locations and elevations of the boring. Boring logs shall include a detailed description of materials encountered including any discontinuities such as fractures, fissures, slickensides, lenses, or seams. Each boring shall be presented in the form of a log that contains, at a minimum, the boring number; surface elevation and location coordinates; and a columnar section with text showing the elevation of all contacts between soil and rock layers description of each layer using the Unified Soil Classification, color, degree of compaction and moisture content. A key explaining the symbols used on the boring logs and the classification terminology for soil type, consistency, and structure shall be provided.

(I) A sufficient number of borings shall be performed to establish subsurface stratigraphy and to determine geotechnical properties of the soils and rocks

beneath the facility. The number of borings necessary can only be determined after the general characteristics of a site are analyzed and will vary depending on the heterogeneity of subsurface materials. The minimum number of borings required for a site shall be three for sites of five acres or less, for sites larger than five acres the required number of borings shall be three borings plus one boring for each additional five acres or fraction thereof. The boring plan shall be approved by the executive director prior to performing the bores.

(II) Borings shall be sufficiently deep to allow identification of the uppermost aquifer and underlying hydraulically interconnected aquifers. Boring shall penetrate the uppermost aquifer and all deeper hydraulically interconnected aquifers and be deep enough to identify the aquiclude at the lower boundary. All the borings shall be at least thirty feet deeper than the elevation of the deepest excavation on-site and in no case shall be less than thirty feet below the lowest elevation on-site. If no aquifers exist within fifty feet of the elevation of the deepest excavation, at least one test bore shall be drilled to the top of the first perennial aquifer beneath the site. In areas where it can be demonstrated that the uppermost aquifer is more than three hundred feet below the deepest excavation, the applicant shall provide the demonstration to the executive director and the executive director shall have the authority to waive the requirement for the deep bore.

(III) All borings shall be conducted in accordance with established field exploration methods.

(IV) Installation, abandonment, and plugging of the boring shall be in accordance with the rules of the commission.

(V) The applicant shall prepare cross-sections utilizing the information from the boring and depicting the generalized strata at the facility.

(VI) The report shall contain a summary of the investigator's interpretations of the subsurface stratigraphy based upon the field investigation.

(v) Ground water investigation report. This report shall establish and present the ground water flow characteristics at the site which shall include ground water elevation, gradient and direction of flow. The flow characteristics and most likely pathway(s) for pollutant migration shall be discussed in a narrative format and shown graphically on a piezometric contour map. The ground water data shall be collected from piezometers installed at the site. The minimum number of piezometers required for the site shall be three for sites of five acres or less, for sites greater than five acres the total number of piezometer required shall be three piezometer plus one piezometer for each additional five acres or fraction thereof.

(C) Groundwater protection plan. The application shall demonstrate the facility is designed so as not to contaminate the groundwater and so as to protect the existing groundwater quality from degradation. For the purposes of these sections, protection of the groundwater includes the protection of perched water or shallow surface infiltration. As a minimum, groundwater protection shall consist of all of the following:

(i) Liner system. All feedstock receiving, mixing, composting, post-processing, screening and storage areas shall be located on a surface which is adequately lined to control seepage. The lined surface shall be covered with a material designed to withstand normal traffic from the composting operations. At a minimum the lined surface shall consist of soil, synthetic, or an alternative material that is equivalent to two feet of compacted clay with a hydraulic conductivity of 1×10^{-7} centimeters per second or less.

(I) Soil liners shall have more than 30% passing a number

200 sieve, have a liquid limit greater than 30% and a plasticity index greater than 15;

(II) Synthetic liners shall be a membrane with a minimum thickness of 20 mils; or

(III) An alternative design that utilizes an impermeable liner (such as concrete).

(ii) Ground water monitor system. The ground water monitoring system shall be designed and installed such that the system will reasonably assure detection of any contamination of the ground water before it migrates beyond the boundaries of the site. The monitoring system shall be designed based upon the information obtained in the "Ground water investigation report" required by subparagraph (6)(B)(v) of this paragraph.

(I) Details of monitor well construction and placement of monitor wells shall be shown on the site plan;

(II) A groundwater sampling program shall provide four background ground water samples of all monitor wells within 24 months from the date of the issuance of the permit. The background levels shall be established from samples collected from each well at least once during each of the four calendar quarters: January-March; April-June; July-September; and October-December. Samples from any monitor well shall not be collected for at least 45 days following collection of a previous sample, unless a replacement sample is necessary. At least one sample per well shall be collected and submitted to a laboratory for analysis prior to accepting any material for processing at the facility. Background samples shall be analyzed for the parameters as follows:

(-a-) Heavy metals; arsenic, copper, mercury,

barium, iron, selenium, cadmium, lead, chromium, and zinc;

(-b-) Other parameters: calcium, magnesium, sodium, carbonate, bicarbonate, sulphate, fluoride, nitrate (as N), total dissolved solids, phenolphthalein alkalinity as CaCo₃, alkalinity as CaCo₃, hardness as CaCo₃, pH, specific conductance, anion-cation balance, groundwater elevation (MSL), total organic carbon (TOC)(four replicates/sample); and

(-c-) After background values have been determined the following indicators shall be measured at a minimum of 12 month intervals; TOC (four replicates), iron, manganese, pH, chloride, ground water elevation (MSL), and total dissolved solids. After completion of the analysis, a copy shall be sent to the executive director and a copy shall be maintained on-site.

(D) Facility plan and facility layout. The facility plan and facility layout shall be prepared by a registered professional engineer. All proposed facilities, structures and improvements shall be clearly shown and annotated on this drawing. The plan shall be drawn to standard engineering scale. Any necessary details or sections shall be included. As a minimum the plan shall show property boundaries, fencing, internal roadways, tipping area, processing area, post-processing area, facility office, sanitary facilities, potable water facilities, storage areas, etc. If phasing is proposed for the facility, a separate facility plan for each phase is required.

(E) Process description. The process description shall be composed of a descriptive narrative along with a process diagram. The process description shall include all of the following.

(i) Feedstock identification. The applicant shall prepare a list of

the materials intended for processing along with the anticipated volume to be processed. This section shall also contain an estimate of the daily quantity of material to be processed at the facility along with a description of the proposed process of screening for unauthorized materials.

(ii) Tipping process. Indicate what happens to the feedstock material from the point it enters the gate. Indicate how the material is handled in the tipping area, how long it remains in the tipping area, what equipment is used, how the material is evacuated from the tipping area, at what interval the tipping area is cleaned, the process used to clean the tipping area.

(iii) Process. Indicate what happens to the material as it leaves the tipping area. Indicate how the material is incorporated into the process and what process or processes are used until it goes to the post-processing area. The narrative shall include, water addition, processing rates, equipment, energy and mass balance calculations, and process monitoring method.

(iv) Post-processing. Provide a complete narrative on the post-processing, include post-processing times, identification and segregation of product, storage of product, quality assurance and quality control.

(v) Product distribution. Provide a complete narrative on product distribution to include items such as: end product quantities, qualities, intended use, packaging, labeling, loading, and tracking bulk material.

(vi) Process diagram. Present a process diagram that displays graphically, the narrative generated in response to clauses (i)-(v) of this subparagraph.

(7) Site operating plan. This document is to provide guidance from the design engineer to site management and operating personnel in sufficient detail to enable them to conduct day to day operations in a manner consistent with the engineers design. As a minimum, the site operating plan shall include specific guidance or instructions on the all of the following:

(A) the minimum number of personnel and their functions to be provided by the site operator in order to have adequate capability to conduct the operation in conformance with the design and operational standards;

(B) the minimum number and operational capacity of each type of equipment to be provided by the site operator in order to have adequate capability to conduct the operation in conformance with the design and operational standards;

(C) security, site access control, traffic control and safety;

(D) control of dumping within designated areas, screening for unprocessable or unauthorized material;

(E) fire prevention and control plan that shall comply with provisions of the local fire code, provision for fire-fighting equipment, and special training requirements for fire fighting personnel;

(F) control of windblown material;

(G) vector control;

(H) quality assurance and quality control. As a minimum the applicant

shall provide testing and assurance in accordance with the provisions of §332.71 of this title (relating to Sampling and Analysis Requirements for Final Product);

(I) control of airborne emissions;

(J) minimizing odors;

(K) equipment failures and alternative disposal and storage plans in the event of equipment failure; and

(L) a description of the intended final use of materials.

(8) Legal description of the facility. The applicant shall submit an official metes and bounds description, and plat of the proposed facility. The description and plat shall be prepared and sealed by a registered surveyor.

(9) Financial Assurance. The applicant shall prepare a closure plan acceptable to the executive director and provide evidence of financial assurance to the commission for the cost of closure. The closure plan at a minimum shall include evacuation of all material on-site (feedstock, in process and processed) to an authorized facility and disinfection of all leachate handling facilities, tipping area, processing area and post-processing area and shall be based on the worst case closure scenario for the facility, including the assumption that all storage and processing areas are filled to capacity. The financial assurance may be demonstrated by using one or more of the following mechanisms: trust funds, surety bonds, letters of credit, insurance, financial test and corporate guarantee. These mechanisms shall be prepared on forms approved by the executive director and shall be submitted to the commission 60 days prior to the receiving any materials for processing.

(10) Source-separated recycling and household hazardous waste collection. The applicant shall submit a plan to comply with the requirements of Subchapters E and F of this title (relating to Source-Separated Recycling; and Household Hazardous Waste Collection).

(11) Landowner list. The applicant shall include a list of landowners, residents, and businesses within one half mile of the facility boundaries along with an appropriately scaled map locating property owned by the landowners.

This agency hereby certifies that the rule as adopted has been reviewed by legal counsel and found to be a valid exercise of the agency's authority.

Issued in Austin, Texas, on

SUBCHAPTER E : SOURCE-SEPARATED RECYCLING

The new rules are adopted under the Texas Water Code, §5.103, which gives the Texas Natural Resource Conservation Commission (TNRCC) the authority to adopt rules necessary to carry out its powers, duties, and responsibilities, and Health and Safety Code, Chapter 361, Solid Waste Disposal Act, which provides the TNRCC with the authority to adopt and promulgate rules consistent with the general intent and purposes of the Act.

§332.51. General Requirements and Applicability.

(a) A permittee shall not accept mixed municipal solid waste from a governmental unit for composting purposes until the commission determines that residents have reasonable access to source-separated recycling programs.

(b) Materials collected or accepted pursuant to this subchapter shall not be placed into the mixed municipal solid waste composting or mixed waste handling operations at a mixed municipal solid waste composting facility, but may be processed separately at such a facility for recycling.

(c) For purposes of this subchapter, recyclable materials that are collected separately from mixed municipal solid waste are considered source-separated recyclable materials. Recyclable materials collected in separate containers or bags and commingled with mixed municipal solid waste shall be considered to have been collected separately unless the bags or containers break during the time the materials are commingled.

§332.52. Demonstration to Provide Reasonable Access for Residents.

The permit applicant shall provide demonstration of reasonable access to source-separated

recycling programs using any one of the four options presented in paragraphs (1)-(4) of this section.

(1) Option 1. At least one collection center for recycling of materials is provided for each mixed municipal solid waste composting facility and at least one collection center for each transfer station from which wastes are delivered to such composting facilities. These collection centers may be located at the composting facility or transfer station or at locations more convenient to the affected residents. "More convenient" means at a shorter average road distance from the residences served by the center, or in a central or high traffic location in the most populated municipality served by the center.

(2) Option 2. Curbside recycling.

(A) For each such municipality with an affected population less than 15,000, single-family homes shall be provided residential curbside recycling at least twice per month for aluminum, steel, and bimetal cans and, at a minimum, three of the materials listed in accordance with §332.53 of this title (relating to List of Recyclable Materials); or

(B) For each such municipality with an affected population of 15,000 or more, single-family homes shall be provided weekly residential curbside recycling of aluminum, steel, and bimetal cans and, at a minimum, four of the materials listed in accordance with §332.53 of this title (relating to List of Recyclable Materials).

(3) Option 3. The permit applicant may submit evidence that the method of reasonable access accomplishes a degree of recovery such that at least 10% of the waste generated by the affected residents is captured for recycling.

(4) Option 4. The permit applicant may present an alternative plan for providing reasonable access to residents. The commission will evaluate alternative plans on a case-by-case basis. At a minimum, the plan shall present the following information:

(A) A description of the residential service areas, and their respective governmental units, from which mixed municipal solid waste is proposed to be accepted; and

(B) A description of the residential source-separated recycling programs and how these programs provide reasonable access.

§332.53. List of Recyclable Materials. The executive director shall establish a list of recyclable materials of which there is an established market for the processing and use of such materials, and shall make the list available to the public. The executive director may revise the list if market factors change.

This agency hereby certifies that the rule as adopted has been reviewed by legal counsel and found to be a valid exercise of the agency's authority.

Issued in Austin, Texas, on

SUBCHAPTER F : HOUSEHOLD HAZARDOUS WASTE COLLECTION

The new rules are adopted under the Texas Water Code, §5.103, which gives the Texas Natural Resource Conservation Commission (TNRCC) the authority to adopt rules necessary to carry out its powers, duties, and responsibilities, and Health and Safety Code, Chapter 361, Solid Waste Disposal Act, which provides the TNRCC with the authority to adopt and promulgate rules consistent with the general intent and purposes of the Act.

§332.61. General Requirements and Applicability.

(a) A compost permittee shall not accept mixed municipal solid waste from a governmental entity until the commission determines that residents in that service area have reasonable access to household hazardous waste collection programs.

(b) Materials collected or accepted pursuant to this subchapter shall not be placed into the mixed municipal solid waste composting or mixed waste handling operations at a mixed municipal solid waste composting facility, but may be processed separately at such a facility for recycling.

(c) Any person who intends to conduct a collection event or intends to operate a permanent collection center shall comply with the requirements of Chapter 335, Subchapter N of this title (relating to Household Materials Which Could Be Classified as Hazardous Waste).

§332.62. Demonstration to provide reasonable access for residents.

(a) The permit applicant shall provide demonstration of reasonable access to household hazardous waste collection using either Option 1 or Option 2.

(1) Option 1. A permit applicant shall provide one of the following alternatives for the collection of household hazardous wastes based upon population:

(A) A permittee with a facility in a service area with a population less than 100,000 shall provide one permanent collection site with a minimum of 12 hours per year of access outside of regular business hours or semi-annual collections each with a minimum of six hours continuous periods of access outside of regular business hours.

(B) A permittee with a facility in a service area with a population between 100,000 and 500,000 shall provide one permanent collection site with a minimum of 36 hours per year of access outside of regular business hours or six collections each with a minimum of six hours continuous periods of access outside of regular business hours.

(C) A permittee with a facility in a service area with a population between 500,000 and 1.0 million shall provide one permanent collection site with a minimum of 48 hours per year of access outside of regular business hours or eight collections each with a minimum of six hours continuous periods of access outside of regular business hours.

(D) A permittee with a facility in a service area with a population over 1.0 million shall provide one permanent collection site with a minimum of 96 hours per year of access outside of regular business hours or sixteen collections each with a minimum of six hours continuous periods of access outside of regular business hours and at locations other than the permitted site that increase reasonable public access to household hazardous waste collection.

(2) Option 2. Alternative plan for providing reasonable access. The permit applicant may present an alternative plan for providing reasonable access to residents. The commission will evaluate alternative plans on a case-by-case basis. At a minimum, the plan shall present the following information:

(A) A description of the residential service areas, and their respective governmental units, from which mixed municipal solid waste is proposed to be accepted; and

(B) A description of the household hazardous waste collection program and how the program provides reasonable access.

(b) The time of operation outside of business hours may be changed with executive director's approval.

(c) For purposes of this section, "business hours" means 8:00 a.m. to 5:00 p.m., Monday through Friday. "Attended" means, at minimum, that a volunteer or employee is present at the site providing educational materials and information to users of the center, guiding them in the proper use of the center, and answering their questions.

(d) Site Managers shall be trained in the 40 hour OSHA Hazardous Waste Operation and Emergency Response Course and have annual eight hour refresher course. All volunteers and employees attending the site shall be trained in appropriate site safety and job duties prior to working on the site.

§332.63. Materials to be Accepted.

Household hazardous waste collection programs required under this subsection shall accept household hazardous waste as defined in §335.402 of this title (relating to Definitions).

§332.64. Public Education.

(a) A written or more effective notice or combination of both that is reasonably designed to reach each household affected by this subchapter shall be distributed in a timely manner to enable any interested resident to participate in each collection opportunity.

(b) The notice shall explain the following:

(1) The benefits of participating in the collection;

(2) The opportunities available pursuant to this subchapter and through other means (such as the lead-acid battery trade-in program);

(3) the materials that can be brought for safe disposal under this program;

(4) the proper preparation of the materials for this program; and

(5) a telephone number at which more information about the services can be obtained.

(c) Attendants at each site shall provide educational materials with guidance for reducing and properly handling household hazardous materials and for the use of less hazardous alternatives.

This agency hereby certifies that the rule as adopted has been reviewed by legal counsel and found to be a valid exercise of the agency's authority.

Issued in Austin, Texas, on

SUBCHAPTER G : END-PRODUCT STANDARDS

The new rules are adopted under the Texas Water Code, §5.103, which gives the Texas Natural Resource Conservation Commission (TNRCC) the authority to adopt rules necessary to carry out its powers, duties, and responsibilities, and Health and Safety Code, Chapter 361, Solid Waste Disposal Act, which provides the TNRCC with the authority to adopt and promulgate rules consistent with the general intent and purposes of the Act.

§332.71. Sampling and Analysis Requirements for Final Product.

(a) **Applicability.** Facilities that receive a registration or permit under this chapter, are required to test final product in accordance with this section. Final product derived from municipal sewage sludge at registered facilities is not subject to the requirements of this section, but must comply with the requirements of Chapter 312 of this title (relating to Sludge Use, Disposal, and Transportation).

(b) **Analytical methods.** Facilities which use analytical methods to characterize their final product must use methods described in the following publications:

(1) **Chemical and physical analysis shall utilize:**

(A) "Test Methods for the Evaluation of Solid Waste, Physical/Chemical Methods" (SW-846);

(B) "Methods for Chemical Analysis of Water and Wastes" (EPA-600); or

(C) "Recommended Test Methods for the Examination of Composts and Composting" (Compost Council, 1995).

(2) Analysis of pathogens shall utilize "Standard Methods for the Examination of Water and Wastewater" (Water Pollution Control Federation, latest edition).

(3) Analysis for foreign matter shall utilize "Recommended Test Methods for the Examination of Composts and Composting" (Composting Council, 1995).

(4) Analysis for salinity and pH shall utilize NCR (North Central Regional) Method 14 for Saturated Media Extract (SME) Method contained in "Recommended Test Procedure for Greenhouse Growth Media" North Central Regional Publication Number 221 (Revised), Recommended Chemical Soil Test Procedures, Bulletin Number 49 (Revised), October 1988, pages 34-37.

(5) Analysis of total, fixed and volatile solids shall utilize Method 2540 G (Total, Fixed, and Volatile Solids in Solid and Semi-solid Samples) as described in "Standard Methods for the Examination of Water and Wastewater" (Water Pollution Control Federation, latest edition).

(6) Analysis for maturity shall utilize the reduction of organic matter (ROM) calculation method, as described in the TNRCC "Quality Assurance Program Plan" (QAPP) or a TNRCC approved Quality Assurance/Quality Control (QAQC) plan during the first 18 months of a facility's operation. Reduction in organic matter is calculated by measuring the volatile solids content at two points in the composting process: when compost feedstocks are initially mixed and when the compost is sampled for end-product testing for total metals and PCBs. For purposes of compost maturity analysis, the effect of the addition and removal of volatile solids and fixed solids to the compost shall be included in the ROM calculation procedure. After the completion of the maturity testing protocol described in subsection (d) of this section, or the

facility QAQC plan, or 18 months, which ever comes first, the method recommended in the protocol and approved by the TNRCC shall be utilized.

(c) Sample collection. Sample collection, preservation and analysis shall assure valid and representative results pursuant to an Agency-approved QAQC plan.

(d) Maturity Testing Protocol.

(1) A maturity testing protocol shall be described in the facility QAQC. The protocol shall consist of the ROM method or a comparison of the interim ROM method to a minimum of three test methods with one test method selected from each of subparagraphs (A), (B) and (C) of this paragraph, together with any method in subparagraph (D) of this paragraph:

(A) Chemical analyses:

(i) carbon/nitrogen ratio,

(ii) water soluble ions,

(iii) water soluble organic matter,

(iv) cation exchange capacity,

(v) electrical conductivity,

(vi) crude fiber analysis,

(vii) humification analysis, or

(viii) ratios of the above measurements.

(B) Physical analyses:

(i) Dewar self-heating, or

(ii) color.

(C) Respiration analyses:

(i) CO₂ or

(ii) O₂.

(D) Other test methods proposed in the facility QAQC plan and approved

by the TNRCC.

(2) The test methods used in the maturity test protocol shall be based on methodologies published in peer reviewed scientific journals, the publication entitled "Recommended Test Methods for the Examination of Composts and Composting (Compost Council, 1995), or other methods as approved by the TNRCC.

(3) The completed maturity testing protocol shall lead to a recommended maturity testing method(s) capable of classifying compost into maturity grades described in §332.72 of this title (relating to Final Product Grades) and identifying materials which are stable but not mature. The maturity test protocol shall address seasonal variations in compost feedstock and shall be

completed within 18 months of the start of a new compost feedstock mixture.

(4) The results of the protocol and recommendations shall be submitted to the TNRCC for review and approval. The basis of the TNRCC review and approval shall be the demonstration that the recommended method adequately classifies compost into maturity classes. The purpose of the TNRCC review and approval is not intended to provide detailed guidance to end users about the agricultural and horticultural compost uses.

(5) The compost maturity protocol does not need to be repeated unless a significantly new compost feedstock recipe is utilized.

(e) Documentation.

(1) Owners or operators of permitted or registered facilities shall record and maintain all of the following information regarding their activities of operation for three years after the final product is shipped off site or upon site closure:

(A) batch numbers identifying the final product sampling batch;

(B) the quantities, types and sources of feedstocks received and the dates received;

(C) the quantity and final product grade assigned described in §332.72 of this title;

(D) the date of sampling; and

(E) all analytical data used to characterize the final product, including

laboratory quality assurance/quality control data.

(2) The following records shall be maintained on-site permanently or until site closure:

(A) sampling plan and procedures;

(B) training and certification records of staff; and

(C) maturity protocol test results.

(3) Records shall be available for inspection by TNRCC representatives during normal business hours.

(4) The executive director may at any time request by registered or certified mail that a generator submit copies of all documentation listed in paragraph (1) of this subsection for auditing the final product grade. Documentation requested under this section shall be submitted within ten (10) working days of receipt of the request.

(f) Sampling Frequencies.

(1) Registered facilities. For those facilities which are required to register, all final product on-site must be sampled and assigned a final product grade set forth in §330.72 of this title (relating to Final Product Grades) at a minimum rate of one sample for every 5,000 cubic yard batch of final product or annually, whichever is more frequent. Each sample will be a composite of nine grab samples as discussed in subsection (g) of this section.

(2) Permitted facilities. For facilities requiring a permit, all final product on-site must be sampled and assigned a final product grade set forth in §330.72 of this title at a minimum rate of one sample for every 3,000 cubic yard batch of final product or monthly whichever is more frequent. Each sample will be a composite of nine (9) grab samples as discussed in subsection (g) of this section.

(3) Alternative testing frequency. One year after the initiation of final product testing in accordance with this section, an operator of a registered or permitted facility may submit to the executive director a request for an alternative testing frequency. The request shall include a minimum of 12 consecutive months of final product test results for the parameters set forth in subsection (h) of this section. The executive director will review the request and determine if an alternative frequency is appropriate.

(g) Sampling Requirements. For facilities subject to sampling and analysis, the operator shall utilize the protocol in the TNRCC QAPP or a TNRCC approved facility QAQC plan shall be followed. The executive director may at any time request that split samples be provided to an agency representative. Specific sampling requirements which must be satisfied include:

(1) Sampling from stockpiles. One third of the grab samples shall be taken from the base of the stockpile (at least 12 inches into the pile at ground level), one third from the exposed surface and one third from a depth of two feet from the exposed surface of the stockpile.

(2) Sampling from conveyors. Sampling times shall be selected randomly at frequencies which provide the same number of subsamples per volume of finished product as is required in subsection (d) of this section.

(A) If samples are taken from a conveyor belt, the belt shall be stopped at

that time. Sampling shall be done along the entire width and depth of the belt.

(B) If samples are taken as the material falls from the end of a conveyor, the conveyor does not need to be stopped. Free-falling samples need to be taken to minimize the bias created as larger particles segregate or heavier particles sink to the bottom as the belt moves. In order to minimize sampling bias, the sample container shall be moved in the shape of a "D" under the falling product to be sampled. The flat portion of the "D" shall be perpendicular to the beltline. The circular portion of the "D" shall be accomplished to return the sampling container to the starting point in a manner so that no product to be sampled is included.

(h) Analytical Requirements. Final product subject to the sampling requirements of this section will be tested for all of the following parameters. The executive director may at any time request that additional parameters be tested. These parameters are intended to address public health and environmental protection.

(1) total metals, to include:

(A) Arsenic;

(B) Cadmium;

(C) Chromium;

(D) Copper;

(E) Lead;

(F) Mercury;

(G) Molybdenum;

(H) Nickel;

(I) Selenium; and

(J) Zinc.

(2) Maturity/Stability by reduction in organic matter on an interim basis and by approved method of maturity/stability analysis after the completion of the maturity/stability method protocol as described in subsections (b) and (d) of this section.

(3) weight percent of foreign matter, dry weight basis.

(4) pH by the saturated media extract method.

(5) salinity by the saturated media extract electrical conductivity method.

(6) pathogens:

(A) salmonella; and

(B) fecal coliform.

(7) Polychlorinated-biphenyls (PCBs) - required only for permitted facilities.

(i) **Data Precision and Accuracy.** Analytical data quality shall be established by EPA standard laboratory practices to ensure precision and accuracy.

(j) **Reporting Requirements.**

(1) **Facilities requiring registration must report the following information to the executive director on a semi-annual basis for each sampling batch of final product. Facilities requiring a permit must report similarly but on a monthly basis. Reports must include, but may not be limited to all of the following information:**

(A) **batch numbers identifying the final product sampling batch;**

(B) **the quantities, types and sources of feedstocks received and the dates received;**

(C) **the quantity of final product and final product standard code assigned;**

(D) **the final product grade or permit number of the disposal facility receiving the final product if it is not Grade 1 or Grade 2 Compost as established in §332.72 of this title (relating to Final Product Grades);**

(E) **all analytical results used to characterize the final product including laboratory quality assurance/quality control data and chain-of-custody documentation; and**

(F) **the date of sampling.**

(2) Reports must be submitted to the executive director within two months after the reporting period ends.

§332.72. Final Product Grades.

(a) **Applicability.** Facilities that receive a registration or permit under this chapter, are required to test final product in accordance with this section. Final product derived from municipal sewage sludge at registered facilities is not subject to the requirements of this section, but must comply with the requirements of Chapter 312 of this title (relating to Sludge Use, Disposal, and Transportation).

(b) **Grades.** Compost material that has undergone the composting process and is ready for distribution shall be considered final product, and shall be classified with one of the following grade names:

(1) Grade 1 Compost;

(2) Grade 2 Compost;

(3) Waste Grade Compost.

(c) **Final product testing.** Final product shall be regularly tested pursuant to §332.71 of this title (relating to Sampling and Analysis Requirements for Final Product) to determine the product's grade. Testing of final product and interpretation of test results shall be conducted in accordance with the Texas Natural Resource Conservation Commission's current Quality Assurance Program Plan, or, in the case of facilities with TNRCC permits or registrations, the Quality Assurance Quality Control Plan specified in the facility's permit.

(d) Final product classification. Final product shall be classified according to the following classification system:

(1) Grade 1 Compost. To be considered Grade 1 Compost, the final product must meet all of the following criteria:

(A) Shall contain no foreign matter of a size or shape that can cause human or animal injury;

(B) Shall not exceed all Maximum Allowable Concentrations for Grade 1 Compost in Table 1 of this section; (Figure 1: 30 TAC 332.72(d)(1)(B))

(C) Shall not contain foreign matter in quantities which cumulatively are greater than 1.5% dry weight on a 4mm screen;

(D) Shall meet the requirements of cured compost as described in Table 2 of this section; (Figure 2: 30 TAC 332.72(d)(1)(D))

(E) Shall meet the requirements for pathogen reduction for Grade 1 Compost as described in Table 3 of this section; (Figure 3: 30 TAC 332.72(d)(1)(E)) and

(F) Shall meet the requirements for salinity and pH for Grade 1 Compost as described in Table 3 of this section. (Figure 3: 30 TAC 332.72(d)(1)(E)).

(2) Grade 2 Compost:

(A) Shall contain no foreign matter of a size or shape that can cause human or animal injury;

(B) Shall not exceed all Maximum Allowable Concentrations for Grade 2 Compost in Table 1 of this section at a compost organic matter content which is equivalent to a mature compost when maturity is determined by reduction in organic matter during the interim period or a maturity test which is part of an approved maturity test protocol; (Figure 1: 30 TAC 332.72(d)(1)(B))

(C) Shall not contain foreign matter in quantities which cumulatively are greater than 1.5% dry weight on a 4mm screen;

(D) Shall meet the requirements of semi-mature compost, mature compost or cured compost as described in Table 2 of this section; (Figure 2: 30 TAC 332.72(d)(1)(D))

(E) Shall meet the requirements for pathogen reduction for Grade 2 Compost as described in Table 3 of this section; and (Figure 3: 30 TAC 332.72(d)(1)(E))

(F) Shall meet the requirements for salinity and pH for Grade 2 Compost as described in Table 3 of this section. (Figure 3: 30 TAC 332.72(d)(1)(E))

(3) Waste Grade Compost:

(A) Exceeds any one of the Maximum Allowable Concentrations for Grade 2 final product in Table 1 of this section, and (Figure 1: 30 TAC 332.72(d)(1)(B))

(B) Does not meet the other requirements of Grade 1 or Grade 2

Compost.

(e) Maturity adjustment. Compost which is semi-mature or mature shall have the metal concentrations adjusted to reflect the metal concentration which would occur if the compost met the criteria for a cured compost as described in Table 2, "Maturity and Stability Standards".

(Figure 2: 30 TAC 332.72(d)(1)(D))

(f) Waste grade final product. Any material which does not meet the final product standards shall be appropriately disposed at a permitted municipal solid waste facility.

§332.73. Allowable Uses of Final Product by Grade.

(a) Applicability. Facilities that receive a registration or permit under this chapter, are required to test final product in accordance with this section. Final product derived from municipal sewage sludge at registered facilities is not subject to the requirements of this section, but must comply with the requirements of Chapter 312 of this title (relating to Sludge Use, Disposal, and Transportation).

(b) Distribution. Distribution and use of final product shall be in accordance with the following restrictions:

(1) Grade 1 Compost. There are no restrictions on the use of Grade 1 compost.

(2) Grade 2 Compost. Grade 2 compost shall not be used at a residence or licensed child-care facility.

(a) **Applicability.** Facilities that receive a registration or permit under this chapter, are required to test final product in accordance with this section. Final product derived from municipal sewage sludge at registered facilities is not subject to the requirements of this section, but must comply with the requirements of Chapter 312 of this title (relating to Sludge Use, Disposal, and Transportation).

(b) **Label information.** All compost distributed within Texas derived from feedstock identified in the registration and permit tiers in §332.3 of this title (relating to Applicability) shall be clearly labelled according to the following requirements. The label information must be grouped together and plainly printed in English and Spanish.

(1) **Labels and vouchers.** Compost distributed in containers shall have a label attached to or on the face of the container. Vouchers which provide the same information as required on labels shall be given to persons receiving compost distributed in bulk; and

(2) **Labels/vouchers information.** The label or voucher shall include the information described in subparagraphs (A) or (B) of this paragraph.

(A) **General statement.**

(i) **Grade 1 Compost.** This product is considered Grade 1 Compost and meets the requirements and standards described in 30 Texas Administrative Code, §332.72 and has unrestricted use.

(ii) **Grade 2 Compost.** This product is considered Grade 2 Compost and meets the requirements and standards 30 Texas Administrative Code, §332.72 and cannot be used at a residence or licensed child-care facility.

(B) Feedstocks. Specify the feedstock or feedstocks from which the compost was derived. When two or more feedstocks are used, the label or voucher shall indicate each feedstock used in descending order or predominance by wet weight. For purposes of specifying feedstocks for this labelling requirement, water added to composting materials shall not be considered a feedstock. The label shall identify one or more of the following general descriptions of feedstock:

- (i) source-separated organic materials;
- (ii) source-separated meat, fish, chicken, oils, or greases;
- (iii) municipal sewage sludge;
- (iv) organic materials derived from a positive sort of mixed municipal solid waste;
- (v) grease trap waste;
- (vi) disposable diapers;
- (vii) the sludge byproduct of paper production; and
- (viii) mixed municipal solid waste.

(C) Incorporation into soil. The label shall state that it is recommended that compost be mixed into the top 15 centimeters of soil.

§332.75. Out of State Production.

Any compost produced outside of the State of Texas, which is distributed within Texas, shall be labeled pursuant to §332.74 of this title (relating to Final Product Labelling Requirements).

This agency hereby certifies that the rule as adopted has been reviewed by legal counsel and found to be a valid exercise of the agency's authority.

Issued in Austin, Texas, on

Figure 1: 30 TAC 332.72

Table 1: Maximum Allowable Concentrations

PARAMETER	Grade 1 Compost (mg/kg)	Grade 2 Compost (mg/kg)
As	10	41
Cd	16	39
Cr (total)	180	1200
Cu	1020	1500
Pb	300	300
Hg	11	17
Mo	75	75
Ni	160	420
Se	36	36
Zn	2190	2800
PCBs	1	10

Figure 2: 30 TAC 332.72

Table 2: Maturity and Stability Standards.

METHOD	SEMI-MATURE COMPOST	MATURE COMPOST	CURED COMPOST
Reduction of Organic Matter (ROM) (%)	Between 20% and 40%	Between 40% and 60%	Greater than 60%
Other Methods	Maturity Protocol	Maturity Protocol	Maturity Protocol

Figure 3: 30 TAC 332.72

Table 3: Additional Final Product Standards.

PARAMETER	Grade 1 Compost	Grade 2 Compost
Salinity (mmhos/cm)	10	
pH	5.0 to 8.5	5.0 to 8.5
Pathogens: Fecal Coliform	less than 1,000 MPN per gram of solid or meets PFRP	geometric mean density less than 2,000,000 MPN per gram of solids or meets PSRP
Salmonella	less than 3 MPN per 4 grams total solid or meets PFRP	No value

A higher conductivity or pH outside the indicated range may be appropriate if the compost is specified for a special use.

**SUBCHAPTER A : INDUSTRIAL SOLID WASTE AND
MUNICIPAL HAZARDOUS WASTE**

The Texas Natural Resource Conservation Commission (TNRCC or commission) adopts an amendment to §335.2, concerning Permit Required, of the Industrial Solid Waste and Municipal Hazardous Waste rules to reference proposed rules affecting the composting of industrial materials in 30 TAC Chapter 332 (20 TexReg 4464). Section 335.2 is adopted without changes to the proposed text as published in the June 23, 1995, issue of the Texas Register (20 TexReg 4535). The commission accepted public comment on the proposed rules until 5:00 p.m. on July 24, 1995. A public hearing to accept verbal and written comment on the proposed rule was held at TNRCC offices in Austin, Texas on July 21, 1995 in conjunction with a public hearing to accept comment on proposed composting rules in 30 TAC Chapter 332. The final rules were adopted by the commission on September 13, 1995.

The commission received one written comment concerning the proposed amendment. The comment was submitted by a private citizen. The commenter is concerned that Chapter 335 addresses industrial solid waste and municipal hazardous waste and does not address composting. Furthermore, the commenter expressed concern that the fiscal note addressed municipal facilities rather than industrial facilities. The commenter requests that all industrial facilities that compost should be subject to 30 TAC Chapter 332.

The amendment proposed for §335.2(a) is intended as a companion rule change to the new 30 TAC Chapter 332 rules. The new compost rules provide an exemption for on-site industrial composting. This exemption is limited to the composting of materials where the composting takes place on-site, and the final product is utilized or disposed on-site. "On-site" is set forth in §335.2(d) as meaning land owned or effectively controlled by the owner or operator of the facility within 50 miles. The commission believes such an exemption is consistent with the Health and

Safety Code, Chapter 361, and the exemption from permitting provided by §335.2(d). The commission emphasizes that this exemption does not apply to final product that is taken off-site for distribution, application, disposal, or any other purpose.

Regarding the fiscal note, the commission utilized the same fiscal note for the proposed amendment to §335.2(a) as it did for the proposed 30 TAC Chapter 332 because the §335.2(a) amendment is a companion rule change. The commission retains the proposed language.

The amended section is adopted under the Texas Water Code, §5.103, §5.105 and §26.011, which provides the commission with authority to adopt any rules necessary to carry out its powers, duties, and policies and to protect water quality in the state. The sections are also promulgated under the Texas Health and Safety Code, Texas Solid Waste Disposal Act, §361.017 and §361.024, which provides the commission the authority to regulate industrial solid wastes and hazardous municipal wastes and to adopt and promulgate rules consistent with the general intent and purposes of the Act.

§335.2. Permit Required.

(a) Except with regard to storage, processing, or disposal to which subsections (c)-(h) of this section apply, and as provided in §335.45(b) of this title (relating to Effect on Existing Facilities), and in accordance with the requirements of §335.24 of this title (relating to Requirements for Recyclable Materials and Nonhazardous Recyclable Materials), and as provided in §332.4 of this title (relating to General Requirements), no person may cause, suffer, allow, or permit any activity of storage, processing, or disposal of any industrial solid waste or municipal hazardous waste unless such activity is authorized by a permit, amended permit, or other authorization from the TNRCC or its predecessor agencies, the Texas Department of Health, or other valid authorization from a Texas state agency. No person may commence physical

construction of a new hazardous waste management facility without first having submitted Part A and Part B of the permit application and received a finally effective permit.

(b)-(k) (No change.)

This agency hereby certifies that the rule as adopted has been reviewed by legal counsel and found to be a valid exercise of the agency's authority.

Issued in Austin, Texas, on