SECTION 319 NONPOINT SOURCE POLLUTION CONTROL PROGRAM

IMPLEMENTATION PROJECT FINAL REPORT

COMPOSTED MANURE INCENTIVE PROJECT (CMIP)

by

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

and its coordination with the related

DAIRY MANURE EXPORT SUPPORT PROJECT

by

TEXAS STATE SOIL AND WATER CONSERVATION BOARD

September 23, 2009

These closely related projects were conducted by the Texas Commission on Environmental Quality and the Texas State Soil and Water Conservation Board in cooperation with the United States Environmental Protection Agency, Region 6, through the use of Clean Water Act Section 319(h) funds.

Grants # **C9-99614606-4**
 # C9-99614607-2
 # C9-99614610-0

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EXECUTIVE SUMMARY

PROJECT TITLE
Composted Manure Incentive Project (CMIP)

PROJECT START DATE 9/27/2000 PROJECT COMPLETION DATE 8/31/2007

TOTAL BUDGET	**$6,061,630**
TOTAL EPA GRANT (C9-99614606-4)	**$3,907,500**
TOTAL EPA GRANT (C9-99614607-2)	**$1,845,830**
TOTAL EPA GRANT (C9-99614610-0)	**$ 308,300**
TOTAL 319 EXPENDITURES (C9-99614606-4)	**$3,708,668**
TOTAL 319 EXPENDITURES (C9-99614607-2)	**$1,623,823**
TOTAL 319 EXPENDITURES (C9-99614610-0)	**$ 308,300**
TOTAL PROJECT EXPENDITURES	**$5,640,791**

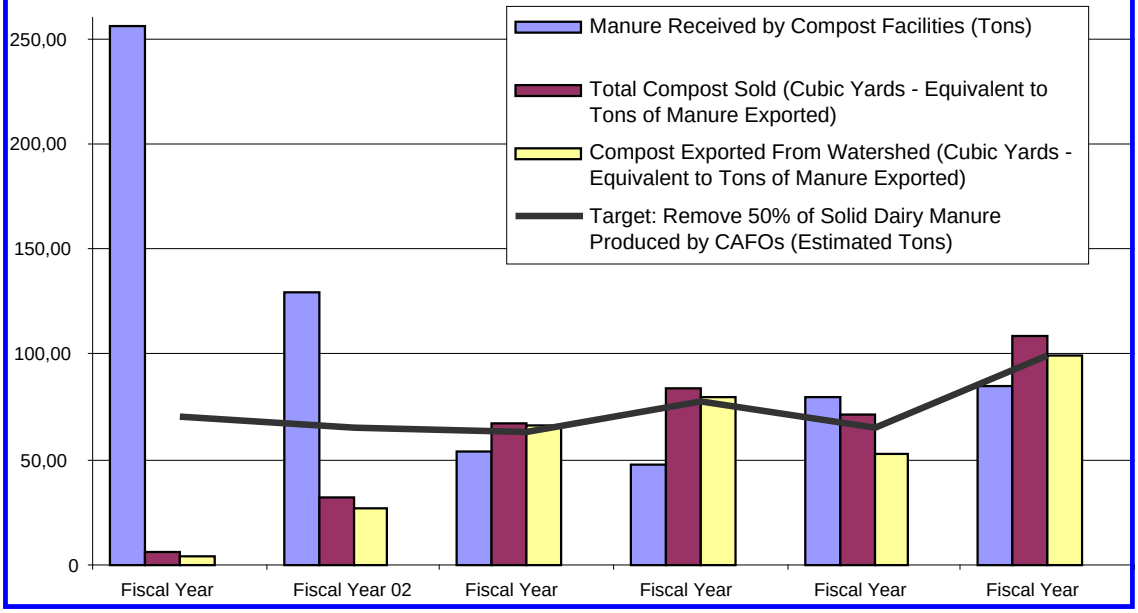
SUMMARY OF ACCOMPLISHMENTS

Through temporary incentives, marketing assistance, and technical support, the CMIP, with the Dairy Manure Export Support and other associated projects, supported the emergence of a new private regional compost industry in the North Bosque and Leon River watersheds. Over the active incentive period (state fiscal years 2001-2006), this new compost industry succeeded in diverting almost half of all collectable solid dairy manure from traditional land application in these watersheds for composting and beneficial use in other locations where its nutrients and soil amending qualities were needed. This resulted in the removal each year, on average, of 93,000 tons of manure, containing an average of more than 409,000 lbs of phosphorus, from the watersheds. The initial objective of the project was the removal of 250,000 tons of manure from the watersheds as a combined area, but as of August 31, 2006, a total of 466,468 tons of manure had already been exported. At the end of August, 2007, one year after the compost purchase incentive was phased out and six months after the manure hauling reimbursement ended, five viable independent composting facilities were continuing to export large quantities of composted manure from the watersheds.

The following are specific results of the project documented as of August 31, 2006:

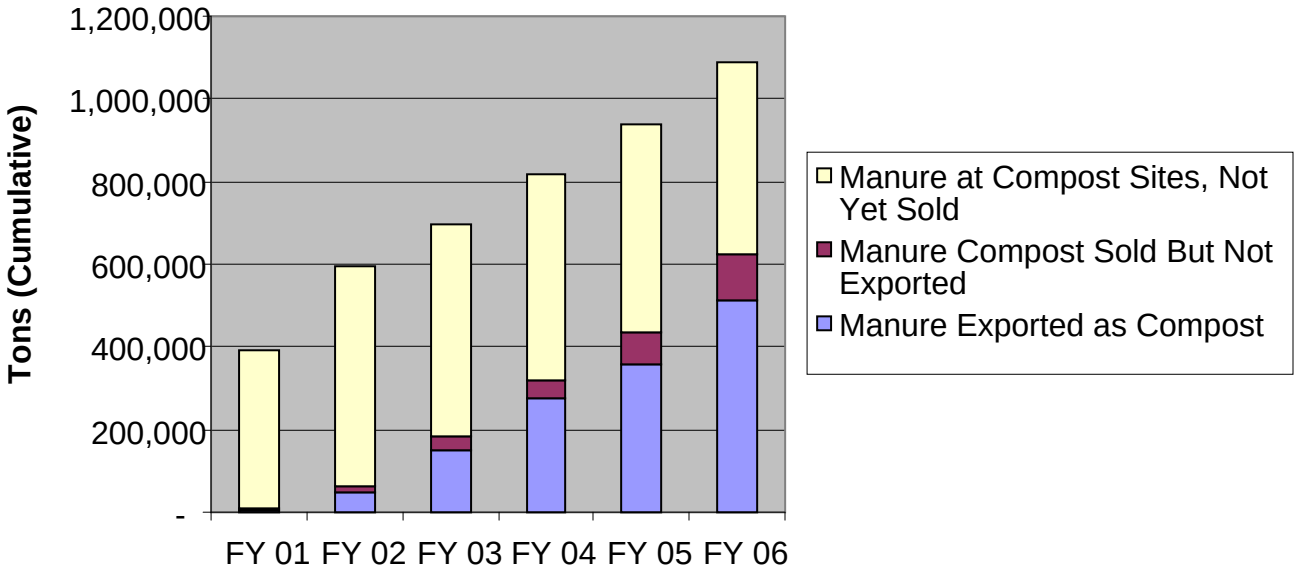
- Hauling of more than 1 million tons of dairy manure from the two watersheds to compost facilities – more than 650,000 tons of dairy manure from the North Bosque watershed alone.
- Export of 466,468 tons of manure from the North Bosque and Leon River combined watershed area as compost.
- Export of more than 329,000 tons of manure from the North Bosque watershed as compost, thus removing more than 1.48 million pounds of phosphorus from the watershed and substantially contributing to the Total Maximum Daily Load (TMDL) Implementation Plan (I-Plan) goal for manure haul-out in the years 2003-2006 (see Figure).
- TxDOT's purchases far exceeded the CMIP goal of 200,000 cubic yards
- Purchases by other users exceeded the CMIP target of 50,000 cubic yards by more than 20%

Figure 1: Manure from the North Bosque Watershed Hauled to Participating Compost Facilities



The black line in Figure 1 represents the TMDL target of removing 50% of the "collectable" dairy manure generated in the watershed each year, which varies with cattle population. It shows an upward trend in fiscal 2006, because the number of cattle in the watershed increased that year. The bars representing total sales and exports of composted manure also show an upward trend in fiscal 2006, due in part to intensive TCEQ marketing and promotional efforts in the final year. These marketing efforts included promotion of the supplemental rebate program, available on a limited basis to large-scale non-governmental compost users, as well as demonstrations of compost erosion control and reclamation practices at Fort Hood and in rock quarries in north Texas. See Attachment B9 for information about estimating the amount of manure generated in the watershed and the goal of 50% removal.

Figure 2: Fate of Manure Hauled to Compost Sites From the North Bosque and Leon River Watersheds, Nov. 2000 - Aug. 2006



Each of the bars in Figure 2 represents the total amount of manure hauled to compost facilities as of the end of each fiscal year (cumulative) from both watersheds under the CMIP and Dairy Manure Export Support (DMES) projects. The yellow bars represent the manure not yet accounted for by compost sales. The blue bars represent the manure composted and exported from the combined North Bosque and Leon River watershed area. The red bars represent manure sold within the watersheds – beneficially used but not exported from the project area. The yellow bars, representing the "backlog" of manure at compost sites and not sold, reached its maximum (534,321 tons) in the second year, fiscal year 2002. By the end of fiscal year 2006, this backlog (468,060) was at its smallest size since the first year of the project. The issue of this "backlog" is discussed further in the "Lessons Learned" section.

INTRODUCTION AND OVERVIEW

The North Bosque/Leon Watersheds Compost Project consisted of several distinct but related projects coordinated through two primary initiatives:

- the CMIP managed by the TCEQ, and
- the DMES Project, managed by the Texas State Soil and Water Conservation Board (TSSWCB).

The overall purpose of these two projects, launched jointly in 2000, was to convert cattle manure in these watersheds into compost (greatly reducing pathogens in the process) and to export it to remove nutrients and fecal coliform bacteria from the affected watersheds and to assure the safe and beneficial use of the compost in locations where its nutrients are needed. An important secondary aim of the project was the soil conservation and water quality benefits of appropriate applications of the compost by major new groups of prospective users, primarily outside the two watersheds, with elements of research, demonstration, and outreach to help build a sustainable market for the composted manure.

Runoff from dairy waste application fields had been identified as early as the 1980s as a major source of elevated levels of phosphorus in the North Bosque River and high levels of bacteria in the Leon River. The composting of dairy manure to make its export from the watershed economically viable had been proposed as a potential remedy as early as 1991 (TAES, 1991; BRA, 1998). EPA had funded a major project promoting this option and a separate demonstration of in-vessel on-farm manure composting in the mid-1990's. As of 1999, however, there were only three or four very small manure composting operations in the area, primarily serving local markets.

In 1999, the TCEQ Nonpoint Source team began considering a project to facilitate the development of an industry capable of exporting large amounts of composted manure from the watersheds. The primary mechanism selected was a temporary rebate on the purchase of composted manure from the North Bosque and Leon River watersheds, as an incentive for documented sales and valid beneficial uses of the material. This incentive was modeled in part on "buy-recycled" programs providing incentives or price differentials for government purchases of recycled products to support the development of environmentally beneficial production systems. The public sector in Texas appeared to be a largely untapped market for composted products. It was hoped that an incentive program for government purchases from new regional sources of composted manure would not result in a net loss of sales for existing compost producers in the state. The TCEQ's Small Business and Environmental Assistance (SBEA) Division had already developed an active outreach program with TxDOT, a potentially very large compost user, to demonstrate compost products in its erosion control and vegetation practices.

The TCEQ Nonpoint Source team coordinated intensively within the agency and with stakeholders in the design of the CMIP project. Large and diverse groups of stakeholders met to discuss the design throughout 1999 and 2000.

- The TSSWCB and dairy industry participants identified the cost of hauling manure from dairies to compost facilities as a significant barrier to the project. The TSSWCB decided to develop its DMES project to complement the CMIP project with a reimbursement of the manure hauling cost together with outreach and technical support to the dairy industry.

- TxDOT agreed to adopt a target of using 200,000 cubic yards of compost over the course of the project and to establish an accounting mechanism to document its own purchases as well as to commission studies of the performance characteristics of the composted manure.

A public meeting in Stephenville in August of 2000 to announce the project drew state legislators and a standing-room-only crowd. Active interest from members of the Texas legislature led to frequent briefings and consultations over the course of planning and implementing the project. In November, 2000, the project teams from TCEQ and TSSWCB conducted a large workshop to provide orientation, training, and application documents to all parties potentially interested in participating in the project as compost facility operators, as manure haulers, or as source dairies.

With the development of TMDL allocation plans for the North Bosque in 2001, dairy producers in these watersheds became more aware of the need to supplement their existing manure management practices or to adopt alternatives that mitigate the pollution problems.

The CMIP provided intensive technical and marketing support for the participating compost operations and financial incentives for their customers, together with technical support for compost purchasers, which fostered the emergence of a new regional dairy manure composting industry. The DMES provided refunds to support the hauling of manure from dairies to the composting facilities. Under the umbrella of these projects, the agencies and their partners conducted dozens of market development, field research and demonstration, and documentation activities to engender, sustain, and record the activities and outcomes of this market-based approach to water quality restoration. Project final reports prepared by Texas Cooperative Extension, the TxDOT, and other project participants present a large part of the work and results of the CMIP project effort. This overall CMIP project report will simply summarize these partner activities and results as part of the overall project effort and reference them through attachments and links.

Final CMIP program close-out included site visits and “exit” interviews with the participating compost facility operators and with a sample of the compost rebate users, completed in summer 2007. DMES continued the manure hauling reimbursement until February 2007. Water quality monitoring to assess the effectiveness of the project in reducing phosphorus and bacterial loadings in both rivers will continue through the Watershed Protection Planning and TMDL implementation work in both watersheds and through other ongoing monitoring programs.

PROJECT GOALS, DELIVERABLES, AND ACTIVITIES

The goals of this project were

- To create a purchase rebate program to facilitate the composting and export of dairy manure from the North Bosque and Leon River watersheds,
- To provide quality assurance and technical assistance to ensure production of quality compost and to promote its beneficial use by state and local agencies, and
- To document the export and use of the composted manure and the environmental outcomes of this activity.

The tasks of the CMIP were distributed primarily among four Texas agencies through closely integrated partnerships: the TCEQ, TCE, the TxDOT, and the Brazos River Authority (BRA). The TCEQ organized and administered the rebate program, provided recruitment, guidance, and oversight for the new compost facilities, and administered the project through interagency agreements. TCE provided marketing and technical assistance to the compost facilities and outreach and technical support to potential users of the compost in coordination with the SBEA department of TCEQ. TxDOT, by far the largest public-sector market for the composted manure produced under this project, administered a rebate documentation program for its own procurement of compost from these watersheds, conducted internal education and demonstration programs regarding the use of the composted manure, and commissioned field and laboratory trials to verify and document the performance characteristics of the composted manure under its own specifications. The BRA conducted studies of the water quality outcomes of the transfer of manure away from local land application in the affected watersheds.

This CMIP project was also integrally connected to a sister grant project, the DMES project as described in the Introduction.

The TCEQ and the TSSWCB drew on federal funding assistance from Section 319(h) of the Clean Water Act to implement the both the CMIP and DMES programs. The TCEQ received an initial $3.9 million in September 2000 and since that time received additional Section 319 funding to bring the total to $6 million. The required 40% state match for the federal funds came from contracted partners and rebate recipients. No CMIP funds were used for TCEQ administrative overhead or staffing. The table below shows the level of CMIP funding by major activity and project participant.

Table 1: CMIP Funding of Major Activities

Activity	TCEQ	TxDOT	TCE	BRA	TOTAL
Purchase Incentives	**$424,140**	**$1,666,667**	**----**	**----**	**$1,709,017**
Water Quality Monitoring	**----**	**-----**	**----**	**$262,940**	**$262,940**
Technical Assistance, Outreach, Research, and Administration	**$148,848**	**$1,879,163**	**$1,259,034**	**----**	**3,287,045**
TOTAL	**$572,988**	**$3,545,830**	**$1,259,034**	**$262,940**	**$5,640,791**

In addition to the federal funds, $25,000 of General Revenue was used for research and technical assistance by the TCE to develop the Fort Hood military compost market. During the 79th Texas Legislative Regular Session, special state appropriations of $98,853 were awarded to TCEQ to enable the agency to expand its compost marketing efforts during FY 2006. These funds were used as match to other 319 grants to work with the quarry and mining industry as potential new markets for dairy manure compost.

PLANNED AND ACTUAL DELIVERABLES AND COMPLETION DATES

The CMIP consists of several sub-projects under three separate grants. Over the course of the project, several activities were revised and/or extended for one to two years beyond their original time frame. The grants originally anticipated completion of project activities by August 2005.

The following table provides the consolidated grant deliverables and their actual completion dates

Table 2: CMIP Grant Deliverables by Original Lead Agency and Actual Completion Date

Deliverables by Lead Agency as Assigned	Disposition and Completion Date if Applicable
TCEQ	
Establishment of a Compost Project Advisory Work Group	Coordination group of project participants held several meetings from 1999 through 2005.
Executed Interagency Agreements with TxDOT and GSC	Agreement with TxDOT executed in 2000. Tasks originally intended for GSC were assumed by TCEQ NPS program.
Executed Technical Consultant Agreement	Agreement with TCE executed in July 2002.
Semi-annual GRTS Progress Reports to EPA	Reports for this project submitted through 2006.
Compost database tracking system	Database originally constructed at TCEQ in 2001 and populated with new data through August 2006.
Documentation from TxDOT and GSC for compost purchases and uses	TxDOT and internal rebate documentation gathered beginning in 2001 and continuing through August 2006.
TCE	
Executed contract with Technical Assistance Contractor	TCE executed a contract with Ron Alexander Associates in early 2003.
Development of composting web site	Web site launched in November 2002. Material added as appropriate through 2006; still active in August 2007.
Reports and materials documenting the following:	
• Recent composted manure uses in government agencies in Texas - types and amounts • Potential uses in selected agencies - types and potential improvement • A prioritized list of such potential uses, in order of probable cost-effectiveness, that have the following characteristics: new uses (not established markets) - non-competition with existing composters; large volume and/or stable long-term uses; high environmental benefit/low potential for nutrient pollution in use	These elements were addressed in the Compost Use and Marketing Survey, completed May, 2003.
• Documentation of the cost of roadside management and other landscape practices before and after implementation of compost; develop cost/benefit evaluation	Roadside management practices were not examined separately; TCE developed a fact sheet on "Economics of Using Composted Dairy Manure," addressing its value as an alternate source of nutrients, accepted April 2006.
• Documentation of vegetation cover, erosion abatement and possibly other direct land management effects of compost use	The last practice verification study was completed in September 2006. All but one had been completed by 2005.
• Case studies of compost use projects and their results.	Case studies submitted as available between May 2005 and January 2006.

Deliverables by Lead Agency as Assigned	Disposition and Completion Date if Applicable
• BMPs and specifications for particular targeted compost uses. BMPs will include recommended blending ratios to establish both native and turf grass establishment. • Compost application guidebooks suitable for agency and contractor landscape managers	Practice verification studies and fact sheets, submitted in final form (with one exception) by spring 2006, provide data and guidance on various uses of composted dairy manure, but not as formal BMPs, specifications, or guidebooks.
• Documentation of government agency specification and utilization arrangements in a form that will assist compost ventures in securing necessary financing	TCEQ provided TxDOT specifications and presentation materials on the TxDOT purchasing process and targets for this project in 2000. This information proved not to be
• Training of local and state purchasers on compost products and how to procure via GSC	GSC/TBPC never established a sales system for CMIP. The one composting firm operating as a set-aside vendor with TIBH Industries received that agency's assistance in outreach to GSC/TBPC purchasers.
• Training of primary highway construction contractors about compost use methods and incentives of highway/roadside projects (working with the Assn. Of General Contractors)	TCE and RAA provided individual consultation with contractors and TxDOT inspectors regarding compost use methods and performance characteristics between 2003 and 2005.
• Performance of pre-application site assessments for compost use projects including soil tests	This activity was not incorporated in the TCE scope of work and was not required under the rebate program.
• Development of site specific compost use plans and designs in several difference applications which will involve experiment design including control areas, baseline data gathering, and storm water monitoring • Supervision and monitoring of several of the compost applications, including all the experimentally designed applications	The practice verification studies served this purpose, completed between May 2006 and January 2007.
• Provision of on-site technical assistance and trouble shooting for compost users.	Provided between 2003 and 2005.
• A Summary Report of technical assistance activities that will be incorporated into a final report for the overall compost incentive project.	This summary of technical assistance activities is incorporated in the TCE final report under the "Results by Topic" section, as submitted in spring 2006.
Compost reporting and tracking forms	Prepared in 2000 and revised as needed by TCEQ, not TCE.
Final Report	Accepted by TCEQ in final form in January 2007.
	TXDOT
Compost Delivery Documents which identify the cubic yards of compost purchased/ used and location where compost was delivered and/or applied.	Copies of TxDOT compost delivery records and forms were maintained at TxDOT offices and tabulated for reporting to TCEQ.
Spreadsheet which rolls up the total amount of incentive payments for each eligible Area or	Spreadsheets were provided to TCEQ documenting the amount of compost specified and utilized by Districts Offices

Deliverables by Lead Agency as Assigned	Disposition and Completion Date if Applicable
District Office	including the associated project costs and incentive payments.
Collection of documentation and invoices for other allowable expenditures as incurred by each eligible Area or District Office.	TxDOT submitted invoices to TCEQ documenting expenses on an annual basis.
Copies of specification and documentation of technical assistance activities.	TxDOT compost specifications can be found at **http://www.dot.state.tx.us/business/specs.htm** using the appropriate specification number: 1058 - "Compost"; 1059 - Compost/Mulch Filter Berms" *(There may be others.)*
Documentation and examples of promotion and education initiatives, by target audience.	TxDOT staff made presentations at multiple conferences, workshops and demonstrations and partnered with several universities to sponsor research promoting the beneficial use of compost in highway construction and maintenance applications.
Final Report	Spreadsheets were provided to TCEQ documenting the amount of compost specified and utilized by Districts Offices including the associated project costs and incentive payments.
The final three tasks below were originally assigned to TxDOT but were ultimately completed by TCEQ.	
• Compost delivery forms which identify the amount of the cubic yards of compost purchased, transported, and locations where the compost was delivered and/or applied for each quarter.	Monthly sales records were provided to TCEQ by participating composters between January 2001 and August 2006. These records identified the purchaser, the amount of CY sold, the percentage of manure, the date of transaction, delivery location and invoice number.
• Spreadsheet or database report which quantifies the amount of incentive payments for each state agency of political subdivision for each quarter	TCEQ compiled a spreadsheet quantifying the amount of rebates paid based on applications submitted by eligible purchasers.
• Documentation and invoices for all hauling, transportation, and application costs as incurred by state agencies and/or political subdivisions for each quarter.	Participating agencies/purchasers submitted rebate applications documenting the amount of cubic yards purchased, including the associated costs of transportation and application.
General Services Commission (Renamed Texas Facilities Commission)	
Final Report	No state agency purchase tracking system was established; all rebates were issued and documented by TCEQ with help from TxDOT in tracking and documenting its own rebates
Brazos River Authority (BRA)	
• Develop a watershed monitoring strategy to evaluate local and regional effects on water quality in response to manure haul-out and composting activities.	The Brazos River Authority, in collaboration with TCEQ, TIAER, and others, developed a monitoring strategy using a subwatershed evaluation. The project QAPP detailing the objectives, field locations, parameters, laboratory procedures and analytical methods was submitted to and approved by EPA in May 2003.

Deliverables by Lead Agency as Assigned	Disposition and Completion Date if Applicable
• Collect appropriate water quality information at the sub- and microwatershed level to document current and potential changes to water quality conditions.	Water quality data was collected between June 2003 and August 2005. Storm water and ambient data was collected at the confluence of microwatersheds and subwatersheds with significant CMIP manure haul-out activities and watersheds with limited or no manure haul-out activities.
• Develop an extensive land use inventory of activities in the study area for inclusion into a geographic information system as a water management tool, attempting to identify areas with active best management practices.	The BRA, working with the Texas Institute of Applied Environmental Research (TIAER) inventoried and mapped watershed characteristics into GIS layers. This information included watershed boundaries, waste application fields, compost facilities, dairies participating in the manure hauling program (identified by TSSWCB) and other land treatment activities.
• Evaluation and reporting.	Because of the two year timeframe for data collection in this project, and the limitations of the data, no linear correlation could be drawn between the Composted Manure Incentive Program and improvements in water quality. However, this dataset, in combination with other datasets collected and analyzed by TIAER, was utilized to evaluate trends in water quality in the North Bosque (See Semiannual Water Quality Report for the North Bosque River Watershed,)

EVALUATION OF GOAL ACHIEVEMENT

The goals of this project were

- To create a purchase rebate program to facilitate the composting and export of dairy manure from the North Bosque and Leon River watersheds,
- To provide quality assurance and technical assistance to ensure production of quality compost and to promote its beneficial use by state and local agencies, and
- To document the export and use of the composted manure and the environmental outcomes of this activity.

The project evaluated the achievement of its goals in terms of the measured removal of composted manure from the watersheds, preliminary results of BMP effectiveness monitoring at the subwatershed level, verifications studies of the agronomic and water quality results of trial uses of composted manure, site visits and interviews with a sample of compost rebate users, and several other programmatic monitoring activities. A later section of this report addresses these programmatic and water quality monitoring efforts in greater detail. The following summarizes the results.

The project established and operated a rebate program for purchases of composted manure from the North Bosque and Leon River watersheds from November 1, 2000 through August 31, 2006. In that period of time, the participating facilities exported 466,468 tons of manure from the North

Bosque and Leon River combined watershed area as compost. The 329,000 tons exported from the North Bosque River watershed substantially met the TMDL target of removing approximately 50% of the collectable manure from the watershed through compost exports. The exports met the 50% target in fiscal years 2003, 2004, and 2006, with a slight shortfall in 2005. The target was adjusted each year with the annual estimate of dairy cattle in the watershed. One year after the end of the rebate program, the five compost facilities that were active through the last years of the project were still in business and exporting large amounts of composted manure despite a very long run of wet weather that had almost halted compost production activities in some of their yards for many weeks.

The rebate program and the compost facility reporting system provided solid documentation of compost deliveries for which rebates were requested, and TCEQ fiscal monitoring of sales records at compost facilities during the project verified the general accuracy of the reporting of overall sales including those not involving rebates. Efforts to estimate a mass balance of manure inputs and outputs through the compost facilities, including the compost and manure tracking systems and inventorying at compost sites, involved too many uncertainties to allow precise verification but generally confirmed the integrity of the system. Preliminary results of water quality monitoring indicate locally significant reductions in phosphorus loading in dairy areas participating in the program.

The project delivered a significant amount of technical assistance and training to participating firms in all aspects of compost facility operation, quality control, and marketing through site visits, workshops, and individual consultations. In addition, the project delivered educational and market development outreach throughout the regional market area on behalf of the participating firms, as well as ongoing problem-solving assistance in delivery and sales matters between the firms and TxDOT and its contractors.

After mixed results in the beginning, the overall quality of compost products and site management improved significantly over the course of the project. TxDOT provided a critical and very large market for the facilities over the project period and continued to do so in the post-project period. The development of other public-sector compost markets was much less successful, but the remaining compost facilities have established other valuable market niches and customer bases that maintain a strong flow of composted manure from the watersheds long after the project incentives were discontinued.

The BRA and the Texas Institute for Advanced Environmental Research (TIAER) conducted monitoring and data analysis to check the effectiveness of the manure removal from the North Bosque River watershed. One study concluded that in three sub-watersheds where the participation in manure haul-out to composting facilities was most active, the concentration of soluble reactive phosphorus was reduced by between 19% and 23%. The project removed a total of over 2 million pounds of phosphorus from the watershed through the export of composted manure. TIAER used the TMDL model for phosphorus loading from manure land application in the watershed to estimate that this removal of manure through composting reduced the loading of phosphorus to runoff by 55,950 pounds over the project period. The model also indicated that the annual reduction in phosphorus loading would increase substantially over the next 10 years if the

manure export initiated by the CMIP continues at a constant rate, as the soil phosphorus content would continue to decline toward agronomic levels.

After receiving inconclusive results from the TCE studies of water quality benefits of the uses to which the composted manure was put, TCEQ commissioned a separate field study of erosion control compost using CMIP composted manure in reclamation of a rock quarry. On the basis of the first full year of sampling the runoff from experimental plots, the study found that the composted manure treatments reduced suspended sediment loading by 98% to 99% and also reduced total phosphorus and total nitrogen loadings. TxDOT's use of 7,169 cubic yards of CMIP erosion control compost, then, resulted in a first-year reduction of more than 5 million pounds of suspended sediment from road construction sites over the course of the project. This is one initial benefit derived from only 3% of the composted manure used by TxDOT alone.

COORDINATION EFFORTS

This project required an extensive coordination effort within TCEQ, with the participating compost facilities and agencies, and with various stakeholders. In 1999 and 2000, the TCEQ NPS staff conducted several interagency consultations on project design at TCEQ and between TCEQ and TSSWCB, as well as consultations with a broad range of stakeholders. Extensive coordination was required to work out the mutually dependent requirements of each agency for dairies and for composting and hauling operations to participate in the project. At the kick-off of the project from August through November 2000, TCEQ and TSSWCB project leads organized joint public announcement events and orientation training events for prospective project participants. As the project developed contracts with the principal performing agencies TxDOT, TCE, and BRA, project leads at TCEQ and TSSWCB organized occasional coordination meetings with these agencies to discuss progress and challenges to be addressed. A very significant interdepartmental coordination effort within TCEQ from 2000 through 2002 was required to address the project's need for a new no-discharge general permit for wastewater from manure composting facilities, which also involved a broad stakeholder and public involvement component, and for technical review and approval of participating compost facilities prior to issuance of the general permit.

TCEQ worked intensively with TxDOT over the early project period to develop a workable system for identifying and internally tracking contractor purchases of qualifying composted manure for TxDOT projects which would be compatible with TCEQ fiscal monitoring needs. At the same time the agencies coordinated to develop a very extensive demonstration program, involving a staff training team representing both agencies, to familiarize TxDOT district and area offices with the composted manure and the various applications in which it could be used.

TCEQ consulted closely with TSSWCB and project stakeholders regarding the design of study through which the Brazos River Authority and, later, TIAER would study the effectiveness of the manure removal effort in improving water quality in the North Bosque River watershed. Concerns for preserving confidentiality and limiting regulatory exposure for participating dairies in the course of these studies led to an approach providing site-specific land use and manure

hauling information to TIAER for analytical purposes without subjecting them as public record through reporting to TCEQ.

BEST MANAGEMENT PRACTICES DEVELOPED AND IMPLEMENTED

1. COMPOST FACILITY RECRUITMENT, PARTICIPATION, AND OVERSIGHT

The implementation of this project depended on the recruitment and support of several compost facilities for converting and exporting manure from the North Bosque and Leon River watersheds. The project provided no direct financial assistance to the private compost firms that participated. The only direct benefits they received were the opportunity to receive deliveries of manure without charge and to offer public-sector customers a rebate (initially $5 per cubic yard) for purchases of their compost. However, the project dedicated considerable effort to the development of programmatic controls and guidance for facilities participating in the project.

The CMIP participation requirements placed a 10% limit on the use of feed-stocks other than manure in order to simplify the tracking of manure. The use of large or varying amounts of "bulking materials" blended with the manure would introduce difficulties in calculating the exact manure content of a cubic yard of the finished compost, particularly since manure and other feed-stocks are reduced in volume at different rates during the composting process. In choosing this policy restricting bulking materials, TCEQ NPS staff used the example of large manure composting operations at feedlots in the panhandle and high plains of Texas which were successfully marketing manure composted without any bulking materials. This contributed to difficulties for the CMIP facilities in meeting minimum organic matter content specifications, particularly for TxDOT sales after 2002, leading to a revision of the CMIP participation rules, as discussed further below in the section on technical and marketing assistance.

- Development of guidelines and application process for compost facility participation
- General Permit for Manure Compost Facilities
- Facility monitoring, temporary suspensions of approval status

Five composting facilities were participating in the project as of August 31, 2006, the last day of the CMIP, and all of these were still operating a year later. All were prohibited from discharging wastewater under any circumstances. Three of the facilities operated under the TCEQ general permit for manure composting, under which compost facilities may use their wastewater for irrigation under restrictions that assure no runoff of wastewater and no accumulation of nutrients in the irrigated soil. The remaining facilities were prohibited from using wastewater for irrigation or releasing wastewater in any manner under any circumstances.

2. FINANCIAL INCENTIVES, ACTIVITY TRACKING, AND FISCAL MONITORING

Federal CWA Section 319(h) grant funds were set aside under the CMIP to be used as incentive

payments to State agencies, political subdivisions and other eligible entities for purchasing compost originating from the North Bosque and Leon River watersheds. The rebate program was a key component of the project's strategy to build a sustainable market for composted dairy manure outside of the impacted watersheds. Between FY 02 and FY 05, the TCEQ disbursed a $5 per cubic yard incentive payment under the CMIP. Beginning September 1, 2005, the rebate was reduced to $4/CY to phase out the federal subsidy. Three incentive programs with different target markets were developed and implemented as part of the CMIP:

1. The TCEQ Rebate Program for TxDOT

TCEQ entered into a contract with TxDOT to allow for advance payment of compost use rebates which were documented internally by TxDOT and reported to TCEQ on a quarterly basis. TCEQ provided templates of tracking forms which TxDOT modified for consistency with its accounting system. Over the three years of this rebate contract, TxDOT documented the use of more than 200,000 cubic yards of qualifying CMIP composted manure in roadway projects. In order to direct TxDOT's compost use to areas near enough to the source watersheds to make long-term use viable, this rebate agreement limited rebates to uses of compost within the TxDOT districts closest to the watersheds: Abilene, Austin, Brownwood, Dallas, Fort Worth, San Angelo, Waco, and Wichita Falls.

During the term of this contract, some of the TxDOT Regional and Area Offices issued internal memos directing that compost be specified in the roadside re-vegetation portion of all construction contracts. In the years following the end of the rebate program, TxDOT compost use continued to increase across the state. Composted manure use, however, declined in the last years of the project as TxDOT's revised compost testing requirements indicated most of the participating facilities failed to meet the minimum organic matter content requirement and occasionally one of the other specifications for compost. Nevertheless, TxDOT use of composted manure has continued on a more limited basis, and has represented an important foundation for the development of markets for this material.

2. The TCEQ Rebate Program for Other Governmental Purchasers

Eligibility for the TCEQ rebate program was open to all agencies and political subdivisions of the State of Texas (other than TxDOT), including cities, counties, regional planning agencies, special districts, school districts, and universities. Purchasers were required to buy compost from a recognized vendor authorized by the TCEQ. In order to receive the rebate, each participating governmental entity submitted a rebate application form developed by TCEQ. Along with the application, purchasers were required to submit documentation identifying the amount of cubic yards purchased and the associated costs of transportation and application. This information was used by TCEQ to: (1) substantiate the incentive payments, (2) verify that the compost was purchased, and (3) provide the 40% matching costs required by the 319(h) grant program. Upon review and approval of the documentation, the TCEQ issued a rebate back to the purchaser.

Rebate applicants under the TCEQ program included seven municipalities, five independent school districts, one Council of Government, one county, three educational institutions and one

state agency. Primary uses cited by purchasers were top dressing for athletic fields, parks, golf courses and general landscaping.

3. The Upper Leon Soil and Water Conservation District Rebate program

The Upper Leon Soil and Water Conservation District (ULSWCD) Rebate Program was initiated in 2004 by the TCE and Texas Water Resources Institute (TWRI) in cooperation with the TSSWCB for the purpose of establishing a market for diary manure compost to private landowners and agricultural producers outside the Bosque watershed. The ULSWCD was utilized as the eligible public entity in order to access the CMIP incentive funds.

Under the ULSWCD guidelines, the buyer contacted a participating compost facility to arrange purchase, delivery and application of compost at a discounted price. Eligible purchasers were limited to 4,000 cubic yards. The buyer then worked with the District to complete the required paperwork and pay for the material (See Attachment B5). Upon receipt of an approved application from the District, the TCEQ issued an incentive payment directly to the ULSWCD who retained $1 for administrative purposes. The payment made by the end user, along with the balance of the TCEQ rebate, was returned to the designated compost facility by the District.

In addition to the necessary forms, each agricultural producer was required to develop a "Nutrient Management Plan" with assistance from the ULSWCD. Requirement of the plan was intended to encourage the producer to work directly with their County Extension Agent on proper compost application. Permitted Concentrated Animal Feeding Operations (CAFOs) and Animal Feeding Operations (AFOs) were not eligible for the rebate.

In August 2005, the ULSWCD program was expanded to allow landscapers, retail distributors and other large compost consumers located outside the North Bosque watershed to participate in the program. Over fifty different entities representing nurseries, landscapers, commercial bagging operations and agricultural producers participated in the program. Retail distribution accounted for the largest volumetric use of composted manure.

The TCEQ compiled and tabulated the level of rebate activity under each program. The table below shows the federal dollars reimbursed under each incentive program.

Table 3: CMIP Rebate Activity by Program and Year

	TCEQ	ULSWCD	TOTAL
FY 02	$12,070	$0	$12,070
FY 03	$24,730	$0	$24,730
FY 04	$17,885	$0	$17,885
FY 05	$9,885	$4,934	$14,819
FY 06	$9,806	$175,254	$185,060
TOTAL	$74,376	$180,188	$254,565

Despite the reduced incentive, the rebate program recorded its most successful year in FY 2006. The increase can be attributed to the expansion of the SWCD program to commercial

purchasers. Several customers made multiple purchases during the project period to take advantage of the incentive program. Many first time users were introduced to the benefits of dairy manure compost as a result of both incentive programs.

In 2005, the seven eligible districts reached TxDOT's original goal to use 200,000 cubic yards of dairy compost. In FY 06, TxDOT continued to distribute incentive reimbursement payments to its participating districts but at the new rate of $4 per cubic yard.

3. TECHNICAL, EDUCATION, AND MARKETING ASSISTANCE

The TCEQ entered into a contract with TCE, subsequently renamed Texas AgriLife Extension, to provide technical and marketing support for the composting effort, including practice verification studies, compost operation training, and product testing. The TCE project, under the title of Dairy Compost Utilization Program, generated a final report in 2006 which is posted at http://compost.tamu.edu/final_report.php.

Following is a brief outline of the tasks of this project.

- Compost Education and Marketing Plan

- Dairy compost production and producer education

- Compost facility site visit report. (conducted review of production practices, record keeping and marketing plan for each facility and provided follow up report with recommended actions)
- Status of dairy manure compost facilities participation in the U.S. Composting Council's Seal of Testing Assurance (STA) Program.
- Assistance for marketing efforts provided to each compost facility.
- Developed a 'Compost Sampling Guideline' for facilities to utilize in sample collection for the STA Program.
- Provided a workshop for compost producers in proper compost production practices.

- Assisted producers in improving quality of material, specifically meeting TxDOT specifications or coordinating with TxDOT to alter specification limits.
- Conducted a survey of potential organic materials available within economic distance to mix with compost material to improve organic matter and lower pH.
- Dairy compost market research and development

- Dairy Compost Use and Production Survey Results report. (conducted survey of compost users and producers in 17 county area to estimate compost use and production)
- Provided a workshop for compost producers to develop marketing strategies.

- Provided a workshop for County Extension Personnel on the use of dairy manure compost and its potential application within each county.
- Soil and Water Conservation District Rebate Program for private producers.
- Assisted public entities in utilization of CMIP.
- 'Incentives to Purchase Dairy Compost' fact sheet outlining the logistics of both incentive programs for dairy manure compost.
- Conducted municipal sales calls to gauge current compost use and future interest. Provided compost use educational material to all parties and submitted potential customer lists to compost facilities.

- Education efforts and material development

    - Attended trade shows and conventions to publicize project and dairy compost use
    - Attended and presented information at various compost use demonstrations and workshops hosted by compost facilities and public entities.
    - An article series developed for the Texas Nursery and Landscape Association monthly magazine.
    - News releases regarding use of dairy manure compost, incentive programs and availability of dairy manure compost were completed and distributed for publication in project region.

Research, Demonstration, and Technology Transfer

- Research, Demonstration and Design Plan (RDDP) including summarized results for each of the following field studies.

    1. Use of dairy manure compost to establish newly constructed landscapes
    2. Utilization of dairy manure compost as a flowerbed amendment under established oak trees
    3. Use of dairy manure compost on coastal bermudagrass (a rate study)
    4. Use of dairy manure compost on coastal bermudagrass (a timing study)
    5. Use of dairy manure compost on irrigated corn silage
    6. Use of dairy manure compost to establish Jose Tall Wheatgrass
    7. Soil and water quality evaluations following various rates and timings of compost applications.

- County-level demonstrations including summarized results or photo documentation (when available). Counties to be included are:

    1. Comanche County – use of dairy compost as topdress material on Comanche Post Office lawn
    2. Erath County – use of dairy compost as nursery potting media & use of dairy compost as topdress material on city soccer fields.
    3. Somervell County – use of dairy compost as topdress material on city ball fields

4. Tarrant County – use of dairy compost as topdress on lawn and as flowerbed media at Hurst Courthouse
5. Coryell County – use of dairy compost as topdress material on courthouse lawn in Gatesville
6. Palo Pinto County – use of dairy compost as topdress material on Santo ISD football field
7. Stephens County – use of dairy compost as topdress material on Breckenridge ISD practice football field
8. Bell County – demonstration to be conducted in 2005
9. McLennan County – demonstration to be conducted in 2005
10. Bosque County – demonstration to be conducted in 2005

- Project related fact sheets including the following.

  1. Marketing of Dairy Compost Brochure
  2. Using Compost for Erosion Control and Revegetation
  3. Using Organic Matter to Improve Sports Fields
  4. Using Compost in the Urban Environment

- Dairy Compost Utilization Website (overview of content including the following links and use statistics).

  1. Project Overview – tasks, deliverables, reports, etc.
  2. Compost Producers – compost producers, analysis of material and standards
  3. Compost Use Resources –dairy compost use information and copies of all project related presentations
  4. Photo Gallery – collection of photos from all demonstrations, dairies, facilities and other performing agencies
  5. Publications – all project related publications
  6. Research and Demos – overview, update and results of all project related field studies and use demonstrations

- Coordination and development of dairy compost application for the restoration of Fort Hood Military Training Area.
- Coordination with project personnel in the application of dairy compost for restoration along the Leon River.

TxDOT Outreach and Specifications for Compost

TxDOT created a special specification, effective in the fall of 2000, just for compost produced by the CMIP facilities. This specification helped promote and track compost sales involving CMIP facilities. In November 2002, TxDOT amended all of its compost specifications, among other things, to reduce the minimum organic matter content from 30% to 25% and to require

testing under the "Test Methods for the Examination of Composting and Compost" (TMECC) of the United States Composting Council. Ironically, the compost facilities participating in CMIP, which had been consistently meeting the 25% organic matter content requirement under the old testing requirements, consistently failed the newer, more lenient standard for organic matter and often exceeded the pH limit at the TMECC-certified laboratories. CMIP producer sales to TxDOT began to drop sharply. TCEQ NPS staff began intensive negotiations with TxDOT to identify a resolution to the specification issue, and changed the scope of the TCE contract to address this issue primarily through trials to determine effective means of increasing the organic matter content of the compost. In 2004, in the wake of the almost complete failure of the CMIP compost products to meet new specifications under the new testing regime, TxDOT adopted temporary Special Specification 1081 to provide special exceptions for manure compost – a lower minimum organic matter content (10% rather than 25%) and a higher maximum pH (9.5 rather than 8.5), which could be used at the discretion of the TxDOT Area Offices. TCE and TCEQ worked with these offices to encourage their use of the special specification for applications in which the manure compost had been used to good effect thus far in the project. The special specification drew mixed reactions from the compost facilities, two of which had succeeded in meeting the new testing standards partly through acquiring and adding feed-stocks high in organic matter.

Outreach by the TCEQ Small Business and Environmental Assistance Division

Compost market development activities were undertaken by staff of the TCEQ SBEA Division to benefit compost producers statewide with a specific emphasis during the CMIP project on those in the Leon & North Bosque River watersheds. Work began with the largest potential compost consumer, the TxDOT, and expanded into industries having similar construction and maintenance activities.

In order to achieve results with TxDOT, it was necessary to gain and secure the confidence of their staff that compost and mulch could be an acceptable substitute for the traditional practices or materials currently used. TCEQ staff provided technical and financial support for:

1. research and development on the use of compost and mulch for construction activities
2. development of materials specifications
3. educational opportunities on compost, mulch and application methods
4. technical assistance to TxDOT staff, contractors, and compost producers

The expansion of the SBEA program beyond TxDOT provided outreach to homebuilders, construction engineers, public works officials, code enforcement staff, storm water inspectors, and the mining and quarry industries. The primary focus of these presentations has been the use of compost and mulches for storm water permit compliance and for re-vegetation of eroding areas. A second market development strategy has addressed ongoing maintenance applications for landscape and sports turf. Based on the level of interest indicated following these workshops, the TCEQ SBEA staff, in cooperation with TCE and the Texas Sea Grant program, developed condensed presentations for wider distribution. This effort resulted in three 45-minute presentations on compost use with emphasis on landscape, sports turf and commercial nursery industries.

More details of the TCEQ SBEA outreach effort are provided in Attachment B6.

Outreach by the Central Texas Council of Governments

Using Clean Water Act §604(b) funds from TCEQ, the Central Texas Council of Governments (CTCOG) organized and hosted workshops during fiscal year 2005 in the cities of Temple, San Saba, Gatesville, and Cameron to introduce local government representatives to the CMIP project. TCEQ and TCE project staff presented information on "Making the Most of Composted Dairy Manure" and on the rebate program and CMIP compost firms were present to offer complementary bulk compost to the participants and discuss possible uses for their products.

PROGRAMMATIC MONITORING RESULTS

DOCUMENTATION OF MANURE HAULING

The TSSWCB established and maintained a tracking database for all deliveries of manure hauled from participating dairies to CMIP participating compost facilities and rebated under the DMES program. More than one million tons of manure was hauled to participating compost facilities before the hauling reimbursement program ended. The figure on page 6 provides year-by-year details.

In addition to the manure hauled and rebated under the DMES program, participating compost facilities reported a total of more than 25,000 cubic yards of manure received but not rebated.

CMIP participating compost facilities were required to track all other materials delivered to their facilities for the purpose of mixing with the manure as part of the composting process or to blend with finished compost as part of a blended product, most commonly a TxDOT mulch blend called Erosion Control Compost. The participating facilities recorded a total of 31,000 cubic yards of these feedstock and blend materials.

DOCUMENTATION OF COMPOST PRODUCTION AND DISTRIBUTION

Total compost sales recorded during the CMIP was 575,886 cubic yards; of this compost, 368,568 cubic yards were made from manure hauled from the North Bosque River watershed. Out of this amount sold, more than 329,000 cubic yards was transported outside the Bosque watershed representing an export rate of 89%. The total amount exported from *both* the Bosque and Leon watersheds was 468,336 cubic yards resulting in an overall export rate from the combined watershed area of 81%.

Total compost sales were tabulated by TCEQ based on monthly records submitted by each participating compost facility during the project period. Composters were required to submit forms developed by TCEQ identifying the purchaser, the amount of CY sold, the percentage of manure, date of sale, delivery location and invoice number (See Attachment B1). This information was

inputted into a Paradox database which enabled the data to be sorted by parameter. Governmental purchasers were identified as one of eight categories: TxDOT, Non-TxDOT State, County, City, Educational Institution, Regional Planning District, Special District/Authority and Other. Sales to individuals and non-governmental entities were labeled "Private" to maintain customer confidentiality.

The table below reflects the breakout by purchaser type of all compost sales recorded between January 2001 and August 2006.

Table 4: Compost Sales by Purchaser Type, in Cubic Yards

Purchaser	FY 01	FY 02	FY 03	FY 04	FY 05	FY 06	Total
TxDOT	5,183	19,603	88,234	89,800	54,295	77,638	334,753
Non-TxDOT State	40	313	420	278	-	550	1,601
County	-	30	-	-	-	-	30
City	-	1,924	2,762	762	3,340	3,766	12,554
Other (Fort Hood)	-	-	-	-	-	50	50
Educational/University	-	402	1,972	257	2,386	1,350	6,367
Regional Planning Dist.	-	-	-	180	-		180
Special District/Authority	-	121	570	124	60	-	875
Private	5,072	27,080	10,570	39,668	51,248	85,838	219,476
Total	10,295	49,473	104,528	131,069	111,329	169,192	575,886

As expected, TxDOT was the largest governmental market for compost having purchased 58% of the total diary manure compost produced. Private purchasers, including agricultural producers and commercial operations, accounted for the next largest group of customers followed by municipalities, universities, counties, special districts, and other organizations. The map below illustrates the geographic locations (by county) where North Bosque and Leon composted manure was delivered and applied. Not surprisingly, deliveries were concentrated in the centralized portion of the State where transportation costs were more economical.

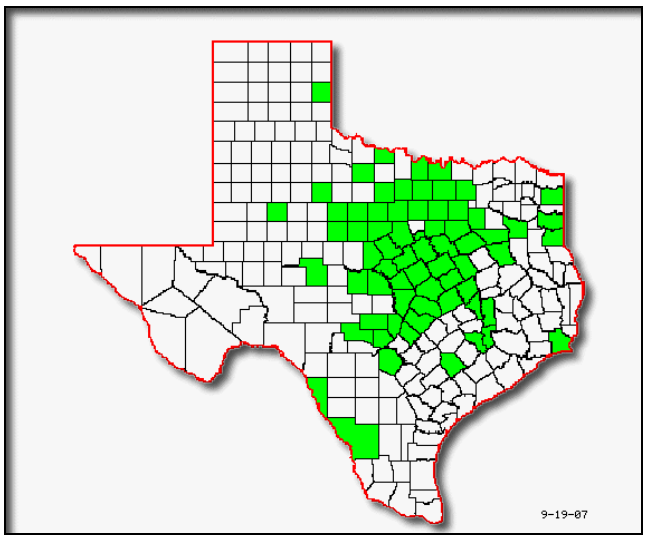


Figure 3: Counties in which TxDOT utilized compost under the CMIP program

COMPOST SITE MATERIALS INVENTORIES AND MASS BALANCE

In May and June 2005, the NPS project manager (PM) for CMIP undertook a "mass balance" check of the manure and compost tracking systems of the CMIP. Due to large uncertainties in some of the factors in the mass balance, the check was inconclusive, but it served to illuminate the difficulties of documenting with precision material flows of hundreds of thousands of tons in such a project.

The PM conducted a volumetric inventory of the manure and composting material at the seven compost sites that were accessible in May and June, 2005. This included all the actively participating sites and two inactive sites, but excluded two sites no longer affiliated with CMIP. The total estimated inventory of material on these sites totaled the equivalent of about 178,000 cubic yards of manure. The details of this inventory appear in Attachment B7.

The remaining two sites (previously participating but closed as of June 2005) held approximately 30,000 cubic yards of stockpiled manure, based on a windshield survey. In round figures, the inventory on all CMIP sites amounted to roughly 210,000 cubic yards of manure and compost.

The total sales of compost reported through May 2005 were 314,800 cubic yards. The total sales through June 2005 were 319,747 cubic yards. Using the rough equivalency of a ton of manure (as delivered) to a cubic yard of composted (or aged) manure, the combined total of compost sales and site inventory accounted for approximately 525,000 to 530,000 tons of manure.

Total reimbursed deliveries of manure to these facilities through May 2005 totaled 873,734 tons, and deliveries through June 2005 totaled 888,146 tons. Two compost facilities reported an additional 25,000 tons of manure delivered to them (total) without the DMES reimbursement during times when the facilities were ineligible for the hauling program. The compost facilities also reported receiving an additional 31,000 cubic yards of "bulking materials" such as wood chips and sawdust, primarily in the latter part of the project, some of which entered the

composting process and some of which was used to make blended products after composting was completed. CMIP compost sales records tracked the compost content of all products sold so as not to count the wood chips or soil used in blended products. The resulting total of approximately 900,000 or more tons of manure and other feedstocks received as of May/June 2005, minus about 530,000 tons accounted for by the inventory and sales documents, leaves about 380,000 tons not accounted for. The following uncertainties might help explain the discrepancy.

- The average equivalency of one ton of manure (as delivered) to one cubic yard of compost (as sold), as used in this mass balance estimate, is dependent on highly variable factors. It is generally based on an assumption of equivalent moisture content between delivered manure and exported compost and a typical amount of loss of mass and volume during the composting process. Much of the manure as delivered had moisture content in excess of 70% as indicated by its free-flowing or saturated condition observed during site visits. In contrast, the compost ready for sale had an average moisture content of about 30% and a bulk density greater than 1700 lb per cubic yard, according to a representative sampling in 2005. A very large loss of moisture content between manure delivery and compost sale would result in a ton of delivered manure yielding much less than a cubic yard of compost having high bulk density and low moisture content. Additional discussion of this equivalency is provided in Attachment B9.
- The rock, clay balls, and other material screened out of the finished compost for sale was not measured or inventoried, but it was significant and may have amounted to 10% or more of the total weight of the manure delivered.
- There was noticeable erosion and runoff of material from compost and manure piles across the compost sites and into the retention ponds particularly after heavy storms.
- In the first five months (November 2000 through March 2001), the DMES program recorded more than 245,000 tons in manure deliveries on a volume reporting basis without inspection or other verification, before the DMES changed to a weight basis requiring weight tickets. These early estimates are likely higher than the actual amount delivered.
- The records of compost sales are also based on estimated volume (the typical practice of the compost industry) and are thus not precise.

There were allegations of some unreported deliveries of material from the compost sites for local land application. This possible unreported diversion of material was not anticipated in the project design because the sale of composted material had been assumed to be the only viable source of income for the compost facilities. The generous hauling reimbursement, especially early in the project, created a tipping fee income to compost facilities simply for receiving the manure, creating an unexpected motivation to divert material even with minimal compensation to make room for more manure deliveries. Because of the above-listed uncertainties and the imprecision of the available measurements of material hauling and inventories, a mass balance verification of the project activities cannot either prove or rule out such diversion. The results of the verification effort do not contradict the project records of manure and compost inputs and outputs to and from the facilities, given the uncertainties, but they leave significant uncertainty about the exact amount and fate of the manure handled under the project.

ESTIMATION OF MANURE AND NUTRIENT EXPORT QUANTITIES

The CMIP required participating compost facilities to maintain complete sales records and to report monthly on total compost sales activity in addition to the rebate reporting system. The reported sales data were entered into a compost and manure tracking database. See Attachments B2 and B3 for the data model and data dictionary for this database system. The on-site sales records were subjected to TCEQ fiscal monitoring site visits and were found to be adequate. The reports provided not only cubic yards of compost for every delivery, but also the destination, including the county and any other location information needed to determine whether it was in the North Bosque or Leon River watershed or outside of both. CMIP facilities were restricted to accepting manure only from dairies identified by the DMES project as being located in one of the two watersheds. Each compost facility received manure from both watersheds and could not track them separately through compost sales. However, the DMES tracking system distinguished the amount of manure coming from each watershed, allowing the CMIP to apply the ratio of manure from each watershed to the total deliveries of compost from the facilities.

TCEQ bases its estimation of phosphorus exports from the watershed exclusively on sales data for compost in cubic yards and on a representative sampling of compost ready for sale at participating compost facilities in 2005. This sampling indicated an average of 4.4 pounds of phosphorus per cubic yard of compost, based on an average P content of 2529 mg/kg and a bulk density of 1745 pounds per cubic yard. See Attachment B10 for details. The total export estimates as of August 2006, then, are 329,000 cubic yards of compost and 1,447,600 pounds of phosphorus from the North Bosque River watershed alone, and 466,468 cubic yards of compost and 2,052,000 pounds of phosphorus from the combined watershed area.

The estimation of tons of manure, and percentage of total manure, exported from the watersheds involves estimates of manure generation rates per cow and the equivalency of tons of manure (as delivered) and cubic yards of compost (as sold). A discussion of these calculations appears in Attachment B9.

COMPOST FACILITY MONITORING

The PM made frequent site visits to the compost facilities throughout the CMIP project. These visits served as opportunities for technical assistance as well as verification of compliance with participation and facility design requirements. On several occasions, these visits resulted in temporary suspension of a facility from eligibility in the CMIP rebate and DMES manure hauling reimbursement pending correction of infractions of the program guidelines. Two fiscal monitoring visits were also conducted at all facilities to assess records kept on sales and material deliveries. TCE also provided compost facility site visits including an initial status and needs survey of the sites in the first year of the project. In June 2007, the PM visited each facility that had participated in the final year and conducted exit interviews with the facility managers. Details of the PM’s exit interviews with each facility operator appear in Attachment B8.

COMPOST USE SITE MONITORING RESULTS

In the spring and summer of 2006, the PM performed site visits and interviews with more than twenty of the sites which received CMIP rebates for manure compost use. The twenty sites were selected from the rebate user database by a stratified random method to be sure the various types of rebate users would be represented. Attachment B12 provides a summary of the uses made of the composted dairy manure at each site visited and the users' comments on the material's performance and their interest in using it further. The users' impressions ranged from negative to enthusiastically positive, with the large majority reporting significant benefits and few if any concerns. The PM's observations of the sites indicated that there were relatively few if any real failures of the compost to have the desired vegetation growth benefits. In several cases, the compost had solved serious horticultural problem spots that had been plaguing the users for some time. In most cases, users cited specific results that provided significant value and satisfaction, most often including the visible greening and thickening of vegetation, reduction in watering requirements, better resistance of turf to wear and dry weather, and better reliability of vegetation establishment from seed. Most of the complaints concerned temporary nuisance issues such as odor or rocks which the contractors subsequently removed. Only one user reported emphatically negative results, and he acknowledged that the compost material he received had unusually poor qualities and was being used in areas with excellent topsoil that typically needed no conditioning. Many of the site hosts reported their intent to continue ordering dairy manure compost despite the end of the rebate program. Several who had discontinued use of the dairy manure compost expressed regret that it was not affordable for routine use, usually due to hauling distance, and that it was superior to products they have used subsequently.

FIELD TRIALS FOR COMPOST USE SITES

Practice verification trials of the use of several horticultural and agricultural compost applications and experimental testing of erosion control compost. Most of these studies only examined the growth and yield response of crops or grasses to compost applications, including corn, forages, and Bermuda hay. These trials are reported in Appendix O of TCE's final report posted at http://compost.tamu.edu/docs/deliverables/final/o.pdf. One study, described in the following section, examined the water quality effects of dairy manure compost in an erosion control application.

SURFACE WATER QUALITY EFFECTS MONITORING AND MODELING

There are several components to the water quality benefits of this project. The factor given the greatest attention, due to a high-priority TMDL project for the North Bosque River and related concerns for Lake Waco, is the reduction in phosphorus loading to and concentrations in the North Bosque River system resulting from the removal of manure from land application within the watershed. Other benefits include reduced loading of other nutrients, bacteria, organic matter (Biological Oxygen Demand), and related pollutants in both the North Bosque and Leon Rivers resulting from manure exports. There are also secondary benefits from the use of the composted manure outside these watersheds in immediate erosion and sediment control and in support of

rapid and durable establishment of protective vegetation cover.

The TIAER conducted some of the studies to evaluate the water quality improvements in the North Bosque, if any, due to the CMIP/DMES projects. One of these studies, reported in 2006, used an analysis of trends in water quality from before the CMIP/DMES effort through 2004. It compared the storm event mean concentrations of nutrients and suspended solids before and after the implementation of the program at seven stream sites representing different levels of participation in the program. It concluded that in the sub-watersheds where the relatively largest amounts of manure were hauled out to composting facilities per cow and per acre of manure application fields, the concentrations of soluble reactive phosphorus (SRP, the constituent relevant to the TMDL) decreased between 19% and 23%. Significant decreases in SRP were not found in the sub-watersheds where there were lower rates of manure removal per cow and per acre, confirming a probable relationship of the change to the removal of manure from the watershed

These stream segments with the greatest water quality improvement have particularly high percentages of land designated as waste application fields, with one watershed having 30% and the other two with over 50% of the land area used for manure application. Additionally, these sub-watersheds were among the four with the highest concentrations of cattle in residence.

An additional report by TIAER, completed in June 2007, found continuing downward trends in nutrient concentrations and particularly of phosphate-phosphorus widely throughout the North Bosque River watershed. There were particular reductions in chlorophyll A, ammonia, nitrates and total suspended solids in Greens Creek and Neils Creek tributaries, and a small reservoir on Scarborough Creek. Sites on the main stem of the North Bosque also showed significant decreases in the amounts of nutrients, suspended solids, algae, and ammonia. Main stem improvements probably reflect reduced pollutant loads associated with new phosphorus removal capacity at wastewater treatment plants along the river, but the overall improvements were interpreted also to reflect in part the reduced loadings due to the CMIP/DMES.

TIAER also assisted TCEQ NPS staff in estimating the overall reduction in nutrient loading in the North Bosque River watershed as a result of the CMIP/DMES project for the active years of the project and into future years. TIAER used its modeling developed for the North Bosque phosphorus TMDL to simulate the phosphorus load reduction effects of changes in manure land applications resulting from this effort on an edge-of-field basis. Although the project had exported some 466,468 cubic yards of composted manure from the North Bosque watershed by August 31, 2006, removing the equivalent of about 233,000 tons of dairy manure (dry weight basis) along with over 2 million pounds of total phosphorus. This is the total in-field phosphorus load reduction for the project in the North Bosque River watershed. Since much of this phosphorus remains on the field, in the soil, or taken up by crop growth, the reduction in phosphorus loading to rainfall runoff is much less on an annual basis.

The TIAER load reduction analysis, summarized in Attachment B12, estimated an average number of acres removed from manure application each year, applying the average annual manure export rate of the CMIP/DMES program to the average annual per-acre manure

application rate for land application fields. The simulation showed widely varying reductions in phosphorus loading per ton of manure removed from year to year, depending on precipitation patterns and other factors. The total reduction in edge-of-field phosphorus releases was estimated to be 55,950 pounds for the six-year period analyzed, or only 2.04 pounds per year for each acre removed from manure application, in contrast to the 89 pounds of phosphorus effectively removed from each acre each year by sparing it the application of 8.6 dry tons of manure. The simulated per-acre load reduction resulting from the suspension of manure applications tends to increase each year that the fields are spared manure applications, as the phosphorus concentrations in the soil fall back to the agronomic level required by the crops.

The above analysis addresses only the benefits of reducing the loading of phosphorus to the North Bosque River and its tributaries. Additional benefits included reduction of runoff volume and sediment loading in the areas where the compost was used.

The TCEQ NPS program initiated a scientific study of the effects of using "erosion control compost" (ECC), as defined and specified by TxDOT, on the loading of suspended sediment and nutrients in land reclamation and stabilization, one of the lesser but significant uses of the CMIP composted manure. The first year of data from this study indicated that erosion control compost reduced loading of suspended sediment to storm water, in comparison to standard fertilization and seeding practices, by 98% to 99%, or over 100,000 pounds per acre. It also reduced total phosphorus loadings by 70% to 80% and nitrogen loadings by a similar amount. Only dissolved phosphorus loadings were increased by the erosion control compost treatment, by about a pound per acre over a year's time. On the basis of these first year data, assuming composted manure applied as part of a 2" layer of erosion control compost (a 50% blend with wood chips), as applied in this study and as typically applied by TxDOT, requires an application of 135 cubic yards of compost per acre. TxDOT used a total of 7,169 cubic yards of composted manure as ECC (less than 3% of the total of more than 277,000 cubic yards of composted manure purchased by TxDOT during the project), enough to cover 53 acres. Therefore, by a conservative estimate, the ECC used by TxDOT reduced the loading of suspended sediment from highway constructions sites by approximately 5 million pounds in the first year after application. This excludes the benefits derived from the other 97% of the compost used by TxDOT alone.

CONCLUSIONS, LESSONS LEARNED, AND PROSPECTS FOR REPLICATION

- *Marketing to governmental entities other than TxDOT*.
    - Compost sales from the North Bosque and Leon watersheds to governmental organizations, other than TxDOT, were disappointing. Total sales to governmental entities eligible for the rebate program other than TxDOT amounted to only 21,657 cubic yards to 26 separate governmental units. In addition, only three of the participating composters took significant advantage of marketing and sales assistance offered by TCE and their compost consultant. Compost sales to private buyers were much more extensive than those to governments. The fact that most units of government contract for, rather than perform, routine landscaping, erosion control, and other services utilizing

compost restricted the market for direct compost sales to public entities. Due to confidentiality protections for the compost facilities in regard to the identity of their markets, TCEQ has limited information about the marketing efforts of the compost facilities themselves and limited access to their private-sector buyers (other than those using the SWCD rebate) to determine their customers' satisfaction and/or concerns with the compost products.

- *Setting appropriate rebate and reimbursement rates to prevent excessive manure stockpiles.*
    - The intent from the beginning of the project was to offer a temporary incentive for potential buyers to try the composted manure, in the hope that this would attract a large enough pool of buyers convinced of the product's value to continue purchasing it after the rebate was discontinued and provide a stable base market. Preliminary market information indicated that the product would likely be affordable, at sustainable pricing, within an 80 to 150 mile radius of the project area. The project did not intend to create a permanent subsidy for this industry.

      The initial rebate to compost purchasers of $5 per cubic yard (reduced in the last year to $4 as a transition to phasing it out) was chosen to give a reasonable incentive linked to the amount purchased, but covering only about half of the compost value excluding transportation. Over the project period the price (before rebate) for a cubic yard of 100% composted manure from participating facilities ranged from $5 to over $15 (excluding delivery costs), most commonly in the range of $8 to $13. The selected rebate rate served the purpose of providing a bargain without distorting the price signal excessively. Some stakeholders urged that the rebate be designed to cover the cost of hauling, which they saw as the primary barrier to exporting the product from the watersheds. The TCEQ offered a flat rebate per volume purchased, and restricted the geographic range of the TxDOT rebate outreach program, in order to focus on the areas most likely to be long-term markets for the regional product, where the full price of the delivered product would be competitive after the end of the project. This approach appears to have been vindicated. The post- survey of rebate users indicated that almost all continuing public sector purchases of bulk composted manure are within a 150 mile radius of the watershed region, and the most common reason for discontinuing its use was hauling cost and the availability of closer sources of compost. Given the very limited use of the rebate by governmental units other than TxDOT, it is possible that a higher rebate might have increased sales activity.

      It appears the manure hauling reimbursement rate was initially set well above the typical cost of hauling. Evidence of this includes the fact that in the opening months of the project, compost facilities received enormous quantities of manure. Some sites received more than 2000 tons per day in the early weeks. This material was largely formed into huge stockpiles, much of which remained in those piles at the end of the project. These stockpiles constituted a significant management issue throughout the program, occupying large portions of the working space of

the facilities, presenting runoff control issues, and presenting significant challenges to later use due to their tendency to remain saturated with moisture and to lose organic matter and nutrients through long-term decomposition, leaching, and volatile losses. Fortunately, a large portion of the stockpiled material remaining at the end of the project was utilized in subsequent years.

Manure haulers reportedly paid tipping fees of $20 per load to several if not all of the compost facilities to accept their material, which would indicate that the reimbursement rate was at the very least $20 per load above cost. There was much discussion regarding whether to reimburse the hauling on a weight or volume basis. The initial rebate was on a volume basis, with the intent to track the manure quantity more accurately by removing the highly variable moisture content from the equation. It was administered through a Soil and Water Conservation District. Because the district did not have adequate staff to inspect or monitor the hauling, and since the volume hauled cannot be documented at all except by visual inspection, and because complaints of misreporting loads emerged, the TSSWCB revised the reimbursement program within the first few months to a weight basis requiring weight tickets. Over the course of the program, the TSSWCB reduced the reimbursement rate several times in order to gradually "wean" the participants from the incentive, ending with a very low rate. The amount of manure hauled to compost facilities did not significantly drop off with these reductions in reimbursement, as the annual hauling records show.

- *Balancing the application of programmatic controls with non-interference in the management of the independent businesses implementing the composting practices.*
    - This project was designed as a market-based approach to diverting manure to compost, and therefore it avoided placing direct controls on the business practices of participants beyond basic compliance with environmental and record keeping requirements. It provided no direct financial assistance to these businesses and had no financial sanctions available to enforce desired participation practices other than removing a firm from eligibility to participate in the project. Further, Texas composting rules set very limited requirements for the testing and performance of compost products made from manure and most other common compost feed-stocks. Sales of compost incompatible with buyer requirements threatened to damage the sales prospects for producers of more consistent quality compost. With limited staff availability for oversight of and assistance to address quality control of the compost products, this proved to be a significant challenge for market development early in the program. The facilities that continued to the end of the program did, however, according to the final rebate user survey and site visits, demonstrate considerable progress in meeting buyer expectations.

      The limitation of programmatic controls on the participating businesses resulted in further challenges noted in the next two items.

- *Conflicts of interest.*

- The incentive program strictly limited its own interference in the business practices of the participants. This absence of controls resulted in some unforeseen conflicts of interest which may well have undermined the effectiveness of the program.
    - Individuals or firms were allowed to participate simultaneously as composting facilities and as manure haulers.
    - No restrictions were placed on how much manure could be accepted by a compost facility in total or over any given period of time.
    - No restrictions were placed on a compost facility's discretion to refuse manure delivery.

  There were complaints about compost operators arbitrarily refusing delivery by any haulers not affiliated with the compost facility. Compost facilities were allowed to refuse loads due to quality concerns; some claimed that this discretion was abused to exclude deliveries from rival firms where the compost facility also acted as hauler, or worked in close partnership with a hauling firm. The DMES program sought to limit the potential for such abuses by providing reimbursement based on the distance from a dairy to the closest available compost facility rather than to whatever compost facility the hauler preferred, but this did not eliminate selective hauling and did not address the concern about refusal of deliveries for reasons other than quality control.

- *Establishing a monitoring system for water quality results.*
    - The TCEQ limited its requirements for information from participants in order to protect confidentiality and sales relationships as well as regulatory exposure. The resulting lack of information about land use practices limited the ability of the TCEQ to analyze and interpret the results of the project.
        - To protect and reward marketing efforts by the compost firms, TCEQ did not require them to report the identity of private buyers not participating in the rebate. The only information required was the county to which each delivery went in order to distinguish which sales constituted exports from the watersheds. This made the documentation of the fate of the compost products partial at best.
        - To protect participating dairies from potential regulatory consequences, no records were reported by the TSSWCB to the TCEQ giving the identity of the source dairies for each load of manure delivered to qualifying compost facilities. There was likewise no requirement that participating dairies report to TCEQ on historical or current manure applications on their application fields or the destination of manure released to third parties. The resulting lack of data prevented exact documentation by TCEQ of changes in land application of manure resulting from participation in the composting project, which would be necessary to design a precise study of local water quality effects of these changed practices. The use of an independent research institution (Texas Institute for Advanced Environmental Research) to receive the confidential data for modeling and

research purposes overcame some of these constraints.

- *Documentation of the secondary water quality benefits from the use of the compost.*
    - The research and practice verification elements of the contracts with Texas Cooperative Extension and the Texas Department of Transportation were intended to verify and document the water quality benefits as well as economic and agronomic benefits of the uses of the compost products. These research efforts, together with many demonstration and outreach activities, provided powerful verification of the effectiveness of the compost products in promoting and protecting the establishment of vegetation in a wide variety of uses. They did not, however, result in a scientific basis for estimating the overall water quality benefits of the uses of compost under the project. One difficulty was the very wide variety of landscape, turf, and erosion control applications in which the compost was used by its many purchasers over a diverse set of soils, slopes, climates, and types of vegetation. The rebate and private user information tracking system would have been inadequate to assign the amount of compost going into each type of use. The cost of the research required to establish storm water load reduction effects of the compost in each of its diverse uses in this project would have been enormous.

      In the final research designs, TxDOT's experiments investigated water quality effects only in analysis of laboratory scale tests of leachate derived from different soil and compost materials. These findings do not translate into water quality impacts for several reasons. A primary reason is that the compost was used in various surface applications or soil amendments rather than in filter media applications.

      The TCE research design included only one trial involving water quality research. The original intent was to track the mass balance of nutrient inputs and outputs in plots with various compost treatments, a control treatment, and an untreated "check" as well as tracking pollutant loadings to surface and ground water, using shallow groundwater sampling as well as soil tests and runoff sampling after simulated rain events. However, TCE expressed doubts about the adequacy of available equipment to provide reliable mass balance results, so the design was modified to test several compost treatments (and control plots and untreated "checks") only for runoff volumes and pollutant loading. The first run of the trial was interrupted (after a single pre-vegetation rain simulation) by damage to the outdoor plots in a very heavy storm. TCEQ required TCE to conduct another trial to include both pre- and post-vegetation establishment rain simulations. The second trial, an indoor rain simulation using soil plots in trays, compared a single compost application – erosion control compost – against a control treatment before germination and after several weeks of growth of a turf grass. In these trials, the compost-treated plots absorbed significantly more initial rainfall before beginning to run off (over 20 minutes at a rate of 3.5 inches per hour) than the control plots (averaging about 5 minutes prior to runoff). The research design

required exactly 30 minutes of runoff to be sampled from each individual plot. As a result, the compost treatments were subjected to significantly more rainfall than the controls in each trial, but the TCE study analysis compared the runoff volumes and pollutant loadings from the two treatments as though they were exposed to the same storm event. Although the trial showed an unmistakable benefit to the compost in reducing suspended sediment, the results were mixed for volume and other constituents, and the nutrient loadings were significantly higher from the compost treatments. The TCEQ appended comments to this study report noting that the study design did not provide a valid basis for drawing conclusions about the water quality benefits of using the erosion control compost treatment. In effect, the project's research component did not generate a basis for estimating load reductions or other water quality effects of the use of even one specific compost product.

After the limitations of these results became apparent, TCEQ designed and funded a new project to provide field comparisons of storm water runoff from compost and other erosion control treatments in a rock quarry reclamation site in Parker County. This university study was designed to collect and sample the entire volume of runoff in natural storm events from quarry site plots with erosion control compost treatments and other treatments. The first year results, released in September 2007, analyzing volume and pollutant loading data from a dozen separate storm events, showed that the compost treatments reduced the sediment losses by at least 98% in comparison to the inorganic fertilizer and seeding treatment, and even resulted in less loading of total nitrogen and total phosphorus. Soluble phosphorus was the only constituent which the compost treatments released in greater amounts than the control plots over the first year. These results, sharply different from the TCE simulated rainfall trial results, have provided a basis for the analysis of water quality benefits of the project in the use of at least one product – erosion control compost; they are not a valid basis for estimating the benefits of using the other types of manure compost products in other kinds of applications.

- *Lag time in securing construction-related compost purchases by TxDOT*.
  - The TxDOT procurement process introduced a significant delay between the bid offerings of the compost facilities and the resulting sales. The compost facilities had to offer bids to the highway contracting firms for construction projects as they were offered for bid or "let." Subsequently, the compost was not needed until the construction project was near completion and the right of way ready for final stabilization and vegetation, which was typically several months to a few years after the letting. Because the project counted on sales to TxDOT for the baseline of demand for the initial sales of the participating compost facilities, there was a much greater delay than anticipated between the establishment of the facilities and the ramping up of deliveries and revenues from sales to TxDOT.

- *Lag time and due to inexperienced compost operators*.

- The initial project plan anticipated some technical assistance would be required to help newly established composting facilities participate in the project. However, it did not foresee the number of applicants who would come forward, many of whom eventually did not complete the process. Nor did it foresee that, in spite of its active notification and invitation to composting firms nation-wide, the project would not attract a single operator with experience in composting on the scale needed to fulfill the requirements of this project. In fact, all but two of the compost operators who ultimately participated in the project had no experience at all in commercial composting prior to the project. The two who did have previous experience had run relatively small operations that were relocated and expanded significantly under the project. These two operations with previous composting experience both withdrew from the project near the midpoint of the project and are not among the five counted as still active at the end of the project. A great deal of time and resources were expended early in the project to provide training in site design, process controls, and testing for compost product QA/QC to meet TxDOT and other commercial specifications, as well as in assisting with general operational planning.

- *Compost quality control issues.* In spite of these efforts, there were numerous instances in which the participating compost facilities delivered unsatisfactory products under the rebate program and to other buyers, creating significant difficulties in establishing confidence in the products related to this project and in developing sustainable markets for them. The primary issues concerned contamination with rocks, sand, and excessive inert material, which contributed to the typically low organic matter content of the manure on a dry weight basis, as well as nuisance odor from immature product. Other issues included high pH, which is partly a natural characteristic of the manure and partly due to the admixture with limestone-based soil, and high salt content. The rocks and other inert material appeared to be come primarily from the manure collection methods used at many dairies, in which the scraping up of manure commonly removed significant amounts of the soil from the lots and the sand from bedding areas. The “manure pack” method of leaving a thin layer of compacted manure on the dairy lots and the use of organic bedding rather than sand are two ways some dairies prevented these problems. Compost facilities became increasingly selective in accepting manure over the course of the project and increasingly consistent in completing the compost stabilization process before delivery.

  The quality issues that impacted repeat sales and marketing to the most customers were excessive rocks (especially for turf top-dressing customers) and odor/nuisance complaints. Sales to TxDOT, however, were most significantly affected by the organic matter content and pH of the product following a change in TxDOT compost testing requirements and specifications during the project. Three of the facilities found ways to adjust their composting feed-stocks and practices to meet the new requirements and continue to supply TxDOT projects; the other two have relied on other markets.

- *Regulatory requirements and approvals for participating compost operations.*
    - At the beginning of the project, the coordination efforts of the TCEQ NPS staff within the agency had not identified any permit requirement which would apply to the compost facilities participating in the project. The agency composting rules (30 Texas Administrative Code Chapter 332) did not generally require such facilities to be permitted or registered, although there is a brief item stating that the facilities must comply with Chapter 26 of the Texas Water Code. Shortly after the project issued "preliminary guidelines" in 2000 for these facilities to participate in the project, NPS staff learned from TCEQ water quality permitting staff that by virtue of handling CAFO manure subject to regulation, and by virtue of agency policies in regard to the North Bosque River watershed, the facilities would need permits for managing storm water and wastewater on a no-discharge basis. It was decided that a new general permit was needed as an affordable and manageable form of authorization for the specific kind of facility participating in this project. This decision set in motion a rule-making process to develop a no-discharge general permit for wastewater from such facilities, allowing the management of collected storm water by non-discharging irrigation or evaporation only, which attracted significant attention and comment from a range of stakeholders. The permit was adopted in October of 2002. To provide for continued compost facility participation in CMIP prior to that time, the NPS staff revised its participation requirements in April 2001 to call for technical demonstration of the facilities' design capacity to retain storm water and operate without discharge, so that the facilities could demonstrate reasonable expectation there would be no discharges requiring permit authorization pending permit approval. This design and review process went beyond agency permitting requirements but was determined to be a necessary precaution for this project. The staff time dedicated to this technical oversight and permit development effort amounted to more than the entire staff effort planned for the project over the first two years. This diversion of NPS staff resources delayed the development of many of the planned technical and marketing assistance activities for almost two years. The limitation of TCEQ regional office resources to address these new facilities resulted in continuing work for NPS staff in regulatory assistance to the facilities even after the issuance of the general permit.

      The new design requirements were added after many of the compost operators had already invested in capital equipment and site preparations based on a simple "best management practices" approach to storm water management. The newer requirements based on strict no-discharge requirements greatly increased the final site development costs for participating facilities, particularly for lined ponds and design engineering. Three of the original participating facilities ultimately ended their participation rather than meet the final project requirements, and several applicants discontinued efforts to be enrolled. In exit interviews, most of the compost operators who continued with the CMIP project cited this mid-course change in participation requirements as their most serious complaint about the

project.

- *State agency purchasing preference issues.*
    - In 2003, one participating compost producer became the exclusive Community Rehabilitation Program for the production of compost with TIBH Industries, Inc, an umbrella firm for programs employing persons with disabilities. As such, under the Texas Administrative Code, this composting firm became the exclusive "set-aside" preferred provider of composted products for state agency purchases through the General Services Commission (later renamed Texas Building and Procurement Commission, and more recently renamed the Texas Facilities Commission). State agencies purchasing compost were expected to buy qualifying products available from TIBH or file a justification for seeking alternate sources. This appeared to give the TIBH-affiliated firm an overwhelming sales advantage over the other participating facilities and to exclude the others from sales to TxDOT and other state agencies. This could have eliminated all but one of the compost facilities from the project's primary market, greatly reducing the chances that the project would result in an industry capable of handling the anticipated amounts of manure unless others chose to operate under its management as workplaces primarily for persons with disabilities. This situation proved to be much less of a disruption than feared. Compost used in TxDOT construction projects was not purchased directly by TxDOT but rather by its contractors, so it was determined that those purchases were exempt from the "set-aside." Few other state agencies purchased significant amounts of compost, and almost all did so indirectly through landscaping and erosion control contractors. Local governments are not bound by the "set-aside" rules.

- *Prospects for replication.*
    - The scope and size of this project in its entirety will likely not be replicated, but some features of it have good potential for use elsewhere. The most challenging aspect of this project was the creation, without direct funding, of an entirely new private industry capable of handling hundreds of thousands of tons of manure annually from dairies scattered over a region of many square miles where there were no large-scale operations before. The prospects for a similar project would be best where a compost industry already exists capable of handling the targeted material such as manure simply by opening new branch plants or by agreeing to receive the material as a new feedstock, or possibly in a small watershed where a single plant might be sufficient to handle the material without excessive hauling distances. Some other states and jurisdictions have already instituted a version of the rebate for any qualifying compost facility in a state (not restricted to specific watersheds), without undertaking any efforts toward facility recruiting or technical or marketing assistance.

FUTURE ACTIVITY RECOMMENDATIONS

- Continued monitoring of water quality results – seeking paired watershed as well as before/after trials to test modeling assumptions.
- Further small-scale trials to calibrate load reduction estimates for specific compost BMPs. There is still very little research information on load reduction effects of the full range of compost applications.

Attachments

Attachment A1: CMIP Partner and Participant List

Agency/Organization	Activities
Environmental Protection Agency (EPA) Region 6	Primary Grantor of CWA 319(h) funds
TCEQ Nonpoint Source Program*	CMIP Project management; technical assistance to all participants
TCEQ Small Business and Environmental Assistance Division*	Technical assistance and outreach to TxDOT; Outreach to other potential markets; technical support for compost facilities
TCEQ Total Maximum Daily Load Program	Management of TMDL for North Bosque River
Texas Cooperative Extension* Sub: Ron Alexander Associates Sub: Texas Agricultural Experiment Station	Technical assistance to compost users other than TxDOT; technical and marketing support for compost facilities; research and demonstration
Upper Leon Soil & Water Conservation District	Administration of rebate for qualifying private buyers
Texas Department of Transportation* Sub: Texas A&M University's Texas Transportation Institute Sub: University of Texas Center for Research in Water Resources Sub: University of Texas at Arlington Sub: Texas Tech University Center for Multidisciplinary Research in Transportation	Primary purchaser of composted manure; rebate documentation; research and demonstration
Brazos River Authority* Sub: Texas Institute for Advanced Environmental Research	Project effectiveness monitoring: water quality
Texas State Soil and Water Conservation Board	Management of partner project – the Dairy Manure Export Support Project
Bosque River Compost Dairy Cow Compost/Shamrock Soil Products O'Neals Compost Organic Residuals Reclamation, LLC Producers Compost	Independent private compost operators participating in the CMIP program. Purchasers of their compost were eligible for the rebate, but these firms received no direct funding.

* Agencies marked with asterisk (*) and their subcontractors performed activities for this project under contract or intergovernmental agreement with TCEQ using EPA 319(h) grant funds. Other participants derived primary funding directly from EPA or from other sources.
Sub = subcontractor

Attachment A2: Compost Project Timeline

September 1999	Memo from TCEQ NPS program to the Executive Director requesting feedback and concurrence in pursuing a composting project for the North Bosque and Cypress Creek watershed.
November 1999	Initial discussion of concept paper for the project with potential partners including TSSWCB, TxDOT and General Services Commission.
January 2000	Stakeholder consultation meeting for the project, with representation from TSSWCB, NRCS, Texas Association of Dairymen, Texas Institute for Advanced Environmental Research, Brazos River Authority, TxDOT, and a compost facility, as well as other TCEQ divisions.
January 2000	Presentation on the project proposal to a joint meeting of the TCEQ and TxDOT Commissioners.
March 2000	TCEQ NPS program submits a Watershed Restoration Action Strategy (WRAS) to EPA proposing a "collaborative composting strategy" as an innovative project complementary to the TMDL for the North Bosque River watershed.
April 2000	Project coordination meeting in Dublin, Texas involving TCEQ, TxDOT, USDA Rural Development, Texas Department of Agriculture, and local businesses and economic development agencies to discuss local market development possibilities for compost products.
August 2000	Meeting for project design feedback and recruitment for potential compost facility operators and interested parties, attended by two state representatives, eight representatives of compost and related industries, and several coordinating agencies
August 2000	Meeting to officially announce and present the project, to solicit the participation of area dairies, and to invite further comments on the project concept, attended by three state representatives, a state senator, and a very large number of dairymen and interested public.
August 2000	Presentation on the project to the Bosque River Advisory Committee.
November 2000	Major joint workshop of TCEQ and TSSWCB to orient all applicants wishing to apply for participation in CMIP and/or DMES as compost facilities, as dairies, and/or as haulers, involving distribution of required application and record keeping forms.
January 2001	Consultation with TCEQ internal auditor to assure the integrity of the record keeping system for the rebate and related activities.
April 2001	Workshop for compost operators on the revised "final" requirements for participation, and the related application process and forms.
May 2001	Workshop for compost operators on compost production, testing, and quality control presented by TCEQ staff and leading compost facility managers in Texas
July 2001	Coordination meeting between TCEQ and TSSWCB regarding CMIP and DMES
August 2001	Public meetings and comments received on composting general permit
October 2002	TCEQ Commissioners issue a new no-discharge wastewater general permit

	for manure composting facilities to provide authorization for irrigation
December 2002	Workshop for participating and prospective compost facilities on the new composting general permit requirements
August 2006	CMIP Project ends Rebate and Technical Assistance programs
June 2007	Exit interviews with compost facility operators and site visits with interviews to a representative sample of rebate user sites

Attachment A3: CMIP Awards Received

2002	Texas Quality Initiative 'Making a Difference' Award, Silver Level (TxDOT)
2002	AASHTO President's Transportation Award, Environmental Category (TxDOT) Appendix 1 - Compost Education: Presentations, Workshops, & Demonstrations
2003	State/EPA Strategic Partnership Award, Region 6 (EPA/TCEQ)
2003	TCEQ-TxDOT Partnership Program Awards
2003	(June/July) Federal Highway Administration Success Story for Environmental Stewardship in Construction and Maintenance http://www.fhwa.dot.gov/resourcecenter/success/successstories/vol2iss04.cfm
2004	Texas Environmental Excellence Award - Finalist
2004	Semifinalist for the Harvard University Innovations in State Government Award

Attachment A4: Texas Commission on Environmental Quality Resources/Links

CMIP Web Page http://www.tceq.state.tx.us/compliance/monitoring/nps/projects/compost.html

North Bosque River Water Quality Status Report, January 2007
http://www.tceq.state.tx.us/assets/public/implementation/water/tmdl/06bosque/bosquereport_feb2009.pdf

Attachment B1: Compost facility participation documents

- Compost Facility Application Checklist (I:\WQPA\WMT\NPS\Compost\Application Files\checklist_master.wpd)
- Requirements for Compost Facility Participation in the CMIP [as last amended in 2005] (I:\WQPA\WMT\NPS\Compost\Forms\cert_requirements finalclean.doc)
- Application of Composting Facility to Participate in the Composted Manure Incentive Program (I:\WQPA\WMT\NPS\Compost\Forms\Attachment A final.doc)
- Compost Delivery Record (I:\WQPA\WMT\NPS\Compost\Forms\Attachment E final06_11_03 %manure.doc)
- Feedstock & Blend Receiving Record (I:\WQPA\WMT\NPS\Compost Forms\Attachment G final.wpd)

Compost Facility Application Checklist
TNRCC Composted Manure Incentive Program

Applicant:

Information requiring certification by a professional engineer:

☐ USGS Map with Compost site and Irrigation site scale drawings certified, showing (labeling)

☐ All existing & proposed structures, including retention facilities, buildings, berms, surface waters and watercourses, etc., and related buffer zones ***(map showing all information, buffer zones should be marked – see list on last page of this checklist)***

☐ Water wells showing buffer zones, numbered & referenced to attached index of wells giving ownership and type of use of each well ***(buffer zone; wells need to be numbered and referenced on index giving ownership & use type of each well)***

☐ Property lines around the compost site, retention pond(s) and irrigation site(s), showing legal ownership of land tracts adjacent to any wastewater irrigated land ***(property lines and ownership information)***

☐ Boundaries of all irrigated land application areas, indicating berms and tail water facilities <u>if any</u>

Any special geological features <u>if any</u> (sinkholes, faults, karst formations, etc.) that could provide direct communication to groundwater from the wastewater retention and application site(s), or within 0.25 miles of the water retention structure(s), or within 0.25 miles of the irrigation fields. ***(Show any that exist, or provide certified statement that there are none.)***

Retention facility design, water balance, freeboard allowance, 100-year flood plain protection are certified including statements to the effect that:

Retention facility design analysis demonstrates storage requirements based on the highest annual rainfall amount and the lowest annual evaporation from a record of at least 25 years, distributed over a 12-month period in proportion to average monthly percentages, OR based on storage of the 25-year, 24-hour storm event runoff for the drainage area. ***(water balance. Need original design analysis. Narrative is needed including sources of data, basis of design, calculations, and assumptions used to make calculations. Sample available on request.)***

☐ Retention facility design provides required storage and includes a top freeboard of not less than two feet, accounting for settlement and slope stability of the materials used at the time of design and construction. ***(Include statement to this effect in engineer's***

certified letter.)

☐ Retention facilities are not located in the 100-year flood plain, as defined in 30 TAC Chapter 301, OR the facilities are protected from inundation and damage that may occur during that flood event.

Certified statement that there are no special geological features (sinkholes, faults, karst formations, etc.) that could provide direct communication to groundwater from the site property, or within 0.25 miles of the water retention structure(s), or within 0.25 miles of the irrigation fields, OR that if there are such features, the site design will prevent direct communication of wastewater from the site to groundwater.

Required Items in the Technical Report for Wastewater Discharge Permits:

(Some items are only applicable if the application involves use of wastewater for irrigation.)

☐ Minor Application Questions are addressed (Page 2, #3a, #3b, and #3c; Page 3, #3d, #3e, and #3g(4); Page 4, #4a and #4b; Page 6, #6.a; Page 7, #7; Page 8, #9; Page 9, #10; Page 10, #12; Page 14, #16g; Page C-1, #1 and #2.

☐ Description, dimensions, and volume capacity of existing and proposed retention pond(s) are provided (Pages 12-13, #16a-b) and (Page C-2, #4).

Description and test results for pond liner(s) are provided (Pages 13-14, #16d-e).

☐ Land use information has been provided for the acreage under irrigation (Page C-2, # 3).

A description is provided of how rainfall run-on will be controlled to prevent extraneous waters from entering the land application site, and tailwater control facilities and operations (if any) have been described (Page C-2, #5). ***(Needs information on how extraneous waters will be prevented from flowing on to the irrigation site, by berms, topography, etc.)***

An annual cropping plan has been provided, including type of crops, and for each crop: acreage, growing season, nutrient requirements, salt tolerance, supplemental watering and fertilization planned, and harvest method and annual number of harvests (Page C-4, #7). The application rate does not exceed 3.2 acre-feet wastewater/acre/year and does not exceed a rate of 100 pounds organic material/acre/day (gen. permit Part III Section B.2.(a)(8)-(9)).

A description of the application method and equipment (e.g. row irrigation, spray irrigation using a center pivot sprinkler system, etc.) has been provided with an estimate of the irrigation efficiency (Page C-4, #8).

A separate engineering report of water balance and storage volume calculations in accordance with 30 TAC Section 309.20, Subchapter C, Land Disposal of Sewage Effluent has been provided (Page C-4, #9)

includes sources of data, basis of design, calculations, and assumptions used to make calculations, such as volumes of runoff, evaporation, evapotranspiration, etc. ***(Brief narrative giving data sources and basis of calc.)***

where irrigation is involved, describes the method of application and provides a nitrogen balance for the crop system**.**

A U.S. Department of Agriculture (USDA) Natural Resources Conservation Service Soil Survey Map has been provide which accurately locates the area to be used for land application (Page C-6: 12). Attached information includes:

the engineering properties (No. 200 Sieve, Liquid Limit, Plasticity)

soil name and mapping symbol

USDA textures and associated depths for each texture class

soil permeability for each texture class

seasonal high water table.

Soil analyses of the soil in the land application area has been provided for the following in mg/kg dry weight basis (parts per million) where applicable (Page C-7: #13).

pH,
electrical conductivity
sodium adsorption ratio (SAR) ***(can be calculated from given Ca, Mg, and Na data)***
total nitrogen ***(needed for baseline value)***
nitrate- nitrogen (extractable)
potassium
phosphorous
calcium
magnesium
sulphur
sodium

Setbacks for wastewater facilities and land application areas *(Will be verified on site drawing)*

100 feet wide vegetative strip between wastewater application areas or tail water control structures and any surface water or watercourse

500 feet distance between any public water supply well and the site's wastewater retention facilities, wastewater land applications areas, and tail water facilities

150 feet distance between any private water well and the site's wastewater retention facilities, wastewater land

application areas, and tail water control structures

150 feet distance between wastewater retention facilities and the nearest property line

50 feet distance between any wastewater application area or tail water control structure and the nearest property line

Property documentation

Demonstration of ownership or lease of site properties (e.g. copy of lease)

Items needed after construction, prior to receiving manure

☐ Certification that the retention facility lining (pond liner) meets the appropriate criteria as stated in the draft General Permit WQG200000 for livestock manure composting operations, Part III, Section B, 3(a)

Analysis of water from retention facility at each instance of irrigation or quarterly, whichever is less frequent, testing for sodium adsorption ratio (SAR) and documentation of date, location, acreage, application rate, and volume of wastewater applied. Limit each application to the agronomic need and leaching requirement of the crop. ***(This will not be required until irrigation is begun.)***

checklist_master.wpd October 31, 2001

Requirements for Compost Facility Participation in the Composted Manure Incentive Project

(This document is incorporated by reference into any application to participate in the Project.)

$**Application.** Participating operators must complete an application form (Attachment A) and receive approval from the TCEQ Composted Manure Incentive Project Coordinator before receiving manure under this project. Provisionally approved facilities will retain their approved status pending Texas Commission on Environmental Quality (TCEQ) approval of the new application, but such operators must submit a complete application under the requirements presented herein no later than May 15, 2001 in order to retain approved status under this project.

$**Compliance with applicable laws and rules**. Participating facility operators are responsible for complying with all applicable laws and rules, including:

$Meet the provisions set forth in the TCEQ composting rules, general requirements, 30 TAC §332.4 and 332.8(a) and (b), and TCEQ composting rules' process control requirements for operations requiring notification, 30 TAC §332.23. (Attachment B)

$ Meet the requirements of Chapter 26 of the Texas Water Code (see Site Controls below).

$ **Eligible materials.** Participating facility operators must:

$Produce compost containing manure derived ONLY from livestock facilities identified by Texas State Soil and Water Conservation Service or TCEQ to be in the North Bosque and/or Leon River watersheds.

$Produce compost containing at least 50% manure by weight. For purposes of this project, "manure" is defined as livestock feces and urine which may contain incidental (less than 10%) bedding and/or feed material. The finished compost may not contain more than a total of 50% materials OTHER THAN manure as defined above, which may only include source-separated yard trimmings, clean wood material, vegetative material, and/or paper as defined in 30 TAC 332.2 (which would include spoiled hay, straw, and other crop and feed residues). Each pile or windrow of composting material and each pile of finished compost on site must be identified by the percentage of manure (by weight) contained in the mix. Each individual sale and delivery of finished compost product must contain a pre-determined percentage of manure, which must be indicated on the sales receipt or invoice and on the Compost Delivery Record reported monthly to TCEQ. However, blended compost products may contain additional materials blended with the compost after it is finished to make a blended product such as "compost manufactured topsoil" as specified by the purchaser.

●**Record keeping and reporting**. Participating facility operators must:

●Maintain all project records and documents accessible to TCEQ or its authorized representative for review and inspection during normal business hours at the location given on the application; and notify the program in advance of any change of location.

●Record, by invoice number, ALL sales of finished compost from the site on the TCEQ Compost Delivery Record form and submit monthly as directed in the instructions (Attachment E). Compost may not be sold for use on agricultural land within the watersheds of the Leon or North Bosque Rivers.

●Prepare a Texas Department of Transportation Compost Incentive Form for each delivery of compost to TxDOT, retain a copy, and submit it to TxDOT as directed in the instructions (Attachment F).

●Retain a signed invoice and receipt for each sale of compost product, containing at minimum the following information:

- invoice number,
- compost facility name and TCEQ control number,
- cubic yards delivered,
- percent manure in the compost itself,
- percent compost in the total product (100% if it is pure compost, or less if it is a blended product),
- dates of delivery, identity of purchaser, address of purchaser, and

- physical address/location at which delivery was made.

Any non-manure materials received at the facility to be added to the manure prior to or during composting (feedstocks) and any manure deliveries that are not reimbursed by DMES must be recorded and submitted monthly to TCEQ (Attachment G). All such non-reimbursed deliveries and non-manure materials must be weighed at a certified scale prior to delivery and reported by weight on the monthly reporting form, and the scale tickets must be retained as part of the facility's records under this program. On the same form, record any materials accepted at the facility for the purpose of adding to the finished compost (blends) to make a blended compost product.

- **Record keeping and reporting**. Participating facility operators must:

- Any non-manure materials received at the facility to be add to the manure prior to or during composting (feedstocks) must be recorded and submitted monthly to TCEQ (Attachment G). On the same form, record any materials accepted at the facility for the purpose of adding to the finished compost (blends) to make a blended compost product.

- Project records related to the State of Texas Composted Manure Incentive Program must be retained for a minimum of three years after completion of the project.
- Notify the Dairy Manure Export Support Project and TCEQ in advance of any significant change in operations, including any temporary closing the facility to deliveries of manure for any reason, with as much advance notice as possible. Use the following numbers for notification unless otherwise directed at a later date:

Process controls. Participating facility operators must:

- Use a process to reduce pathogens, including a protocol for monitoring of temperatures, as required in 30 TAC §332.23 and as described in the application. (Attachment B)
- Operate the composting process as described in the application. Before making any change in this process, the applicant must receive approval (30 days prior to making the change) from the Composted Manure Incentive Program manager at TCEQ.

- **Site controls.** Participating facility operators must:

- Provide a detailed site diagram in the application showing the property boundaries, site boundaries, all structural storm water and process water controls (ponds, berms, etc.), unloading areas for manure and any other feedstocks, compost loading areas, storage and processing areas, any structures on the site, and areas for other major activities.
- Maintain access control at the facility to prevent delivery of unauthorized materials.
- Demonstrate that the structural and management controls for storm water and process water at the site (including any off-site irrigation) will prevent any discharge of water or pollutants to waters in the state. Demonstrate that any net retained storm water and process water will be utilized in the composting process and/or in irrigation. Documentation must include a completed Technical Report for Industrial Wastewater Discharge Permits (Attachment C). Obtain a permit if required, e.g., if water from the processing site will be used for irrigation (Attachment D, and instructions, Attachment E). **This requirement for documentation, construction, and maintenance of storm water and process water controls, and for obtaining a permit if applicable, must be met before a facility begins to receive manure under this program.**

- **Record keeping and reporting**. Participating facility operators must:

- Maintain all project records and documents accessible to TCEQ or its authorized representative for review and inspection during normal business hours at the location given on the application; and notify the program in advance of any change of location.

- Record, by invoice number, ALL sales of finished compost from the site on the TCEQ Compost Delivery Record form and submit monthly as directed in the instructions (Attachment E). Compost may not be sold for use on agricultural land within the watersheds of the Leon or North Bosque Rivers.
- Prepare a Texas Department of Transportation Compost Incentive Form for each delivery of compost to TxDOT, retain a copy, and submit it to TxDOT as directed in the instructions (Attachment F).
- Retain a signed invoice and receipt for each sale of compost product, containing at minimum the following

information:

- invoice number,
- compost facility name and TCEQ control number,
- cubic yards delivered,
- **percent manure in the compost itself,**
- percent compost in the **total** product **(100% if it is pure compost, or less if it is a blended product)**,
- dates of delivery, identity of purchaser, address of purchaser, and
- physical address/location at which delivery was made.
- Any non-manure materials received at the facility to be added to the manure prior to or during composting (feedstocks) **and any manure deliveries that are not reimbursed by DMES** must be recorded and submitted monthly to TCEQ (Attachment G). **All such non-reimbursed deliveries and non-manure materials must be weighed at a certified scale prior to delivery and reported by weight on the monthly reporting form, and the scale tickets must be retained as part of the facility's records under this program.** On the same form, record any materials accepted at the facility for the purpose of adding to the finished compost (blends) to make a blended compost product.
- Any non-manure materials received at the facility to be add to the manure prior to or during composting (feedstocks) must be recorded and submitted monthly to TCEQ (Attachment G). On the same form, record any materials accepted at the facility for the purpose of adding to the finished compost (blends) to make a blended compost product.
- Project records related to the State of Texas Composted Manure Incentive Program must be retained for a minimum of three years after completion of the project.
- Notify the Dairy Manure Export Support Project and TCEQ in advance of any significant change in operations, including any temporary closing the facility to deliveries of manure for any reason, with as much advance notice as possible. Use the following numbers for notification unless otherwise directed at a later date:

TCEQ Composted Manure Incentive Program: Bill Carter, phone 512-239-6771, fax 512-239-4410
TSSWCB Dairy Manure Export Support Project: John Foster, phone 254-733-2250, fax 254-773-3311

- Upon finding that an operator is not complying with the requirements listed in this document, or is not complying with the terms of a TCEQ permit, the TCEQ Executive Director has discretion to temporarily or permanently revoke the approval of a site or an operator from participation in this program.

Updated June 13, 2005

Attachment A Control Number_____
(for TCEQ use only)

APPLICATION OF COMPOSTING FACILITY TO PARTICIPATE IN THE COMPOSTED MANURE INCENTIVE PROGRAM

This form is required of any composting facility intending to supply composted manure to a state or local agency under this program. The facility may begin delivering composted manure thirty days following submittal of this form. Owners/operators are required to meet the provisions set forth in 30 TAC §332.4 – "General Requirements"; §332.8(a) and (b) – "Air Quality Requirements" applying to exempt facilities; and §332.23 – "Operational Requirements for Operations Requiring Notification." ***It is the operator's responsibility to become aware of and to comply with all applicable state and local requirements.***

If you have any questions, please contact Bill Carter at TCEQ at (512) 239-6771.

Please send your completed form to

Composted Manure Incentive Program
Water Quality Planning and Assessment Section - MC 165
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, Texas 78711-3087

Please type or print using black ink.

Applicant

Name of Primary Applicant:_____
Check All That Apply: □ Facility Operator □ Facility Owner □ Land Owner

Name of Facility:_____

Mailing Address:_____
_____
_____
Telephone Number: (_____)_____
Fax Number: (_____)_____
Email: _____
Contact Person:_____

Title: _____

Site location

1. Legal description of the property and the county, book, and page number of the current ownership record from the county deed records
_____
_____

2. A boundary metes and bounds drawing and description of the site (attach as an exhibit)

3. A city or county roadway map with the site shown and labeled (attach as an exhibit)

4. The geographic coordinates of the entrance to the site.
   North_____degrees_____minutes_____seconds
   West _____degrees_____minutes_____seconds

5. A description of how to get to the site from an intersection of two state roadways:

   _____
   _____

Site Property owner information

Name _____ Title_____

Mailing Address:_____
_____
_____

Telephone Number: (_____)_____

Process description and site controls (attach as exhibits)

1. Site drawing. A scale drawing and legal description of all land which is to be a part of the disposal operation will be included in the technical report. The drawing will show the location of all existing and proposed facilities to include: buildings, wastewater treatment facilities, wastewater retention facilities, irrigated land application areas, tail water control facilities, buffer zones, and water wells. This drawing should have an index of wells, adjacent property, and other prominent features. Attach a completed TCEQ Industrial Technical Report (Attachment C).
2. If the site has obtained a TCEQ permit, give the permit number here: _____.
3. Describe in detail the process to reduce pathogens, including a protocol for monitoring of temperatures in each batch of compost produced, as required in 30 TAC §332.23.
4. Describe the overall handling of materials from arrival of manure and any other feedstocks through the storage and loading of finished compost.
5. Describe how you will prevent unuseable materials from entering the facility, and how such materials will be disposed of if found. Include your plan for removal of unuseable trash to an authorized solid waste facility and your plan for control of windblown material.
6. Describe odor control measures.
7. Describe your fire prevention and suppression plan that shall comply with provisions of the local fire code.

Composting experience of principal participants (attach as an exhibit if additional space is required)

For each principal participant in this operation, list all previous large-scale composting experience. Give the name of each facility with which the participant has served, company name, location, and the individual's title, responsibilities, and period of involvement at the facility.

Records Access and Retention

Provide address of physical location (if different than stated above) where project records and documents will be kept and accessible to TCEQ or its authorized representative for review and inspection during normal business hours. Project records related to the State of Texas Composted Manure Incentive Program must be retained for a minimum of three years after completion of project.

_____
_____
_____

Signatures

The operator of the composting facility, the owner of the facility, and the owner of the land must all be co-applicants and sign the following statement:

"I agree that this composting facility will be operated in accordance with the process description and site controls described in this application and in compliance with the "Requirements for Compost Facility Participation in the Composted Manure Incentive Project." I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Facility Operator:

_____

Signature of Responsible Party* Date

_____

Printed Name of Responsible Party* Title

_____

Tax Identification Number

Facility Owner (if different from above):

_____

Signature of Responsible Party* Date

_____

Printed Name of Responsible Party* Title

_____

Tax Identification Number

Property Owner (if different from above):

_____

Signature of Responsible Party* Date

_____

Printed Name of Responsible Party* Title

_____

Tax Identification Number

* For a sole proprietor, the proprietor signs. For a partnership, a general partner signs. For a corporation, a responsible corporate officer signs: president, secretary, treasurer, or vice president in charge of a principal business function. For a municipality or other public agency, a principal executive officer or a ranking elected official signs. See 30 TAC §305.44.

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State of Texas **COMPOST DELIVERY RECORD** Name of Facility: _____

Composted Manure Incentive Program Month _____ Year _____ Control Number: _____

Date	Invoice #	Purchaser Name & Phone Number	Physical Location / Address Delivered	County	CY	% Manure in compost	Blend material contents if any	% Compost

State of Texas Composted Manure Incentive Program
COMPOST DELIVERY RECORD

INSTRUCTIONS

This form is designed to record ALL shipments of compost products from composting facilities participating in the Composted Manure Incentive Program, including deliveries to the Texas Department of Transportation (TxDOT) as well as those to other purchasers. Deliveries to TxDOT sites will be recorded on a TxDOT Compost Incentive Form as well as on this record form.

You may use the form provided or create your own form providing the same information. Please enter your company name, control number, and address on the upper part of the form. Each line item on this record represents an order covered by a single invoice and a single destination. This may be for one truckload or one hundred truckloads. If an invoice includes deliveries to more than one destination, make a separate entry for each destination under that invoice.

- Date – the date of the final truckload delivered for this invoice and destination
- Invoice # – the identification number on your receipt or invoice for payment of this delivery
- Purchaser Name and Phone Number – the name of the company and/or person purchasing the compost, phone number, and contact person (if different from purchaser name)
- Physical Location / Address Delivered – the physical address to which this compost was delivered, or description of location if there is no address (including CSJ# if applicable). You must provide enough information here, together with identification of county (#5), to locate the place (destination) accurately on a map. For example, you may give the road/hwy number and number of miles in a specific direction from the nearest major intersection.
- County – the county in which the destination identified in #4 is located
- CY – the total volume (cubic yards) delivered for this invoice and destination.
- % Manure in Compost – the percentage *(by weight)* of manure in the compost used in the product, as measured when the piles or windrows were formed at the beginning of the composting process. If the compost is made entirely out of manure, put 100%; if it is made out of 50% manure and 50% wood chips, put 50%. Each pile or windrow should be documented as having a specific % manure *by weight*.
- Blend Material Contents if Any – list any material such as soil or wood chips that was blended with your finished compost at your site to make this product, before delivery to the consumer
- % Compost – the percent of compost in the product delivered *(by volume)*. If the product is

all compost, put 100%; if it is 75% soil and 25% compost, put 25%.

Submit your completed COMPOST DELIVERY RECORD forms on a monthly basis to Carol Whittington, TNRCC, by fax (512-239-4410) or by mail to:

Carol Whittington
Watershed Management Team MC-147
TNRCC
P.O. Box 13087
Austin, Texas 78711-3087

If you did not deliver any compost, please fill out the top of the form and mark "No deliveries this month" across the middle of the form.

State of Texas **FEEDSTOCK & BLEND** Name of Facility: _____

Composted Manure Incentive Program **RECEIVING RECORD** Control Number: _____

Date	Scale Ticket #	Supplier / Origin Name & Phone Number	Description of Material	Tons	
				Feedstock	Blend

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Attachment G

State of Texas Composted Manure Incentive Program
FEEDSTOCK & BLEND RECEIVING RECORD
INSTRUCTIONS

This form is designed to record ALL shipments you receive of
1. "feedstock" materials OTHER THAN MANURE, which you will mix with manure to make compost products,
2. "blend" materials, which you will mix with finished compost to make blended products such as "compost manufactured topsoil," and
3. any manure which was delivered to you WITHOUT DMES REIMBURSEMENT.

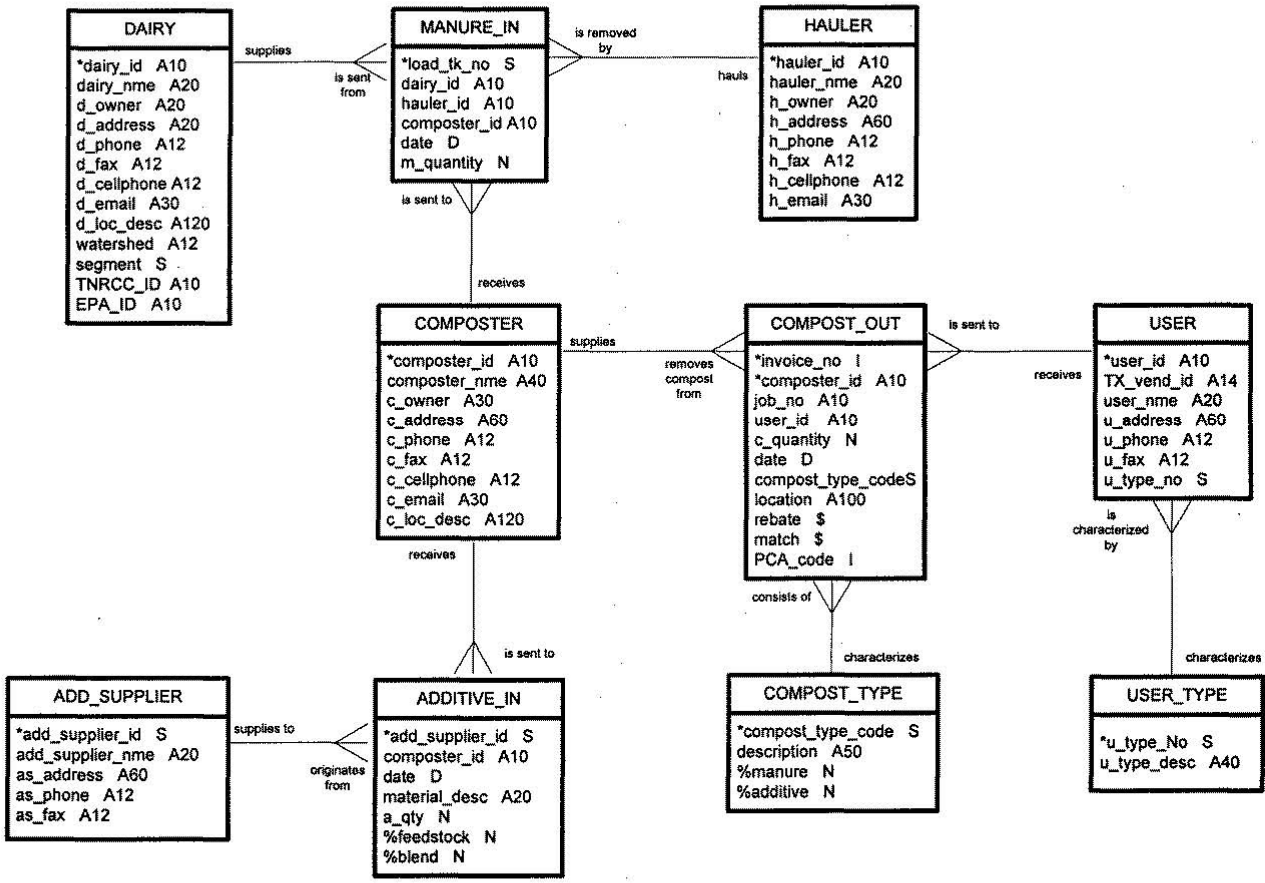
You may use the form provided or create your own form providing the same information. Please enter your facility name and control number on the upper part of the form. Each line item on this record represents a single truckload delivery of material to you, covered by a single scale ticket.

1. Date – the date of the truckload delivery for this invoice or transaction
2. Supplier / Origin Name & Phone Number – the name of the company and/or person supplying the material, phone number, and contact person (if different from supplier name)
3. Description of Material – identify the material received – for example, soil or shredded wood
4. Tons – the total weight received under this truckload – put tons of "feedstock" materials in the left subcolumn and cubic yards of "blend" materials in the right subcolumn. See the definitions above. All materials that may be used as feedstocks to make compost must be weighed at a certified scale, and the weight reported in tons. For <u>blend materials only</u> – if none of these materials will be added during composting – you may measure in cubic yards instead of tons, and no scale ticket is needed. If you report any blend materials in cubic yards, write "CY" next to the number of cubic yards.

Submit your completed FEEDSTOCK & BLEND RECEIVING RECORD forms on a monthly basis to Carol Whittington, TNRCC, by fax (512-239-4410) or by mail to:

Carol Whittington
Watershed Management Team MC-147
TNRCC
P.O. Box 13087
Austin, Texas 78711-3087

Attachment B2: Compost Manure Incentive Program Data Model



Attachment B3: Composted Manure Incentive Program Data Dictionary

DAIRY.DB		
dairy_id	A10	TxDOT-assigned DMES number
dairy_nme	A20	name of facility
d_owner	A20	primary owner/authorized agent of faciility
d_address	A20	mailing address
d_phone	A12	telephone number
d_fax	A12	facsimile number
d_cellphone	A12	cellular telephone number
d_email	A30	electronic mail address
d_loc_desc	A120	full description of physical location of facility
watershed	A12	either “North Leon” or “Bosque”
segment	S	4-digit segment number on which facility is located
TNRCC_ID	A10	TNRCC permit number
EPA_ID	A10	EPA permit number

COMPOSTER.DB		
composter_id	A10	TNRCC-assigned CMIP number
composter_nme	A40	facility name
c_owner	A30	facility owner
c_address	A60	facility mailing address
c_phone	A12	telephone number
c_fax	A12	facsimile number
c_cellphone	A12	cellular telephone number
c_email	A30	electronic mail address
c_loc_desc	A120	full description of physical location

MANURE_IN.DB		
load_tk_no	S	DMES load ticket number
dairy_id	A10	ID number of originating dairy
hauler_id	A10	ID number of hauling operation

composter_id	A10	ID number of composting facility receiving load
date	D	date of manure haul
m_quantity	N	quantity (lbs.) of manure delivered

COMPOST_TYPE.DB		
compost_type_code	S	ID number of compost type
description	A50	description of unique compost type
%manure	N	percentage of manure (by weight) in final compost?
%additive	N	percentage of additive (by weight) in final compost?

Attachment B4: Total Feed-stock and Blend Material Reported by Compost Facilities, in Cubic Yards

Feed-Stock and/or Blend Material	Bosque River	Dairy Cow	Erath Earth	Gustine	O'Neals	Organic Residuals	Producers	Texas Best	Total
Wood chips/mulch	650		10,640	3,680	3,245		3,940	7,200	29355
Sawdust/wood flake			86	840					926
Pecan Litter				750					750
Other							100		100
Total	650		10726	5270	3245		4040	7200	31131

Note: These reported figures include some material blended with finished manure compost to make Erosion Control Compost blends, and which is not counted as part of the composted manure. These figures also omit some material known to have been delivered to particular sites.

Attachment B5: Soil & Water Conservation District Rebate Program

[Insert documents from I:\WQPA\WMT\NPS\Compost\Reports\Final Report Appendices:

- SWCD Incentive One-Pager.pdf.lnk SWCD Rebate Application Form.doc.lnk

  SWCD Rebate Program Policy.doc.lnk SWCD & Compost Facility Memo 5-18-04.doc.lnk

  SWCD (rebate diagram) process.doc.lnk

Attachment B6: Compost Gets Results! Market Development and Technical Assistance by the TCEQ Small Business and Environmental Assistance (SBEA) Department

Compost market development activities were undertaken by staff of the TCEQ Small Business and Environmental Assistance (SBEA) Department to benefit compost producers statewide with a specific emphasis on those in the Leon & North Bosque River watersheds. Work began with the largest potential compost consumer, the Texas Department of Transportation (TxDOT) and expanded into industries having similar construction and maintenance activities.

In order to achieve results with TxDOT, it was necessary to gain and secure the confidence of their staff that compost and mulch could be an acceptable substitute for the traditional practices or materials currently used. Activities to establish that confidence included:

5. research and development on the use of compost and mulch for construction activities
6. development of materials specifications
7. educational opportunities on compost, mulch and application methods
8. technical assistance to TxDOT staff, contractors, and compost producers

This statewide market development strategy resulted in TxDOT becoming the largest compost consumer in the nation. It purchased more than 477,000 cubic yards statewide in FY 2005 alone. It purchased 300,000 cubic yards through the CMIP program alone in the four years ending August 2006.

TxDOT has developed specifications for compost and for several applications of compost and mulch, including erosion control surface treatments and filter tubes, which are widely copied and referenced by other compost users.

The expansion of the SBEA program beyond TxDOT provided outreach to homebuilders, construction engineers, public works officials, code enforcement staff, storm water inspectors, and the mining and quarry industries. In addition to on-site demonstrations and workshops at application sites, the program has provided lunchtime presentations at engineering firms and conference presentations for several professional associations, including the state homebuilders' association and their local chapters. The primary focus of these presentations has been the use of compost and mulches for storm water permit compliance and for re-vegetation of eroding areas. As a result, two national homebuilders have implemented the use of compost and mulch in several of their Texas projects.

A second market development strategy has addressed ongoing maintenance applications for landscape and sports turf. The TxDOT model was used again to train participants on the benefits of compost and application methods under the heading of "Compost Gets Results!" It was offered to landscapers, sports turf managers, landscape architects and irrigation

installers and offered:

- four hours of training
- opportunity to work with application equipment
- continuing education credits for professional licenses

TCEQ Small Business and Environmental Assistance Workshop Final Report Information

	FY01		FY02		FY03		FY04	
Total Surveys mailed	n/a		80		106		203	
Question Responses	Yes	No	Yes	No	Yes	No	Yes	No
1 workshop effective			24	0	54	1	104	0
2 useful information			24	1	54	1	104	0
3a organization consideration			19	5	37	16	30	30
3b personal consideration			22	2	37	12	72	26

Survey participants were solicited to offer additional comments on the workshops and for other subject matter. Beside positive responses on the workshops and the agendas, they expressed interest on compost quality, compost teas, application methods, etc.

Based on the level of interest indicated following these workshops, the TCEQ SBEA staff, in cooperation with Texas Cooperative Extension and the Texas Sea Grant program, developed condensed presentations for wider distribution. This effort resulted in three 45-minute presentations on compost use with emphasis on landscape, sports turf and commercial nursery industries. The common elements included the effects of compost applications on plant health, reduced water consumption, and benefits for water quality and pollution prevention. The presentations were designed to conform to the format of professional association meetings and a general audience. The following table records the dates, type of activity, and number of attendees at the resulting presentations.

DATE	PROJECT NAME	TYPE OF ACTIVITY	ATTENDEES
FY05			
1/6/05	Capital Area Erosion Control Group	Workshop	32
1/20/05	Capital Area Erosion Control Group	Demonstration	37
1/23/05	US Composting Council (USCC)	Workshop	26
1/25/05	USCC	Workshop	100
2/7/05	Texas Public Works Association	Workshop	66
2/20/05	Int'l Erosion Control Assoc.	Workshop	36
2/23/05	Travis County	Demonstration	0
2/24/05	TCEQ Inspector Training	Demonstration	38
3/8/05	CMA Engineering	Workshop	13
4/1/05	Austin Green Builders	Workshop	8
4/12/05	TCEQ Water Mangers	Workshop	24
4/28/05	LCRA - Eagles Nest	Demonstration	38
4/28/05	LCRA	Workshop	38
5/2/05	Environmental Trade Fair	Workshop	25
5/5/05	Abilene Builder Association	Workshop	20
5/10/05	Permian Basin Builders Association	Workshop	30
5/26/05	Austin Home Builders Association (HBA)	Demonstration	30
6/15/05	Houston Builders Association	Workshop	25
6/16/05	Houston Builders Association	Demonstration	25
7/12/05	Permian Basin Builders Association	Demonstration	17
7/14/05	Lubbock Builders Association	Workshop	38
7/14/05	Lubbock Builders Association	Demonstration	38
7/19/05	Abilene Builder Association	Workshop	12
7/19/05	Abilene Builder Association	Demonstration	12
	Year-end totals	**15-W, 9-D**	**728**
FY06			
9/21/2005	CMA Engineering	Workshop	9
11/15/05	Victoria Recycling Seminar	Workshop	53
12/1/05	LCRA-City of Burnet	Demonstration	18
1/12/06	Fort Hood	Demonstration	49
2/27/06	Dallas-Habitat for Humanity (HFH)	Workshop	13
2/27/06	Dallas-Habitat for Humanity (HFH)	Demonstration	13
3/7/06	Longview	Workshop	42
3/8/06	Longview	Demonstration	19
3/8/06	Tyler	Demonstration	10
5/3/06	Tyler	Workshop	38

5/3/06	Tyler	Demonstration	38
6/15/06	E. Dallas Builders Association	Workshop	0
6/15/06	E. Dallas Builders Association	Demonstration	14
7/12/06	San Angelo	Workshop	94
7/12/06	San Angelo	Demonstration	24
7/25/06	Bryan-College Station	Workshop	16
7/25/06	Bryan-College Station	Demonstration	16
	Year-end totals	**8-W, 9-D**	**466**
FY07			
10/3/06	Lubbock Habitat for Humanity (HFH)	Demonstration	16
10/17/06	Georgetown Home Builders Association (HBA)	Workshop	17
10/18/06	Georgetown HFH	Demonstration	12
11/1/2006	McKinney HFH	Demonstration	14
1/23/2007	Conroe HFH	Demonstration	9
1/25/2007	NW Houston HFH-Tomball	Demonstration	8
2/27/2007	Denton HFH	Demonstration	20
3/6/2007	San Antonio-Brooks	Workshop	20
3/6/2007	San Antonio-Brooks	Demonstration	21
4/4/2007	Lower Rio Grande Valley HBA	Workshop	128
4/5/2007	Lower Rio Grande Valley - Harlingen	Demonstration	9
4/5/2007	TCEQ Region 15	Workshop	6
4/6/2007	Lower Rio Grande Valley-Brownsville	Demonstration	0
4/19/2007	NewBraunfels HBA	Workshop	54
4/20/2007	NewBraunfels HBA	Demonstration	20
5/21/2007	SCIECA-San Antonio	Presentation	21
6/26/07	GBRA-Kyle-Plum Creek	Demonstration	29
7/10/07	GBRA-Lockhart-Plum Creek	Demonstration	16
	Year-end totals	**5-W, 12-D**	**420**
	TOTALS	**28-WORKSHOPS 30-DEMONSTRATIONS**	**1,614**

At all of its outreach activities, the SBEA distributed compact discs containing the presentations, together with a wealth of reference information including technical and regulatory guidance documents. A current version of this electronic resource is posted on the TCEQ web site at http://www.tceq.state.tx.us/assistance/compost/stormwater_control.html.

Outreach and Demonstration Examples

Fort Bend I.S.D., Rosenburg
Larry Curlis, Director of Operations Fort Bend I.S.D. attended a workshop held in Houston. He became so impressed with the water saving potential that he implemented compost use on some of their practice fields.

Barton Creek Development, Stratus Property Company, Austin
In 2005, a 10 million gallon detention pond had to be built in a multi-million dollar subdivision. It left a wide area of exposed white rock as a result of excavation and caused the neighbors who overlooked the site to complain. Several traditional options were considered such as concrete, but this would not have corrected the hole's aesthetics. The Ken Gorzycki, the golf course superintendent had attended a compost workshop and spoke about the TxDOT projects and accomplishments by using compost. As a result, it was decided to try a compost/mulch and grass seed blend for revegetation. They were able to overcome the challenge of applying this material on a very tall 1:1 slope resulting in a 70 percent vegetative cover within two weeks. To date the site continues to flourish with grass and wildflowers.

Chester W. Ditto Golf Course, Arlington
This is one of four city-owned and –operated golf courses. The City of Arlington has one Audubon Signature course. Superintendents at the other three are given autonomy and typically use traditional management practices. After attending an SBEA workshop, the superintendent of one of the "traditional" golf courses was looking to reduce irrigation and pesticide use. His course is surrounded by established residential development and thus is heavily used. He began testing compost use on his course to determine how it would integrate with other operations, the golfers, and overall aesthetics. Because of the positive results, the city is discussing conversion of all its golf courses to an organic approach using compost.

K.B. Homes and Rylander Homes, Houston
Two national production home builders have successfully incorporated the use of compost, mulches, and mulch filter tubes in their Houston division operations. Both builders have been pleased with the results, in terms of effectiveness and of financial considerations. They have been able to reduce storm water control costs by more than 50 percent per site.

North Texas Tollway
The original purchase of compost for this project was 50,000 cubic yards. Additional orders for 80,000 cubic yards were placed.

Attachment B7: Compost & Manure Inventory Results for CMIP Compost Facilities

Compost facility	Date of inventory	Total Tons Manure & Product on Site (Cubic Yards)		
		Surge Piles/Old Manure	In Process or Product	Total
Organic Residuals Reclamation	June 15, 2005	0	5,621	5,621
Texas Best Compost	May 27, 2005	34,650	123	34,773
Bosque River Compost	May 27, 2005	0	9,750	9,750
Gustine Compost	May 26, 2005	20,000	4,500	24,500
Dairy Cow Compost	May 26-27, 2005	29,287	5,929	35,216
Producers Compost	May 26, 2005	15,725	32,389	44,182
O'Neals Compost	June 16, 2005	15,394	8,562	23,956
TOTALS		115,056	66,874	177,998

Attachment B8: CMIP: End of Project Questions for Compost Operators, June, 2007

Compost Operation	ORR	Producers:	O'Neals	Bosque River	Dairy Cow
What 5 things have been most helpful to your company in the last 5 years? See last page for a list of possible factors.	DMES program -- got dairymen involved. The ULSWCD rebate helped -- a little market expansion	Establishing the TxDOT market -- it is still almost their exclusive market. Hauling reimbursement was also critical. Cooperative trucking arrangements with some other composters has been helpful. TCE advocacy & assistance helped. Also, list of potential city customers was helpful but yielded very little in sales. Joint venture with Microgy very promising for future.	CMIP rebate has been the biggest help. The loss of the manure hauling reimbursement was not a problem (O'Neals became ineligible for the hauling reimbursement by 2004). Going to a 50-50 blend of manure and mulch in composting has greatly improved product. Rising fertilizer costs are increasing interest in compost.	Biggest factor is people -- Technical assistance from RAA, TCE, TCEQ and TxDOT. Important in resolving frequent contractor/purchaser confusion. Rep. Sid Miller intervention with TxDOT. And at long last, prices rising.	Establishing the TxDOT market. Still the biggest market. Joint venture with Shamrock Soil Products, opened up many new markets

Compost Operation	ORR	Producers:	O'Neals	Bosque River	Dairy Cow
What 5 things have been most unhelpful to your company in the last 5 years? See last page for a list of possible factors.	Lack of enforcement of compost quality and other rules of the program, such as time & temperature. Allowing operations to ignore this gave the area's product a bad name. Also, Rain this spring has shut operation down.	Changing requirements of CMIP program: ponds not initially required. Would have planned site differently if we participated at all. Market leads from RAA not helpful due to distance, nature of material -- intrinsic manure product limitations: too heavy for bagging. CMIP paperwork was not a problem. ULSWCD office was confused, not responsive to questions.	Switches in requirements from TxDOT -- O'Neal spent thousands of dollars to meet TxDOT specs, then the special spec provided other composters who did not make the effort a way to avoid it. Also, inconsistencies of testing results, and inconsistency in customer payments. Some delay or avoid payment; O'Neal has had to get contractors to help pressure buyers. Also other vendors giving the product a bad name by supplying shoddy product.	The unlimited hauling allowed in DMES initially and excessive reimbursement rate resulted in a rush on equipment, scarcity of trucks. Now, not enough pressure on dairies to haul out more: hard to get dairies to pay ~$45/truckload cost of haul-out, but has improved. Cost-share, tech assistance programs continue to support land application. High, increasing freight costs have hurt. TxDOT market has been very difficult; $400-500 testing cost quarterly. Not planning to pursue further. Also ULSWCD rebate had too many strings, more hassle than it was worth. STA testing program involved too many changes, contractors were often confused -- RAA was helpful in resolving issues.	TxDOT specifications -- contain several elements not reasonable for manure products, particularly pH (even after wood material addition). Uncertainty about compost testing results. Very inconsistent results particularly with E coli and salmonella. Also manure quality -- dairies resistant to manure pack for pathogen concern reasons, tend to scrape up a lot of rock.

Compost Operation	ORR	Producers:	O'Neals	Bosque River	Dairy Cow
Who or what group provided each of those forms of assistance above? See list of technical assistance providers on the last page.	Ellen of the DMES office was particularly helpful	See notes above.	Very little effect of outside help. Most understanding of processing methods came from visiting the Black Cow (Bono?) composting operation at the very beginning of the program. TCE's concept of blending OM into compost useful, but changing specifications created confusion.	See above	
How did you first learn about the project, and what were the top factors that convinced you to participate in this project?	Sabino Cortez of Erath Earth, who was already participating in 2000, discussed a joint venture with Paul Fagan.	[Jim and Jef Beyer, original site operator/owners, attended early information meetings for area dairy operators in 2000.]	Son Darrell told him.		

Compost Operation	ORR	Producers:	O'Neals	Bosque River	Dairy Cow
How have you changed your operation over the last 5 years? Have you changed equipment? Have you added services, such as compost spreading/topdressing?	Very little change -- using same windrow turning equipment in the same way. Main change is more selectiveness in accepting manure	Yes, we have changed operation: kept same equipment but added services, including application of compost. Very little change -- well-financed from the beginning, with $1 million providing capital for original equipment. However, the joint venture with the gas plant may result in big changes. Very different material, lighter and much higher in OM.	Started out with screeners having gas engines; has changed to electric motors. Added 2 bigger articulated loaders and 3 18-wheel rigs. Basic method the same -- loaders. Maintains higher OM level than windrow turning.	It has been a major learning experience: experimentation with equipment, with much help from RAA. Fortunately, local clay has provided good surface, can work on it after one day of dry weather.	Biggest change has been joint venture with Shamrock Soil Products, which provides wood chips and marketing. Compost now typically 25% wood, 75% manure. Developed new product line -- liquid foliar feed product from manure extract, molasses & emulsified fish. Have also added an old bagger, very labor intensive.
What would you have done differently starting out if you could do it over? What are the most important things you have learned in this venture?	Would have been more restrictive about manure to be accepted. Learned critical need for consistent manure inputs.	Would not have entered into the business if the requirements for site design and construction had been known at the beginning			Being more selective about manure. Now only accept from 2-3 large dairies (Aurora, Excel), which keeps this 9-acre operation fully occupied.

Compost Operation	ORR	Producers:	O'Neals	Bosque River	Dairy Cow
Are there compost product types or uses that you have been particularly successful in selling, such as turf top-dressing or erosion control?	Primarily selling wholesale for retail distribution. The primary bulk sales/uses are for athletic fields & golf courses. Have discontinued TxDOT sales.	Top dressing. Have sold a lot to TxDOT for Compost Manufactured Topsoil, both preblended and blended on site, as well as Erosion Control Compost. Some sales to farmers for pasture land, but not many can afford it. Total of 300-400 loads sold for pasture use.	Most sales to farmers and landscapers. Some specialized products like finely ground material for golf courses. Landscaper in Hamilton buys 2-3 loads per week. Surprising success helping trees recover from disease. Friends are regular buyers -- for hay & oat fields.	Largely wholesale compost for retail distribution	TxDOT still primary market. Picking up more business in landscaping market in San Antonio & Austin, some agriculture sales (including foliar feed for organic producers of sorghum, corn, sudan, coastal), some local distribution sales, nurseries in Abilene & Brownwood. Distribution network for cedar & native mulch all over has opened compost markets.

Compost Operation	ORR	Producers:	O'Neals	Bosque River	Dairy Cow
What are your plans and prospects for your company/venture? Do you expect any expansion or other changes in the near future?		No expansion or change planned. Possible new product types and markets for composted residue from digester, which has much higher organic matter content (due to removal of inert material in preparation for gas plant).	Same moderate scale activity. Personal use on ranch land near Evant as fall-back. Has had to minimize activity temporarily during recovery from surgery.	No major changes. Planning to apply under revised permit with irrigation plan. Trying to interest Stephenville in yard waste diversion; possibly sludge. Investigating frac sand -- backflow after well pumping; need chlorides testing	Good prospects; plenty of ongoing contracts for compost, mulch, and soil blends. Plan to add new bagging equipment, 28 bag/minute capacity. Extracting microbes from compost blended with molasses & emulsified fish for a liquid foliar feed product (fertilizer substitute) being used around Mexia -- sprayed after each cutting, helps break down crop residues.
What you would want others to know about the TCEQ compost project? What has it accomplished, and where has it fallen short?		Needed assurances from the beginning about what will be required of the site. Went in expecting total of $2000 for site preparation; later had to develop 3 ponds at a cost of $80,000.	The problem of "crooked dealings" by other operations. Example – reported that another operator entered conversation with him implying interest in buying his operation, then used the information to convince a buyer he was not capable of supplying their needs.		Need realistic specifications for manure compost; relate to specific soils & their needs. Typical compost specifications are tailored to the properties of yard waste compost.

Compost Operation	ORR	Producers:	O'Neals	Bosque River	Dairy Cow
What lessons did you learn to help you move forward? Who or what taught them to you? See last page for possible sources.		TxDOT provided practical information needed.	Black Cow (Bono) compost operation provided model.	Equipment, process options; several marketing leads. RAA most helpful	There is a 3:1 volume reduction in the compost mix. Overs provide an excellent compost starter, cutting time of composting in half.
What is your status in terms of finances and prospects for continued operation?		$1 million in the hole -- original investment still not paid back, although operating costs, expenses, & interest have been covered. The arrangement with the gas plant (methane digester) is what is keeping things going now. Don't expect to get continuing sales from many customers -- sales are dwindling. Centex is the primary buyer now, for TxDOT jobs. This company believes in the value of the product.	Good. Can always use compost in own ranching operation if sales fall through.	Good. Recently became much more confident of continuing sales to distributors.	Good

Attachment B9: Method Used to Develop Quantity of Dairy Manure Available for Hauling from the N. Bosque and Upper N. Bosque watersheds

Dairy cattle numbers: estimate derived from several sources by TAIER during TMDL development: 40,450 dairy cows. The goal as shown in Figure 1 of this report varies year by year according to the TCEQ Dairy Outreach Program Area office annual estimates of cattle in the two watersheds. The following calculations use the reference figure of 40,450 dairy cows.

Amount of manure produced by one dairy cow per year, based on documentation from Dr. John Sweeten of Texas A&M provided to Camp Dresser & McKee for use in the Brazos River Authority Report, "Erath County Animal Waste Management Study," September 1998.

- 3.07 tons manure/lactating cow/yr **on a dry weight basis**
- 2.36 tons dry-handled manure/lactating cow/yr **on a dry weight basis after deducting the 23% of total manure in the area that is flushed** into lagoons and not recovered by solids separation
- 2.36 tons dry-handled manure X 2 = 4.73 tons dry-handled manure/lactating cow/yr (after deducting flushed manure) **at 50% moisture**, the typical condition of manure when loaded on trucks

Total dry-handled manure in watershed as collected: 40,450 cows X 4.73 tons/cow/yr = **191,328 tons/yr**

Goal of hauling out 50% of dry-handled manure: 50% of 191,328 = **95,664 tons/yr goal (for 40,450 cattle)**

****

"COLLECTIBLE MANURE"
Dr. Sweeten derived a figure of 43% of total manure production being "collectible," deducting not only the flushed manure but also 1/3 of the total manure generated in open lots, which he believed would be rendered unsuitable for composting by mixing with soil & rock. If the goal were 50% removal of "collectible manure" by Dr. Sweeten's definition, the goal for 40,450 cows would be

- 3.07 dry tons X 43% = 1.32 dry tons/cow/yr X 2 = 2.64 tons/cow/yr as collected
- 2.64 tons/cow/yr as collected X 40,450 cows = 106,800 tons/yr
- 106,800 tons/yr X 50% haul-out goal = **53,400 tons/yr goal**

However, the CMIP staff determined that manure collected under this program did not exclude anything like 1/3 of the open lot manure from collection and hauling, so this adjustment for "collectible manure" only excluded the portion documented to be flushed into liquid manure management systems.

EQUIVALENCY OF ONE TON MANURE TO ONE CUBIC YARD COMPOST

Dr. Sweeten calculated the amount of compost yield in cubic yards based on an assumption of 50% shrinkage of the starting manure volume during composting and a final compost bulk density of 1000 lb/CY. On that basis, he calculated that at most, a ton of manure would yield a cubic yard of compost, and that if the manure starts out at 1600 lb/CY, then a ton of manure would only yield about .62 CY of compost (that is, a cubic yard of compost would represent 1.6 tons of manure).

Measurements taken during the CMIP indicated the manure as received by the compost facilities was around 1600 lb/CY. However, given the high beginning bulk density of the manure, project staff are inclined to believe the shrinkage during composting is less than 50%. Also, staff allowed bulking material to be added to the manure, which was used minimally until the last year of the project but then grew substantially. So, staff are inclined to be more conservative than Dr. Sweeten's conversion estimate of one ton manure yielding .62 CY compost, using his most conservative estimate of one ton manure yielding one CY compost, as a rough but conservative estimate of how much manure is behind each CY of compost.

Attachment B10: Calculation of Total P and N Content of CMIP Compost Sold

Average properties of 2005 quality-assured A&M sampling and TMECC-testing of 14 composite samples of compost representing all participating compost facilities:

Bulk density: 64.6 lb/cf x 27 cf/cy = 1745 lb/cy

Phosphorus content: 2529 ppm P (see table of data from representative samples below). One pound compost contains 0.002529 lb P

Phosphorus pounds per cubic yard: 0.002529 lb P per lb compost X 1745 lb/CY compost = **4.4 lb P per CY compost.**

Total Nitrogen content: 0.63%. One pound compost contains 0.0063 lb N.

Nitrogen pounds per cubic yard: 0.0063 lb N per lb compost X 1745 lb/CY compost = **11 lb N per CY compost.**

As of the end of FY2005, total of 207,700 CY of composted manure had been exported from the North Bosque:
207,700 X 4.4 = 913,880 lb P exported
207,700 X 11 = 2,284,700 lb N exported

As of the end of FY 2005, a total of 316,600 CY of composted manure had been exported from the total project area including the North Bosque and Leon River basins:
316,600 x 4.4 = 1,393,000 lb P exported
316,600 x 11 = 3,482,000 lb N exported

Raw data on N and P content of the 13 compost samples from QAPP sampling, 2005, excluding duplicate samples

Sample #	P	Organic N	Nitrate	Ammonia
	Mg/kg	%	Mg/kg	Mg/kg
1	2619	.48	348	36
2	2885	.50	72	339
3	3306	.56	208	91
4	3734	.64	471	100
5	2587	.64	305	22

6	2791	.88	202	171
7	2896	.91	32	543
8	1590	.85	18	196
9	3219	.61	265	284
10	1467	.45	296	93
11	1637	.36	282	96
12	2350	.41	152	99
13	1792	.36	44	331
Total	32873	7.65	2695	2401
Average	2529	.59	207	185

Nitrate + Ammonia averages .04%. Organic N + Nitrate + Ammonia averages .63%

Attachment B11: CMIP Rebate User Site Visits Report (2007)

Site Visit Host	Areas, Application Methods and Practices	Comments on Performance and Prospects
CSJ[1] 0836-02-044 TxDOT SH 195 near Killeen Ali Bashi	Roadsides & median were treated with 1" layer, then blended in place with a tiller on a bobcat along an 8-mile stretch of roadway. Alternate treatment is topsoil, fertilizer, & seeding. On steeper & taller slopes, used fiber blanket over Compost Manufactured Topsoil (CMT[2])	Satisfied. Now use CMT on almost all jobs since this CSJ was done. Compost substitutes for fertilizer.
City of Waco Graeme Siebel	1. Airport entrance: 50-50 mix of composted manure with soil on an earthen mound at the entrance sign. The mound needed improvement; it was redone recently with compost, planted in jasmine, which requires watering. Compost helped with water holding capacity. 2. Heart of Texas Soccer fields – topdressed 160,000 sq ft about 3 years ago. Had to remove a lot of rocks from compost. Routinely add 6 lbs of N per 1000 sq ft. 3. Previously grew trees potted in 100% compost. The tree nursery was later ceded to a college in a land swap. It used local compost made by the City.	1. Happy with the results in the airport mound planting area. 2. Rocks were a problem in the turf treatment load, but not in the other. The City required the contractor to remove the rocks.
CSJ 0049-02-009 SH 6 near Riesel Tony Moran & David Beard	Applied dairy compost starting at the Riesel end of CSJ on northbound side and went all the way, using a slinger truck with 2 paddles. Later on the opposite side used a standard manure spreader hauled behind a truck. Compost came from Gustine and ORR. Originally compost applications were not followed by fertilizer, but fertilization following compost had begun at the time of the site visit.	Seemed to be a very slow, labor-intensive process to apply, then incorporate the compost. More Johnson grass seemed to come up with compost applications. However, intend to continue using CMT on new projects. Observations: Grass was ready to mow, almost fully mature and seeded, with good coverage. This was the case with almost all TxDOT sites.

CSJ 0048-09-023 Three-mile stretch of IH 35 at the East/West split in Hillsboro Charles Padgett	Several applications: (1) berm running along a corn field at the edge of the highway right of way; (2) compost logs as check dams in a roadside drainage swale/ditch; and (3) CMT application across the right-of-way.	Mr. Padgett tried compost berms, logs, and CMT, and has discontinued all such uses. 1. The berm burnt the grass surrounding it, didn't let anything grow on it (no seed germination) for several weeks. It also became infested with insects, and was subsequently torn up by armadillos, skunks, opossums, etc., and served no purpose. 2. He tried logs across swales in various configurations such as V's and U's, but nothing worked. The flow washed out the material through the mesh in high-flow areas. Also, even when partly buried, water always undercut them. They were all torn out and replaced by silt fences and rock filter dams. 3. CMT provided no benefit since the local black soil is very good "when properly seeded and fertilized." Addition of compost seemed to prevent appropriate compaction for erosion resistance. General comments: Design contractors don't seem to understand BMP options and what they can & can't do. Mr. Padgett was still open to new ideas. He thought compost/mulch logs might make sense as a wrap for drop inlet protection.
CSJ 0172-04-028 US 287 in Midlothian John Kiser	Blade/loader application of 4" of CMT, mostly pre-blend (4:1 mix of embankment material with compost). First, resurface job with "embankment material" – clean soil – then add compost,	Similar to results of topsoil applications which it replaced. Continuing to use dairy manure compost in CMT on almost all projects.

	then seed with fertilized hydromulch, then water as needed. Plant Dallas District TxDOT seed mix with winter wheat as temporary seeding. Also use a lot of soil retention blankets where erosion potential is the highest. Very helpful in Midlothian area – a large hill with bad soils, highly expansive shaley clays. In the past have had to import topsoils.	
CSJ 2374-03-054 IH-20 in Dallas Phil Crabtree	Loader spread material which was then tilled. Alternative is topsoil replacement. Topsoil is not replaced when using CMT; they mix compost into 4" of surface material/spoil. Apparently using standard fertilization together with the CMT.	Observation: good grass cover, particularly in the roadside area above a concrete apron. Fully mature grass mix.
CSJ 8050-18-032 Lake June Rd & Belt Line, Dallas: Phil Crabtree	Applied CMT to both sides of a stretch of Lake June Road, including slopes on 4 corners and 2 sides of a large intersection with I-635.	Nice, dense turf areas well maintained along this suburban roadway.
CSJ 2374-02-098 IH-635 in E Dallas near US 80 Phil Crabtree	Major highway intersection: landscaped and turf areas on 4 corners of a bridge over IH-635. All were treated with CMT. Mulched areas with trees and a grass swale, with a shrub row on one side of the bridge. The turf appears to have been installed as sod.	Observation: Vegetation was healthy and good coverage.
UT Southwest Medical Center, Dallas Cheryl Sewell	Compost was broadcast over a newly constructed grass area that had been failing on a large hillside. Compost was applied from the crest of the hill down to about 20 feet above a creek flowing through the property. It was overseeded and aerated as well 2 years in a row. Formerly bare and yellowed areas have recovered, the turf color is much better, and even the trees have improved – many	The property managers were very happy with the results. The significant restoration of the site was mostly attributed to the manure compost. However, they discontinued its use in ongoing maintenance due to the hauling cost and the availability of local compost in Dallas. They would prefer to use the Bosque manure

	had been failing prior to the compost application. This hillside had been formed during construction of a new building with much construction debris and poor subsoils at the surface. The primary philanthropist funding the new building was unhappy with the initial landscaping and pressured the Center to repair it. The dairy compost proved to be a most important tool in the restoration.	compost and would buy it if it were cost-competitive locally. Observation: the landscape looked very healthy.
North Lake College, Irving Vicki Wheeler	1. A baseball field was mostly bare before the compost application was made. The existing soil did not support grass. The staff "aerified" the field running in 4 directions, then applied 1" of compost with a topdresser, then dragged with a drag mat to smooth but did not till or incorporate. Then overseeded with common Bermuda and hydromulched. Fertilized it every 2 weeks with 2 lb N per 1000 sq ft. Each application resulted in improved fertilizer performance, intense growth, and better wear tolerance. 2. With left-over compost, staff experimented with addition of about ¼" layer of compost tilled into flower beds when the flowers were changed out. The results were even more dramatic than with the ball field, and is now standard practice for the planting beds.	Staff are satisfied and look forward to continuing use. It was a great help in restoring a stressed ball field turf. Staff are still using the original compost stockpile. The staff attributed the idea of using the manure compost on ball fields to a local consultant, who cited Dr. McAfee of Texas A&M as the source of the idea.
City of Farmers Branch Robin Edwards	Four separate use sites: 1. Dallas Christian College soccer complex – 10.4 acres of playing fields & perimeter. Applied a very light, less than ¼" topdress layer with a rented Turf Tiger broadcast spreader. 2. Cox soccer complex: light application to add organic matter about 4 years previously.	1. The material was very sweet and workable, no objectionable odors. 2. Performance has been hard to determine; the fields were already intensively maintained, fertilized every 1 to 4 weeks, frequently aerated and watered. Now mowed

	3. Farmers Branch Park: 13 acres, less than 2 years ago. 4. Valley View median planting beds, for the primary purpose of reducing moisture loss from the beds, as well as other benefits	twice a week. 3. Odor problem occurred with the most recent load: complaints came from blocks away, but particularly from an adjacent grocery and restaurant. Previous load had had a gravel problem, which was cleaned up by the contractor. The director has said he will not use composted manure at this site again. However, it did have the benefits of reducing compaction, very important in high-use areas. Staff see the primary value of the compost in building the soil profile, introducing beneficial microbial activity, and so on (based on study of horticulture). Experience has shown that the compost consistently causes an almost immediate greening-up of turf and reduced damage to the turf. 4. There have been reduced watering needs on the median.
Southlake: Bicentennial Park Terry Lee	Topdressed almost all turf areas with about ¼" layer of compost	Marked improvement occurred in ballpark areas that had been bare or had poor growth. Compost seemed to help where excess sodium had made some grass chlorotic. There has been a rapid short-term greening, lasting about a month after application. The turf has been strengthened against wear. The compost handled well, generating only minor short-term odor after spreading. Financial note: this was one of the few cases in which the government returned the compost rebate to the

		budget from which the compost was purchased.
Southlake: Bob Jones Park Shane Cloud	Topdressed soccer fields only	This program was using compost as one component in a gradual process of building the soil profile, as well as for fertilizer value to green up the turf. The compost arrived still steaming wit some odor for a while, but did not generate complaints and no problem spots where used. The rebate process went smoothly. The program would like to use composted manure 2 times per year or at least annually.
CSJ 074703073 Roy Lankford	CMT was applied with a belt-propelled side discharge spreader driving on the highway shoulder. The application was about 1" deep and tilled into 3" of soil with a disc, then seeded. Watered until 70% grass coverage was accomplished. The alternate treatment would have been rplacement of topsoil. Bermuda seeded for permanent cover.	Compost seemed to result in faster initial grass coverage and in better moisture holding properties.
City of Arlington: Tierra Verde Golf Course Marc Calburn	1. Divot replacement mix, ½ sand & ½ compost, used to fill all divot holes. 2. Fairway & green topdress with 1/8" compost monthly year-round 3. Topdress along edges of the rough for wildflower plantings 4. Monthly heavier top-dressing where wear is greatest and where drying out is a concern, primarily in the sandy areas. 5. Used as a conditioner in all planting beds; "eyeball" the amount needed to get the desired soil texture	The golf course was continuing to order Bosque manure compost after the end of the rebate. Had not always requested the rebate when available, just forgot – the rebate was not a major concern. Quick greening effect was observed after compost applications. Horticultural purposes cited were organic matter, improvement of cation exchange capacity, nutrients, and moisture retention.
CSJ 0080-08-017 Acton,	On 3:1 slopes, 3" application of ECC[3]. On normal roadsides the application was 1" of 100% dairy compost, not tilled,	TxDOT had some problems with some of the CMIP sources meeting organic matter & salt

Hood Cou Marc McEndree	planted in as-is. All applications have been blown on. On very steep slopes, they placed fabric blankets over the ECC. Seeding has been by hydromulch. Fertilizer use has been discontinued. They usually use permanent seeding with temporary applications, because they often succeed (which is not as reliable with other soil treatments).	specifications, but two suppliers continued to meet specifications. Some of the areas successfully vegetated with compost had not had success with previous practices. A couple of loads delivered early on were immature, had odor & fly problems, Sometimes TxDOT has found contractors using compost to cover up inadequate grading. TxDOT has started converting from rock filter dams to compost socks. Reuse of rocks in washed-out areas is no longer done, so removal of rock dams became a problem.
CSJ 2398-01-036 Abilene Alan Hufstutler	Most areas were ripped and CMT was blended on-site, about a 1" application then tilled in. These treatments are not always "dressed" or compacted. Contractors typically watered only as needed to get vegetation established, typically a ¼" depth 3 times per week. On a "header" slope of a bridge approach, vegetation had earlier failed and there had been a lot of rill erosion and soil wash-out onto the access road. TxDOT applied 4" of CMT and topped it with a heavy application of a sprayed-on product at 3500 lb/acre rate. This was a great success.	The Abilene area has a serious challenge with highly erodible gypsum-based alkaline soils. Compost makes a big difference, but the local TxDOT office cannot afford effective application rates in many cases. One-inch applications often have little effect. Mr. Hufstutler noted that TxDOT inspectors who farm have a better handle on what it takes to get grass established than most of the landscape architects.
Lingleville ISD Lingleville High School Dennis Hughes	The construction contractor arranged the purchase of compost in 2001 and applied it to the grounds all around the new high school, which had been mostly a bare caliche surface with weed and wildflower patches only. The compost was spread with front end loaders to a 2" depth, dragged with a harrow, and hand-seeded	The superintendent was "shocked" at how fast grass was established on the formerly bare ground. Grass cover has remained very good without further maintenance, despite the regular use of the grounds as an athletic field.

	with common Bermuda. The school irrigated it well the first year but has not watered it since. The remaining compost material was added as a 4” layer in flower beds in front of the administration building.	

[1] CSJ stands for Control-Section-Job, a term for TxDOT projects. It identifies the specific job and the area being constructed or maintained.
[2] CMT stands for Compost Manufactured Topsoil, a 3:1 blend of soil with compost, sometimes “blended in place” (1” compost layer tilled into the top 3” of soil).
[3] ECC stands for Erosion Control Compost, a 1:1 blend of compost and wood mulch.

Attachment B12: **Total P removal for 6 years of manure haul off (/year/unit area):**

Fiscal Year	Total P removed Kg/ha/Yr	Total P removed lbs/ac/Yr
2002	1.28	1.16
2003	0.82	0.73
2004	4.55	4.06
2005	2.20	1.97
2006	2.54	2.27
Subtotal 2002-6	**11.39**	**10.19**
2007	2.23	1.99
Total reduction from all cropping systems and soil types	**13.62**	**12.18**
Average reduction per year from all cropping systems and soil types	**2.27**	**2.03**

Data from Texas Institute for Applied Environmental Research analysis using its North Bosque River TMDL model for phosphorus loading factors related to manure application fields

To derive an average annual P load reduction value per acre removed from manure application based on the table data above:
P removal in 2002-2006: 10.19 lb/ac total, divided by 5 years = **2.04 lb/ac/Yr** average
In FY 2007, a residual effect of removing **1.99 lb/ac/Yr** (even with resumed manure applications at N rate)
This table shows the high variability of load reduction effects year by year caused by different precipitation patterns and other variables unrelated to the amount of manure removed.

Using the above analysis to derive an annual P load reduction total from the program as a whole (both watersheds):
In 2002-2006, CMIP led to the export of **466,468 cubic yds compost.** Assuming the manure P content [0.52%; 10.4 lbs/ton] by dry weight is 2.36 times of what is in compost as sold [0.22%; 4.4 lbs/cy], 2.36 cu. yds. of compost will be equal to one ton of applied manure on a

dry weight basis as used in the APEX model. Therefore, the total dry weight manure hauled off in tons is equal to 0.423 X compost material in cu. yds. (e.g., 466,468 * 0.423 = 197,352 tons) of composting materials removed from the N Bosque & Leon watersheds in the same period. That is, an equivalent of
39,470 tons per year of **dry-weight** manure were removed from the watersheds on average during 2002-2006.
One acre is removed from manure application each year per 8.6 tons of dry-weight manure removed/yr (av. application rate)

- (converted from 19.16 metric tons/ha/yr, as provided by TIAER; 19.6 metric t/ha/yr / 2.47 = 7.9 t/ac/yr)

39,470 ÷ 8.6 = 4,996 **acres** removed on average from annual manure application over the period 2002-2006
4,996 acres removed from manure application X **2.04 lb/ac/Yr** P removal (2002-2006, see above) =
10,192 lb P per year removed from runoff. 2002-2006

- 6,523 lb P per year from the N. Bosque watersheds (source of 64% of the manure)
- 3,669 lb P per year from the Leon watersheds (source of 36% of the manure)

9,134 lb P residual removal for 2007.

- 5,846 (CORRECTION: 13,816) lb from the N. Bosque (64%)
- 3,3288 lb from the Leon (36%)

The P content of manure exported from watersheds per year on average, FY 2002 - 2006: 39,470 tons X 10.4 lb P/ton manure = 410,488 **lb P per year**

According to these calculations, the average reduction each year in edge-of-field P loading to runoff is just over 2.3% of the P content of the manure exported each year from the watersheds during 2002-2006.

<u>To illustrate what this means for a single acre</u>:

- 8.6 tons of dry-weight manure had previously been added every year, containing **86 lb of P**.
- With CMIP, the acre is now spared these applications of **86 lb. P per year**.
- During the 5-year period considered, the edge-of-field losses of P are reduced by an average **2 lb. per year**.

IMPORTANT ASSUMPTIONS:

The manure in APEX simulations

a. Was applied on dry weight basis,
b. Total P content of dry manure is 0.52% (10.4 lbs/ton),
c. Total P content of compost material is 0.22% (4.4 lbs/ton), and
d. Application rate was almost ½ of the regular wet manure application rate

ATTACHMENT C1: TEXAS COOPERATIVE EXTENSION REPORTS AND RESOURCES

LINKS

Link: Dairy Compost Utilization Project Web Page http://compost.tamu.edu/index.php

- Project Overview – tasks, deliverables, reports, etc.
- Compost Producers – compost producers, analysis of material and standards
- Compost Use Resources –dairy compost use information and copies of all project related presentations
- Photo Gallery – collection of photos from all demonstrations, dairies, facilities and other performing agencies
- Publications – all project related publications
- Research and Demos – overview, update and results of all project related field studies and use demonstrations
- Dairy Compost Utilization Project Final Report
- Appendices to TCE Final Report:
  A: Compost Facility Assessment Report
  B: Dairy Compost Quality Assessment – Seal of Testing Assurance results
  C: Organic Matter Improvement Study Report
  D: Modification of Low Quality Dairy Manure Compost
  E: Dairy Compost Use and Production Survey Results
  F: County Compost Use Demonstration Reports
  G: Texas Chapter of American Society of Landscape Architects article
  H: Texas Nursery and Landscape Association 6 Article series
  I: News Releases
  J: Example Story Tip
  K: Case Studies as News Releases
  L: Initial Fact Sheets
  M: Revised Fact Sheets: http://compost.tamu.edu/publications.php
    Compost Sampling Guideline
    Erosion Control and Revegetation Fact Sheet
    Sports Fields Fact Sheet
    Urban Compost Fact Sheet
    Establishing New Landscapes Fact Sheet
    Economics of Dairy Manure Compost Fact Sheet
    Compost Application Fact Sheet
    Corn Production Fact Sheet
    Forage Production Fact Sheet

Specialty Forages Fact Sheet
N: Texas Sales Calls and Literature Distribution
O: Research and Demonstration Reports http://compost.tamu.edu/research.php
Practice Verification Studies (7)
Demonstration Site Reports (7)
Case Studies (5)
P: Revegetation of Drastically Disturbed Roadsides on Fort Hood, Texas
Q: Green Turf: From the South end of a North facing cow

Attachment C2: Texas Department of Transportation Reports and Resources

LINKS

Utilizing Compost as an Alternative Method to Standard Seedings
Final Report 0-457101 (November 2003)
TxDOT Project Director: Ben Bowers, Maintenance Director
Authors: Fedler, Clifford B.; Pearson, Philip; Borrelli, John; Green, Cary; Galyean, Michael; Provin, Tony; Rivera, Daniel; Texas Tech University, Center for Multidisciplinary
Research in Transportation (TechMRT)

Characteristics of Composts: Moisture Holding and Water Quality Improvement
Final Report 0-4403-2 (August 2003)
www.utexas.edu/research/ctr/pdf_reports/0_4403_2.pdf
TxDOT Project Director: Barrie Cogburn, Design Division
Authors: Kirchhoff, Christine J.; Malina, Joseph F.; Barrett, Michael; University of Texas at Austin, Center for Transportation Research (CTR)

Effects of Using Compost as a Preventative Measure to Mitigate Shoulder Cracking
ftp://ftp.dot.state.tx.us/pub/txdot-info/rti/psr/0-4573-s.pdf;
http://tti.tamu.edu/documents/5-4573-01-1.pdf; http://tti.tamu.edu/documents/0-4573-2.pdf
Laboratory and Field Studies 4573-2, UT Arlington
TxDOT Project Director: Richard Williammee, P.E., Fort Worth District

Characteristics of Compost Filter Berms
http://tti.tamu.edu/documents/0-4572-S.pdf; http://tti.tamu.edu/documents/0-4572-1.pdf
0-4572, Texas Transportation Institute (TTI)
TxDOT Project Director: David Zwernemann, P.E., Design Division

TxDOT compost specifications (Item 161. Compost)
ftp://ftp.dot.state.tx.us/pub/txdot-info/cmd/cserve/specs/2004/standard/s161.pdf

TxDOT compost web page ftp://ftp.dot.state.tx.us/pub/txdot-info/gsd/pdf/yrr_march.pdf;
see also www.txdot.gov/services/general_services/recycling/recycleable.htm

Attachment D1: TxDOT CMIP COMPOST EFFORT TIMELINE

10/1-2/96	Master Composter Training (introduction to TNRCC)
7/15/97	Initial meeting with committee and Private/Public composters
1/98	Statewide Specification 1009 (later 1027) approved
6/20/01	Item 161 (compost specification) draft presented to SRC
9/27/01	Item 161 approved by SRC sub-committee
2/2003	Item 1058/1059 (compost application specifications) approved for use.
2003	Compost Socks used by one-time use specifications
3/18/2004	Item 1081 allows for low OM and high ph on dairy manure compost
6/2004	Item 161 appears in published 2004 spec. book

TxDOT Demonstrations (pre-workshop)

5/12/99	Big Spring
7/1 /99	Athens
8/16/99	Dallas
3/6/00	Lubbock
3/27/00	San Antonio
4/11/00	Killeen
5/18/00	Columbus
9/27/00	Laredo

TxDOT Workshops & Demonstrations

10/25/00	Wichita Falls
10/26/00	Paris
11/1/00	Childress
1/11/01	Brownwood
2/21/01	Yoakum
3/13/01	Odessa
3/14/01	San Angelo
3/20/01	Bryan
3/27/01	Abilene
9/18/01	Kerrville
9/26/01	Waco
10/25/01	Dallas
10/26/01	Decatur
11/1/01	Texarkana
11/8/01	Pharr
3/28/02	Lufkin
5/9/02	Corpus Christi
5/29/02	Beaumont

4/11/03	Amarillo
6/27/03	Austin
9/9/03	NTTA – Dallas
9/22/03	Dallas District Area Engineer's Quarterly Meeting (workshop only)
12/03	Meeting with Bob Daigh at Austin District

TNRCC Workshop Presentations

8/13/98	Stephenville
12/8/98	Amarillo (Alternative Waste Management Workshop)
3/25/99	Lubbock
4/8 /99	Bryan
1/20/00	El Paso
3/23/00	Bryan
4/13/00	Gonzales
11/14/00	Denton, NTSU Maintenance/Texas Recycles Day Event
2/20/01	Corpus Christi A&M
3/15/01	Cleburne
5/10/01	Bryan
11/7/01	McAllen
1/17/02	San Antonio
1/22/02	Austin (Barton Creek CC)
1/31/02	Galveston
3/20/02	Binational Water Quality Seminar, Ciudad Acuna

Conference Presentations

3/12/98	TNRCC Nonpoint Source Pollution Conference, Brownsville
5/6/98	TNRCC Environmental Trade Fair, Austin
7/ /98	Texas Compost Summit, San Antonio
11/4/98	TNRCC Composting Biosolids Workshop, Austin
1/27/98	TxDOT Road to Recycling Conference, Austin
7/26/99	Texas Compost Summit, Austin
2/14/00	TxDOT Construction Conference, Waco
10/11/00	TxDOT Transporation Short Course
5/22/01	BioCycle Conference, St. Paul, Minnesota
9/26/01	NRVMA, Waco
10/16/01	TxDOT Transportation Short Course
6/20/02	Texas Chapter US Soil & Water Conservation Society, Waco
7/10/02	WASHTO, San Antonio
7/11/02	Joint Quarterly Meeting (ENV, USEPA, US Fish & Wildlife, FHWA)
2/28/03	North Texas COG "Smartscape" Workshop, Arlington

8/25/03	Int'l. Conf. on Environment in Transportation, Lake Placid, NY
3/18/04	New Mexico DOT Compost Workshop – Santa Fe, NM
1/25/05	US Composting Council Annual Conference, San Antonio

District Presentations (pre-workshop)

2/10/00	Waco District Staff meeting
3/28/00	Corpus Christi District training
5/16/00	Ft. Worth Area Engineer's meeting
5/17/00	Austin District (Wes Burford/Terry Jackson/Robert Stuard)

REFERENCES

Texas Agricultural Experiment Station (TAES) and Texas Agricultural Extension Service (TCE). Feasibility of Large Scale Alternatives for Dairy Waste Recycling and Treatment, Erath County Region of Texas. October 15, 1991.

Brazos River Authority (BRA). Erath County Animal Waste Management Study. Camp Dresser & McKee. September 1998.

Assessment of Preexisting and Post-Implementation Effects for the North Bosque River Watershed: CleanWater Act Section 319 Report. Anne McFarland and Jimmy Millican, Texas Institute for Advanced Environmental Research, August 2006 http://tiaerweb.tarleton.edu/pdf/PR0602.pdf

Interim Annual Assessment of Water Quality Trends for the North Bosque River through 2006. Anne McFarland and Jimmy Millican, Texas Institute for Advanced Environmental Research, June 2007.

Semiannual Water Quality Report for the North Bosque River Watershed, January 1, 2002 - December 31, 2006. Todd Adams and Anne McFarland, Texas Institute for Advanced Environmental Research, January 2007.

Impacts of a Manure Composting Program on Stream Water Quality. A. Bekele, A. M. S. McFarland, and A. J. Whisenant. Transactions of the American Society of Agricultural and Biological Engineers, 2006. Vol. 49(2): 389-400.

Maryland's Manure Transport Program:
http://www.mda.state.md.us/pdf/MDAtransportrepr305-2.pdf