NC ORGANICS RECYCLING STUDY: MATERIALS MANAGED 2011-2015 & FOOD RECOVERED 2015

Environmental Assistance and Customer Service
ENVIRONMENTAL QUALITY

North Carolina Department of Environmental Quality
Division of Environmental Assistance and Customer Service
Recycling and Materials Management Section

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ABOUT NCDEQ DEACS RAMMS

The N.C. Department of Environmental Quality's Division of Environmental Assistance and Customer Service (DEACS) offers assistance to local and state agencies, businesses, and residents throughout North Carolina for a wide range of environmental issues. Through its technical services, DEACS helps its customers: navigate regulatory and permitting challenges; become more environmentally efficient and make the most of available resources; achieve and be recognized for environmental excellence; contribute to economic growth; and understand how to address environmental problems.

NCDEQ's DEACS Recycling and Materials Management Section assists private and public sectors through technical support and grant funding. The Recycling Business Assistance Center provides assistance to start-up, existing, or relocating recycling businesses, and works one-on-one with recycling companies to assess needs and provide direct and indirect assistance. The Local Government Recycling Assistance Team supports NC municipalities and counties in operating cost-efficient and effective recycling programs.

CONTACT

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EXECUTIVE SUMMARY

This study highlights the materials managed at commercial composting facilities for the past five years and analyzes the food recovery efforts through four strategies: food rescue, animal feeding operations, commercial composting, and anaerobic digestion. North Carolina established a number of solid waste statutes in the early 1990s that drove the development of the regulated commercial composting industry. This early state government encouragement (including a yard waste landfill ban effective January 1993) in combination with strong private sector investment has created a healthy commercial composting industry with 87 composting operations statewide that service the needs of millions of residents. This past year, 52 facilities (permitted by N.C. Department of Environmental Quality's Division of Waste Management) reported receiving more than 600,000 tons of organic material, creating approximately 219,000 tons of Grade A compost and 194,000 tons of mulch, and selling to the public approximately 58 percent of all material processed.

New federal encouragement for organic waste diversion is coming from the U.S. Environmental Protection Agency and the U.S. Department of Agriculture to reduce food waste by 50 percent by 2030. Fortunately, North Carolina has a robust food recovery infrastructure, consisting of commercial composting facilities with enough total permitted capacity to process the majority of the excess food to meet the EPA/USDA's goal, and a large, growing network of food rescue organizations, animal feeding operations, anaerobic digestion facilities, and private sector corporate sustainability and zero waste goals in place. The combination of all these pieces — support from state and local governments and corporate commitments coupled with non-profit and private sector diversion services — is crucial to diverting organic materials from the landfill, creating jobs, improving soil health, reducing hunger and meeting the federal food waste reduction goal.

INTRODUCTION

This study analyzes the materials received and products created at permitted composting facilities from 2011 through 2015 as well as the impact of various food recovery activities in 2015.

North Carolina has been composting for decades with some communities composting food scraps commercially since the 1990s. Materials received and composted at commercial composting facilities have been reported to the state since the late 1990s. Overall, this study addresses the need for citizens, as well as the public and private sectors, to understand the commercial composting infrastructure and how it helps better manage organic material streams.

Support from the public and private sectors has been instrumental in increasing the existing infrastructure. Other contributing factors influencing the development of the infrastructure are these four NC General Statutes:

§ 130A-309.04. State solid waste management policy and goals.

(a) It is the policy of the State to promote methods of solid waste management that are alternatives to disposal in landfills and to assist units of local government with solid waste management. In furtherance of this State policy, there is established a hierarchy of methods of managing solid waste, in descending order of preference:
(1) Waste reduction at the source;
(2) Recycling and reuse;
(3) Composting;

§ 130A-309.09B. Local government waste reduction programs.

(a) Each unit of local government shall establish and maintain a solid waste reduction program. The following requirements shall apply:
(3) Units of local government are encouraged to separate marketable plastics, glass, metal, and all grades of paper for recycling prior to final disposal and are further encouraged to recycle yard trash and other organic solid waste into compost available for agricultural and other acceptable uses.

§ 130A-309.10. Prohibited acts relating to packaging; coded labeling of plastic containers required; disposal of certain solid wastes in landfills or by incineration prohibited.

(b) No person shall knowingly dispose of the following solid wastes in landfills:
(3) Yard trash, except in landfills approved for the disposal of yard trash under rules adopted by the Commission. Yard trash that is source separated from solid waste may be accepted at a solid waste disposal area where the area provides and maintains separate yard trash composting facilities.

§ 130A-309.11. Compost standards and applications.

(a) In order to protect the State's land and water resources, compost produced, utilized, or disposed of by the composting process at solid waste management facilities in the State must meet criteria established by the Department.

General Statutes 130A-309.04 and 130A-309-09B both affirm the state's support for alternative disposal methods for solid waste and the encouragement of local governments to compost. **General Statute 130A-309.10** banned yard waste from municipal solid waste landfills (yard waste is still allowed to be disposed of in land clearing and inert debris (LCID) landfills, although many of the LCID landfills recycle the yard waste and sell it as mulch or compost). Lastly, **General Statute 130A-309.11** provides the guidance necessary for the N.C. Department of Environmental Quality's Division of Waste Management to develop the composting rules (**15 NCAC 13B .1400 Rules**), which were issued in 1996. This created a path to regulate the production of soil amendment products manufactured from byproducts (organic solid waste material) of other processes, such as agricultural and manufacturing operations, city yard waste collection programs, leftover food, manures from animal operations, grease trap from restaurants and other organic materials.

Besides the initial North Carolina legislative support to divert organic material from the landfills, the most recent international and national governmental support comes from a United Nations agreement released in September 2015 and a similar joint agreement released in October 2015 by the EPA and the USDA establishing a food waste reduction goal of 50 percent by 2030. By improving the effectiveness of managing food by reducing losses, rescuing it or diverting it, hunger and greenhouse gas emissions can be decreased dramatically. According to Feeding America, 48 million people in the U.S. (or 15 percent of the population) lived in food insecure households in 2014.[1] Additionally, according to the Natural Resources Defense Council, 40 percent of food produced goes uneaten and just a 15 percent reduction in food losses would be enough to feed 25 million Americans every year.[2] Lastly, according to the EPA, 20 percent of U.S. methane emissions (the most prevalent greenhouse gas with the highest global warming potential) came from organic waste decomposing in landfills in 2014.[3] Organic waste reduction and diversion as well as effectively managing excess food have multiple economical, societal, and environmental benefits.

Throughout the state, there is an increasing interest in composting organic waste, specifically food scraps. The state Division of Waste Management issues composting demonstration approvals that allow small operations to test composting methodologies before they seek a full permit, making it easier for new companies to assess business models and composting operations. Established public and private commercial composting operations are often seeking ways to improve their composting processes or the marketability of their compost products. Businesses that generate excess food are requesting information on food scrap collection as well as on-site composting systems to meet corporate sustainability and zero–waste-to-landfill goals. Schools and higher education institutions are increasingly interested in diverting material from the landfill through off-site facilities or doing it themselves to meet their sustainability initiatives, typically with some level of help from students. And several corporate grocery stores have established programs throughout their locations to donate food

[1] Feeding America – Hunger and Poverty Facts and Statistics.

[2] Natural Resources Defense Council – Wasted: How America is Losing Up to 40 Percent of Its Food from Farm to Fork to Landfill (published August 2012).

[3] US Environmental Protection Agency – Methane Emissions.

or divert it from landfilling. Some of these grocery stores include Walmart, Food Lion, Harris Teeter, Publix, Whole Foods, Weaver Street Market and Kroger.

The demand for composting services has increased in the past few years, and as citizens and consumers request lower carbon footprints and improved environmental practices, the demand for organics recycling services will only continue to grow. Fortunately, North Carolina is poised to increase the processing of organic material, add value to different types of "waste," and increase collection of wholesome food.

OBJECTIVES

The following study was developed to understand the following:

- the flow of incoming feedstocks through composting facilities;
- the flow of products created at composting facilities;
- the ability of the current commercial composting infrastructure to handle increasing amounts of organic material, especially food scraps;
- the impact of the existing strategies to divert excess food from the landfill; and
- the need for additional data and research.

METHODOLOGY

Data was compiled from the annual composting facility reports collected by the state Division of Waste Management (DWM) Solid Waste Section and the state Division of Water Resources (DWR). It is important to note the information presented in the GENERAL, INPUTS/FEEDSTOCKS, and OUTPUTS/PRODUCTS sections of this study is derived from the 52 permitted composting facilities under the N. C. Department of Environmental Quality (NCDEQ) Division of Waste Management, and, unless otherwise noted, it does not include materials managed by composting operations under landfill permits or materials managed by facilities permitted under state Division of Water Resources. The FOOD RECOVERY section consists of DWM and DWR data, as well as data obtained from e-mail and phone interviews with several non-profit organizations and private businesses. Microsoft Access and Excel software were used to analyze the data and generate the figures. Due to the limited sampling and diverse types of data, averages are mostly used, as advanced statistical analysis would not provide dependable information. As the dataset grows, additional statistical analysis should be explored.

RESULTS & DISCUSSION

The following section consists of four major components:

- GENERAL: information about composting facilities, capacity and tipping fees;
- INPUTS / FEEDSTOCKS: analysis of the incoming materials received at composting facilities;
- OUTPUTS / PRODUCTS: analysis of the products created at the composting facilities; and
- FOOD RECOVERY: analysis of four strategies utilized to rescue wholesome food to feed people and animals, and with the rest generate soil amendment and electricity.

A discussion of the findings is followed after each figure or table to describe trends and supply additional information that may come from other sections.

General

This section provides information related to the permitted composting facilities, permitted capacity and tipping fees. Overall, the industry has diverse operations ranging from public and private facilities managing multiple, steady tipping fees, and available permitted capacity to increase processing of organic materials. The next three figures and table will show this.

Figure 1 – Number of NCDEQ DWM permitted composting facilities.

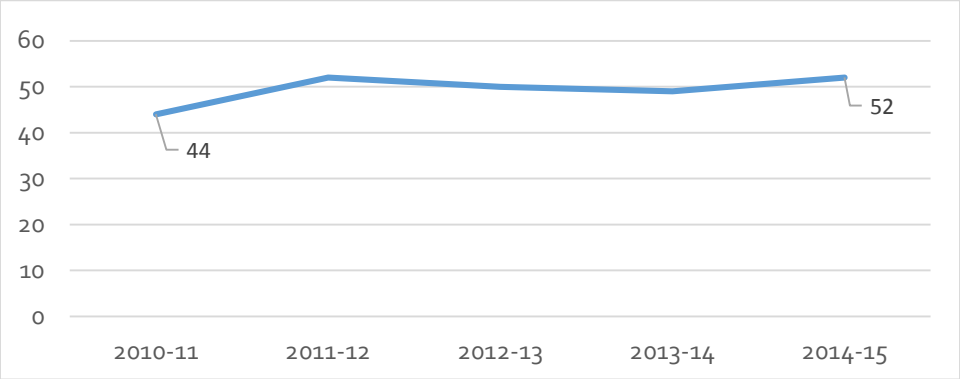


Figure 1 shows a steady trend in the number composting facilities permitted under the state Division of Waste Management (DWM) Solid Waste Section. This number excludes the composting demonstration approvals that DWM issues. The total number of facilities that reported composting tonnages in fiscal 2014-15 is 52, consisting of 24 private operations, 23 publicly-operated sites, and five higher education institution operations. It is important to note this figure does not take into account other facilities that manage yard waste regulated by the state Division of Waste Management (such as eight demonstration composting facilities, 258 yard waste notification sites, and 16 land clearing and inert debris landfills) nor facilities regulated by the Division of Water Resources (such as ten wastewater treatment plants composting biosolids generated on site, one anaerobic digester, and one commercial composting facility).

Figure 2 – Fiscal 2014-15 Total Permitted Capacity: 1.8 Million Tons (by NCDEQ DWM permitted composting facilities)

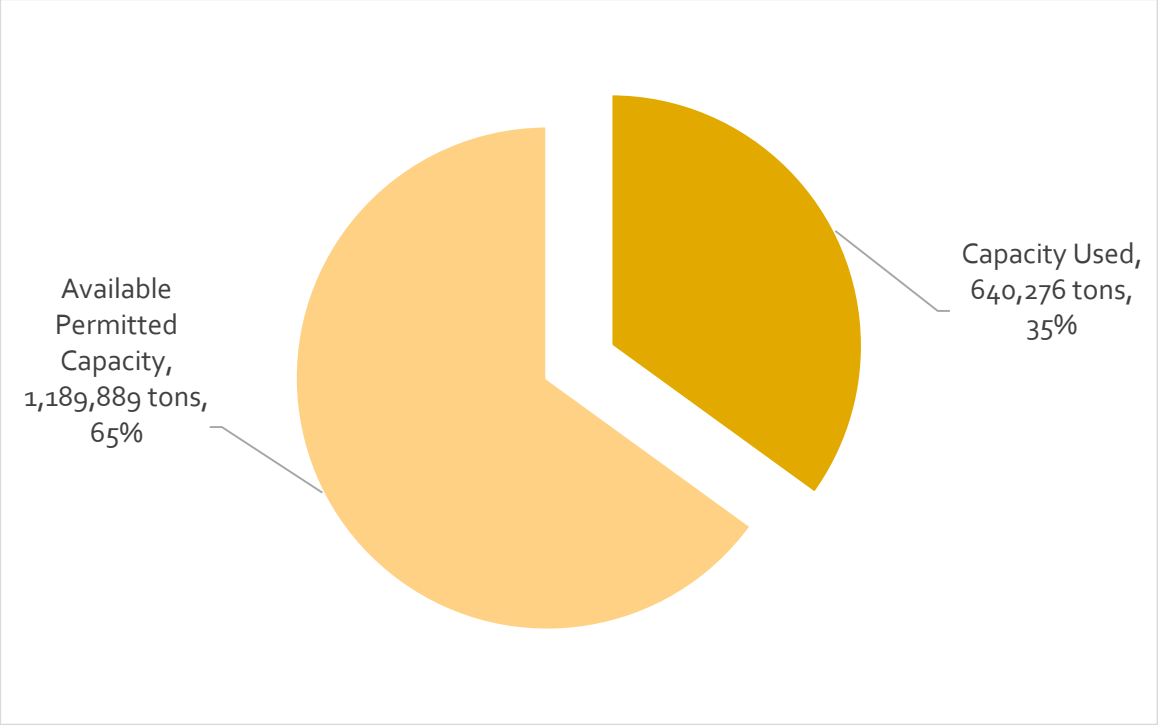


Figure 2 shows that North Carolina is using 35 percent of its available permitted capacity to process organic material (by NCDEQ DWM composting facilities) and has an available permitted capacity to process an additional 1.2 million tons of organic material. It is important to note this is an approximation based on the available data from the NCDEQ DWM permitted composting facilities. Whereas the permit did not list the permitted tonnage, reported tonnage from the previous year was used, and whereas the permit listed the permitted capacity in cubic yards, the bulk density factor used was 0.5 tons to cubic yards, based on average bulk densities for yard waste. This approximation is conservative because it does not assume higher values than those found through available documentation.

Figure 3 (next page) shows the average tipping fees at some composting facilities. Composting tipping fees are necessary to cover capital, operational, and maintenance costs. Many of the operations use heavy machinery such as tractors, loaders, mixers, turners, screeners, bagging equipment, spreaders and trucks. They also use vehicles to transport incoming feedstock and outgoing finished products. Other costs include employee salaries, personal protective equipment, scales, restroom facilities, truck scales, electricity, water, permits and engineering design. In general, the revenue from the final products (compost or mulch) is not able to cover all of the expenses incurred, either because not enough is sold, markets demand lower prices, or because the finished products were simply given away as a city or county service to its citizens. For these reasons and others, composting facilities rely on tipping fees to cover the majority of their expenses.

Figure 3 – Average tipping fees ($ per ton) as reported by NCDEQ DWM permitted composting facilities.

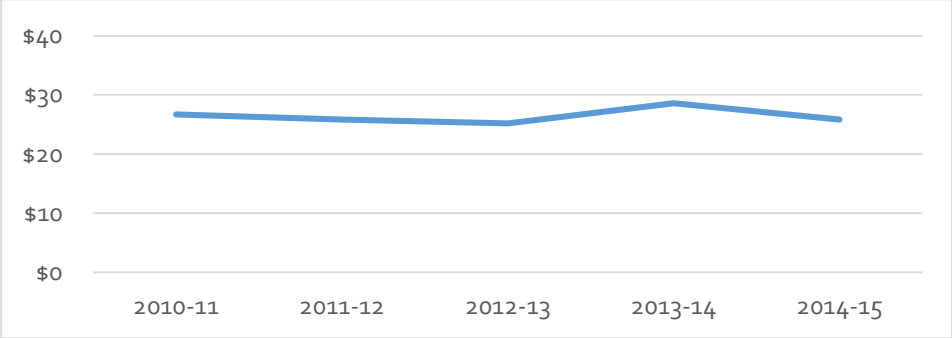


Figure 3 shows a steady average tipping fee of $26.40 per ton for the past 5 years. Most recently, in fiscal 2014-15, 21 commercial composting facilities reported average tipping fees, with an overall average of $25.90 per ton. **Table 1** shows a breakdown of fiscal 2014-15 tipping fees by nine privately and 11 publicly operated facilities. **Table 1** excludes one reported value, $49 per ton, as it was the single higher education entity that reported a tipping fee; considered an outlier for the purpose of this study. The averages are fairly similar among both types of public and private facilities. It is important to note that different facilities will charge varying tipping fees per client depending on the frequency, amount, and type of material that is received. **Figure 3** provides an overall average and does not reflect the variety of tipping fees throughout the state. Composting facilities accept a variety of feedstocks and operate on the basis of "compost recipes," similar to baking or cooking, therefore the tipping fee will change if the composting facility is in great need of a certain feedstock or the supply is short.

Table 1 – Breakdown of reported tipping fees ($ per ton) by different composting facilities.

Tipping Fee	Private (9)	Public (11)
High	$ 30	$ 40
Average	$ 24.33	$ 25.09
Low	$ 10	$ 15

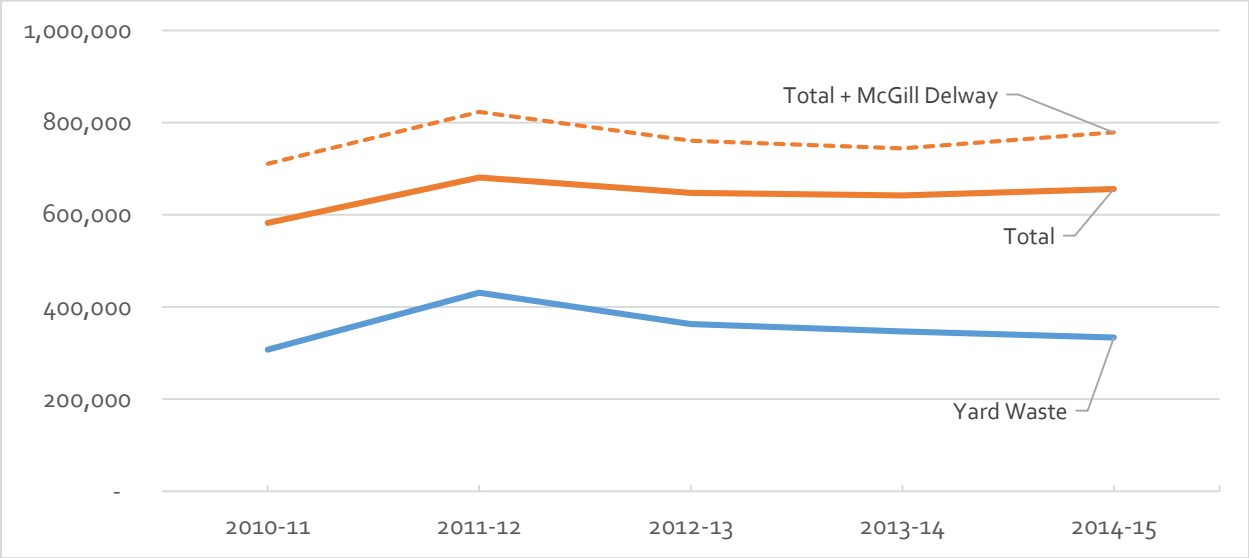
Lastly, given the limited amount of data currently available, some facilities provided information on jobs generated. Six private permitted composting facilities employed a total of 145 people, handling approximately 390,000 tons of materials in fiscal 2014-15. Based on this, 3.7 jobs were generated per 10,000 tons of material composted. The Institute for Local Self-Reliance in 2013 found that Maryland composting facilities can generate 4.1 jobs per 10,000 tons of material composted per year while landfilling in Maryland generated 2.2 jobs per 10,000 tons of material landfilled per year.[4] North Carolina's small data sample is relatively close to Maryland's findings. However, additional job information is required to provide a more accurate value.

[4] Institute for Local Self-Reliance – Pay Dirt: Composting in Maryland to Reduce Waste, Create Jobs & Protect the Bay (published May 2013).

Inputs / Feedstocks

This section provides an analysis of the incoming materials received at the composting facilities in the past five years. The next five figures show a steady amount of materials received, the breakdown of the types of feedstocks, the evolution of materials processed through facilities spread out throughout the state, and the composting facilities that processed the largest amounts of material.

Figure 4 – Total materials and yard waste received (in tons).



The solid lines on **Figure 4** show a fairly similar trend year to year between the total amount of materials managed and the amount of yard waste managed by composting facilities permitted by NCDEQ DWM. Since 2010, there has been an overall 12 percent increase of total material received, or 2 percent per year. There has also been an overall decrease of 23 percent of yard waste received since 2011, or a 5 percent decrease per year. On average, yard waste has constituted 54 percent of the total materials received and made up 51 percent of composted materials during the last fiscal year. The dashed line shows the total tonnage including materials managed by McGill Delway's composting facility which is permitted by the state Division of Water Resources. It is important to emphasize that there are other facilities that manage organic materials (mainly grinding yard waste materials, such as Yard Waste Notification Sites, and Land Clearing and Inert Debris (LCID), Construction and Demolition (C&D) and Municipal Solid Waste (MSW) landfills) that may report their tonnages through non-DWM reporting forms and were not included as part of this report. Future research areas include compiling the additional reports to create a more accurate picture of the composting activities in NC.

Figure 5 (next page) shows relatively steady levels of pallets and sawdust received at composting facilities and a significant increase of clean wood processed (128 percent increase since 2011, or 26 percent per year). The increase in processed clean wood comes from three private composting facilities: Earth Farms Organics, Wallace Farms, and Hensons. The dashed lines show the 5-year trend of each one of the materials in **Figures 5 and 6** (next page).

Figure 5 – Non-yard waste high-carbon materials received (in tons) by NCDEQ DWM permitted composting facilities.

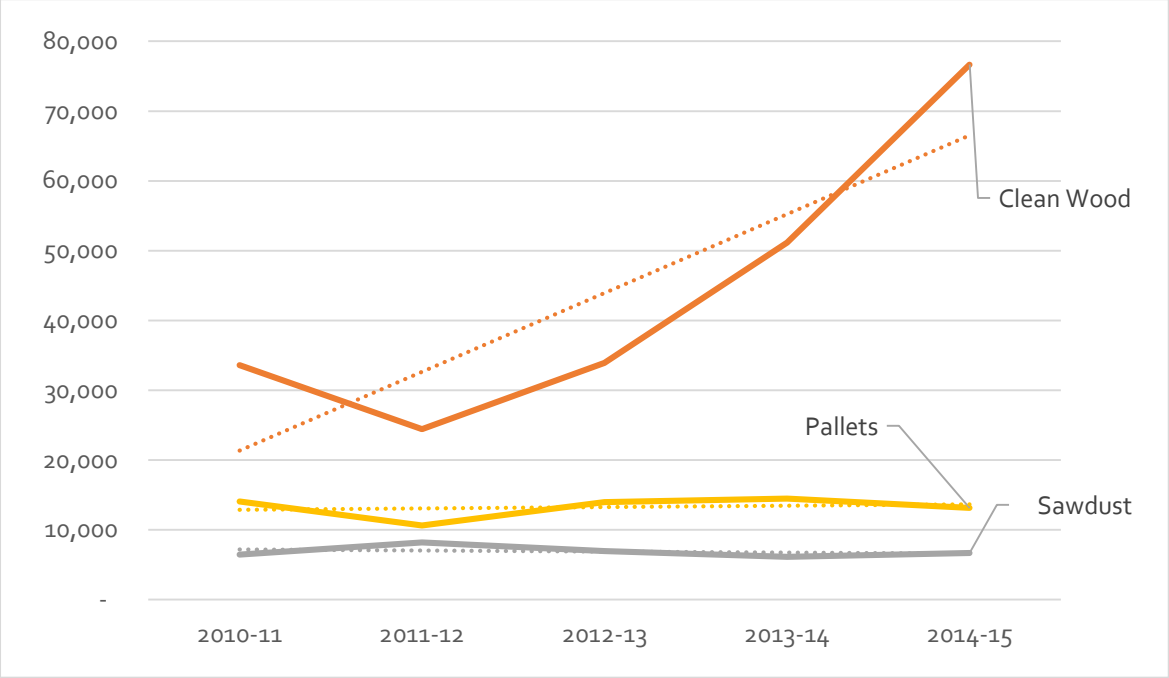


Figure 6 – High-nitrogen materials received (in tons) by NCDEQ DWM permitted composting facilities.

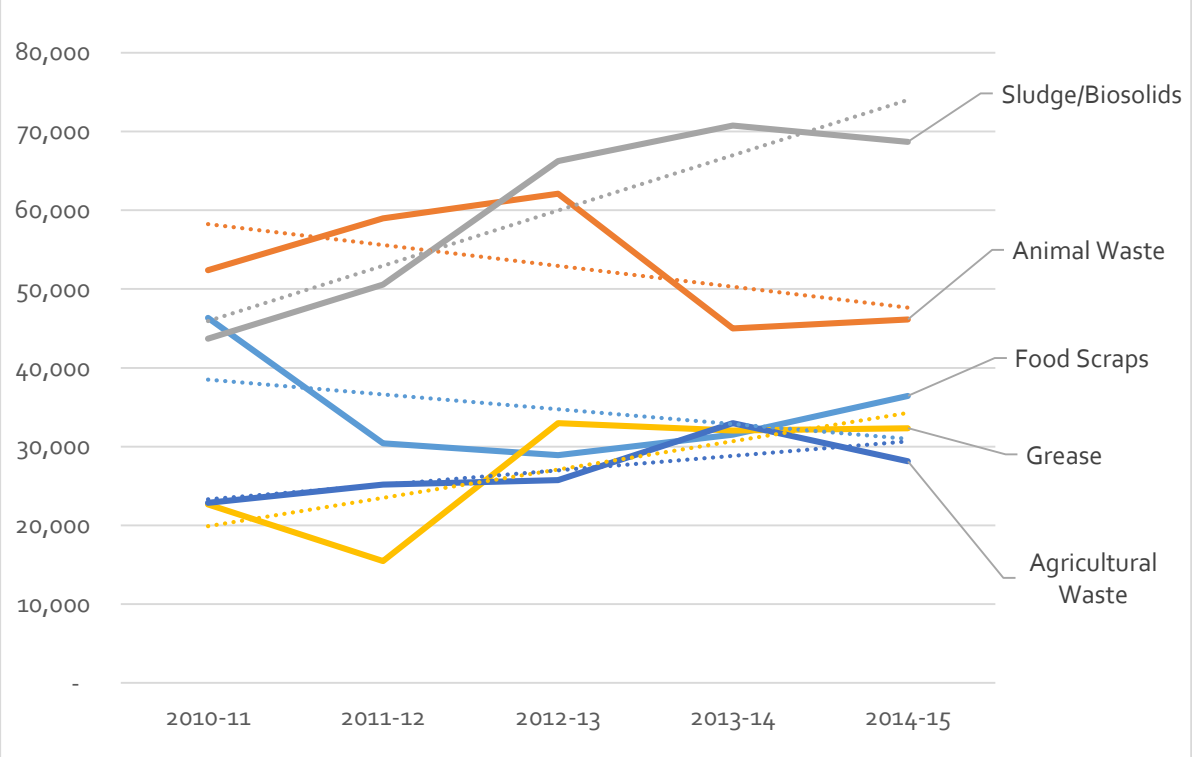


Figure 6 (previous page) shows the trends for the other materials processed at composting facilities that would be considered high in nitrogen content, such as sludge or biosolids, animal waste, food scraps, grease trap waste and agricultural waste. It shows upwards trends for sludge/biosolids (57 percent increase since 2010, or 11 percent per year), grease (43 percent increase since 2010, or 9 percent per year), and agricultural waste (23 percent increase since 2010, or 4.6 percent per year). It shows downwards trends for animal waste (12 percent decrease since 2010, or 2.4 percent per year) and food scraps. However, it is important to note that even though food scraps are showing a negative trend during the past five years, the past three reporting years have been slowly increasing (26 percent increase since fiscal 2012-13, or 8.7 percent per year).

Figure 7 shows the evolution of each reported material received at all of the NCDEQ DWM composting facilities for the past five years. Yard waste makes up the majority of the materials received. Pallets and sawdust show to stay relatively the same throughout the past five years. On the other hand, clean wood increases as it reaches fiscal 2014-15 (5 percent increase per year since 2012). High-carbon materials (such as yard waste, clean wood, sawdust, and pallets) consist of 65.5 percent of the received materials, while high-nitrogen materials (food scraps, animal waste, sludge/biosolids, agricultural waste, and mortalities) consist of 31.5 percent, and the rest (inerts, soils, and others) consist of 3 percent in average.

Figure 7 – The "evolving ton", a stacked comparative distribution of materials received by NCDEQ DWM permitted composting facilities (by percentage relative to the year materials were received).

Figure 8 – Permitted composting facilities that received the most material in fiscal 2014-2015.

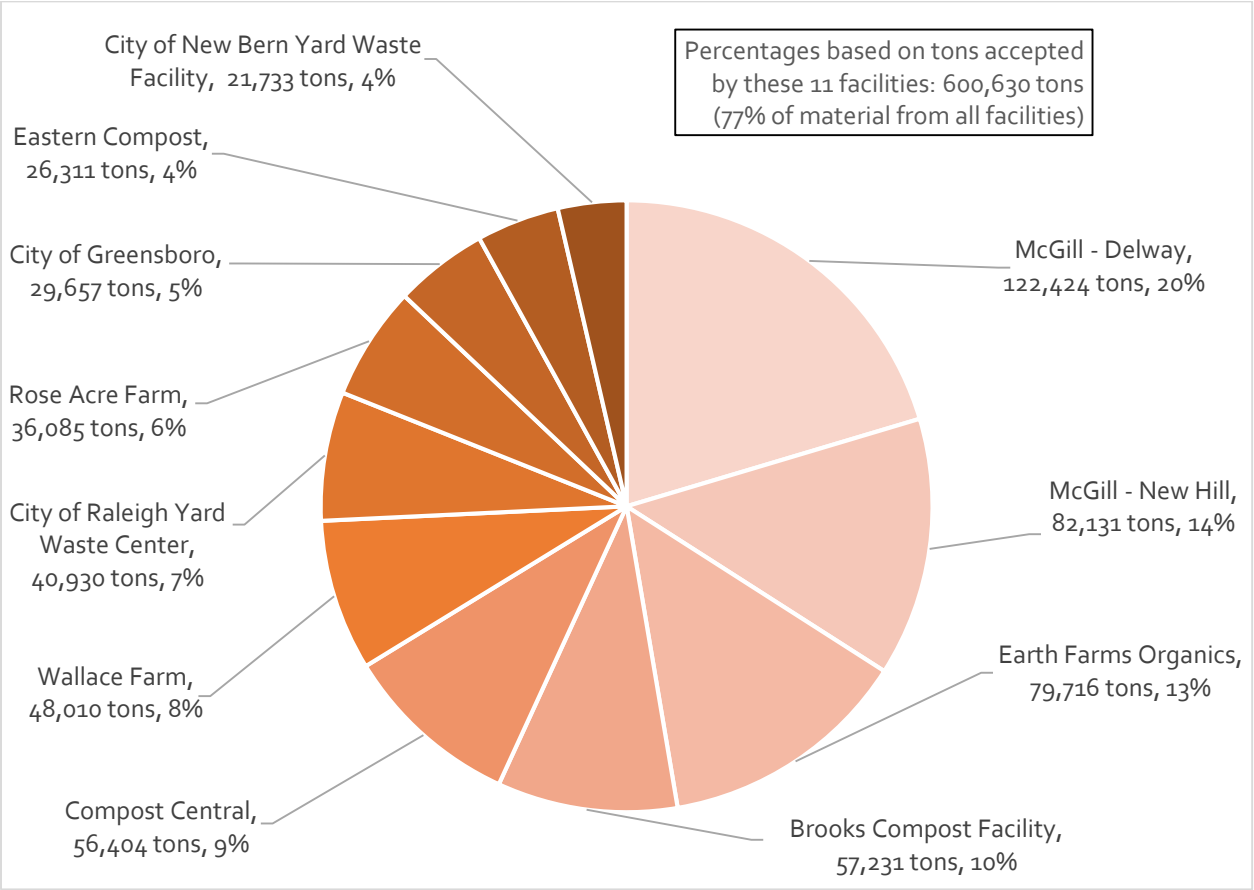


Figure 8 shows 11 facilities that received the most material in fiscal 2014-15. The amount of material they received is 77 percent of the total material received by all facilities (778,412 tons including McGill – Delway). Of these 11 facilities, four of them are publicly operated Type 1 composting facilities (permitted to process mainly high-carbon/woody material): Compost Central in Mecklenburg County, City of Raleigh Yard Waste in Wake County, City of Greensboro in Guilford County, and City of New Bern Yard Waste Facility in Craven County. And seven are privately operated Type 3 and 4 composting facilities (multi-feedstock): McGill-New Hill and Brooks Compost in Chatham County, McGill-Delway in Sampson County, Earth Farms Organics in Gaston County, Wallace Farms in Mecklenburg County, Rose Acre Farm in Hyde County, and Eastern Compost in Edgecombe County.

Table 2 – County origins of organic waste processed (as reported by the NCDEQ DWM permitted composting facilities in fiscal 2014-15).

County	Material %	County	Material %
Wake	22%	Avery, Brunswick, Buncombe, Carteret, Catawba, Chatham, Cumberland, Davidson, Edgecombe, Franklin, Lincoln, Moore, Nash, and Orange	1 % each
Mecklenburg	15%		
Guilford	8%		
Forsyth	7%		
Hyde	6%	Alamance, Anson, Ashe, Bertie, Columbus, Granville, Halifax, Haywood, Hoke, Iredell, Johnston, Jones, Macon, Martin, Mitchell, Montgomery, Onslow, Pamlico, Pitt, Randolph, Richmond, Robeson, Rockingham, Rowan, Rutherford, Sampson, Scotland, Stanly, Union, Vance, and Wayne	less than 1% each
Durham and Craven	5% each		
Watauga	4%		
Cabarrus and Gaston	3% each		
Harnett	3%		
Lee and Wilson	2%		

Table 2 shows the counties from where the most material originated from in fiscal 2014-15 as reported by the composting facilities. Out of these, the counties that contributed the most are Wake, Mecklenburg, Guilford, Forsyth, Hyde, Durham, and Craven. The first three align with the locations of where the largest public operations are located and other nearby private operations. As well as Hyde County, an extremely rural county, which ranks high because its single source of generation and processing of organic material is the composting facility at Rose Acre Farms.

It is important to note that this only accounts for the materials received at NCDEQ DWM permitted composting facilities, it does not include the organic material managed by the 258 NCDEQ DWM Yard Waste Notification sites, nor DWR-permitted McGill-Delway facility, nor the others mentioned earlier, which could include small mulching or processing operations. If these values were taken into account, it would provide a more accurate perspective on the amount of total organic material contributed by each.

Outputs / Products

This section contains seven figures showing the trends over five years of products manufactured at composting facilities. These products are Mulch, Grade A Compost, Grade B Compost, engineered soils, client-specific soil mixtures and others. The differences between Grade A Compost and Grade B Compost are described on the Solid Waste Compost Rule .1407. There are three requirements to manufacture Grade A Compost: (1) contain less than six percent manmade inerts per sample (inerts must be less than 1 inch in size), (2) undergo a temperature-controlled composting method to meet "PFRP" (Process to Further Reduce Pathogens), and (3) meet the metal concentrations as established by the rules. Grade B Compost can have more than six percent manmade inerts per sample, does not need to meet PFRP, but must meet the metal concentrations. Mulch on the other hand is made from grinding yard waste, creating piles, turning it a few times, and creating a product that is not as carefully managed as Grade A Compost is. Compost is much richer in plant available nutrients than mulch, mainly because Compost has been decomposed much farther, however mulch is typically used to protect soil or compost. They are both great products and have different functions.

Figure 9 – Total products created & sold to the public (in tons) at NCDEQ DWM permitted composting facilities.

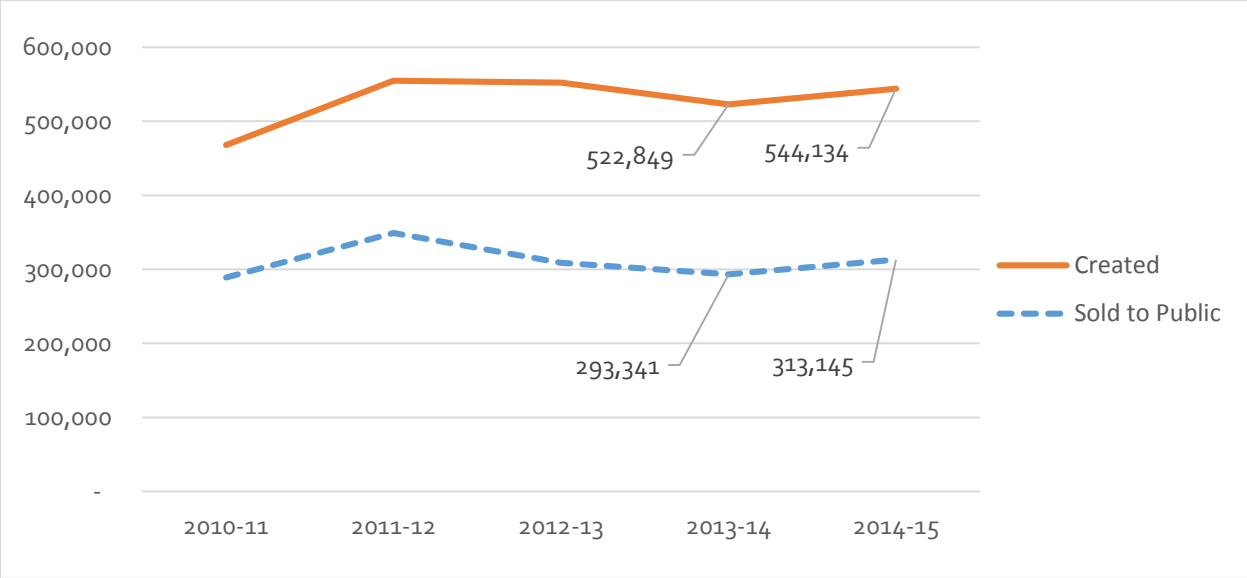


Figure 9 shows a steady production of products created followed by a similar trend of products sold to the public. Since 2011, composters have been generating over 500,000 tons of material and selling on average 300,000 tons of material every year (roughly 60 percent of total material created). **Figure 10** shows the other destinations of the total amount of products created, such as using it on site (mainly for erosion control or landscaping), giving it for free to the public, stockpiling for future use or allowing it to cure, disposing of the material due to contamination, or finding other uses. In general the trends for all, except for stockpiling, are steady for the past four fiscal years. **Figure 10** (next page) shows Stockpiling decreased by 35,461 tons (down 30 percent) and **Figure 9** shows an increase in products sold to public of 19,804 tons (up 0.1 percent) from fiscal 2013-14 to fiscal 2014-15.

Figure 10 – Other end uses of total products created (in tons) at NCDEQ DWM permitted composting facilities (excludes products sold to public).

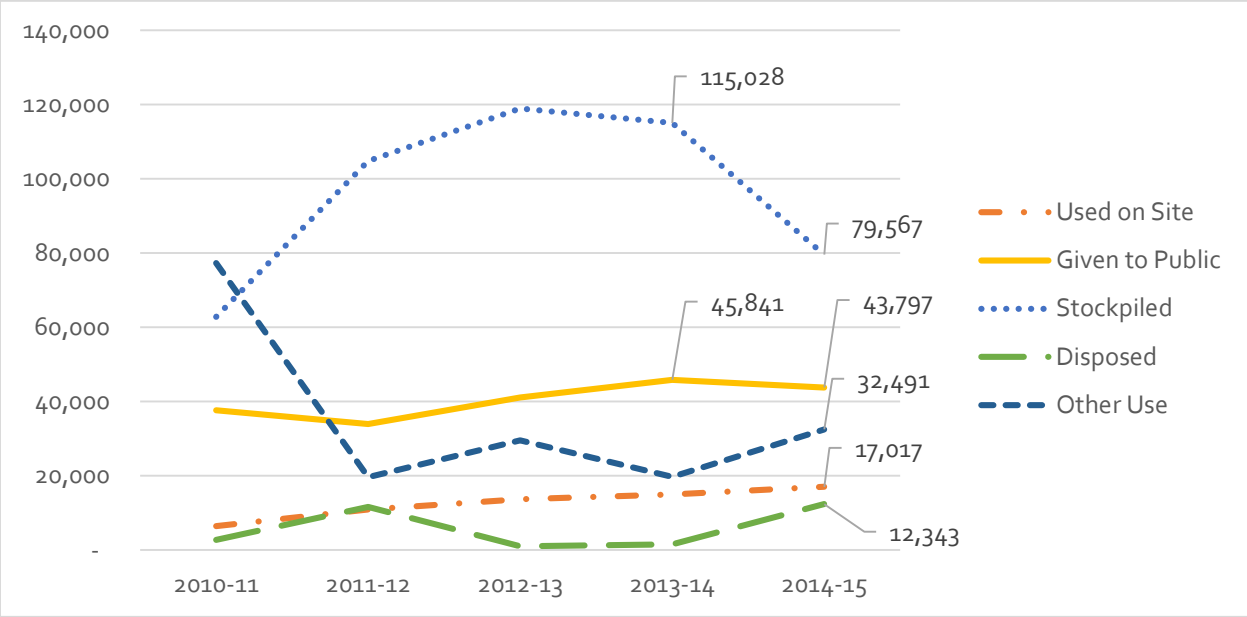


Figure 11 – Stacked comparative distribution of products created by end use at NCDEQ DWM permitted composting facilities (by percentage relative to their year of production).

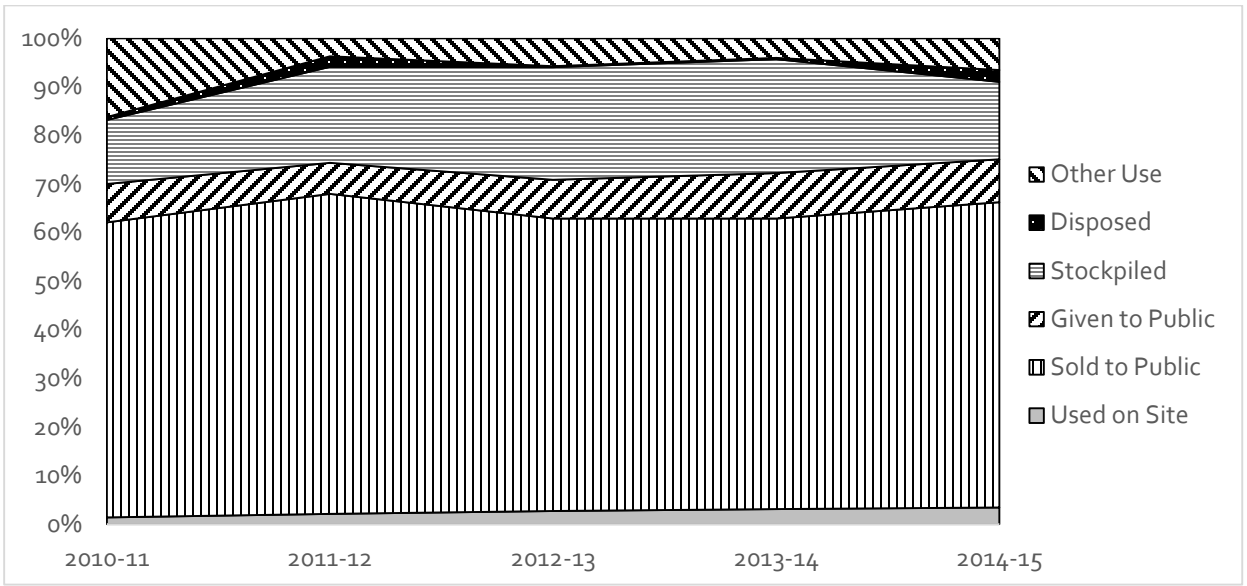


Figure 11 shows a breakdown of the end uses of the materials created throughout the composting facilities. It shows steady trends for finished products Used on Site (2 percent average), Given to the Public (8 percent average), and Sold to the Public (59 percent). It is also shown that the material Disposed was not significant until this past fiscal year (2 percent), and the "Other Use" category continues to fluctuate. Due to the state NCDEQ DWM annual reporting form, the "Other" category may be confusing to composting facility operators depending on what is considered "Other Use" (such as material sold as boiler fuel, used as landfill alternative daily cover, or other uses).

Figure 12 – Stacked comparative distribution of Mulch created at NCDEQ DWM permitted composting facilities (by percentage relative to their year of production).

Figure 13 – Stacked comparative distribution of Grade A Compost created at NCDEQ DWM permitted composting facilities (by percentage relative to their year of production).

Figures 12 and 13 (previous page) show the relative distributions of Mulch and Grade A Compost, respectively, in regards to their end uses. Both figures show that Mulch and Grade A compost are mostly sold to the public with a small amount given to the public. The stockpiling of Mulch has been increasing for the past five years, while stockpiling of Grade A Compost stockpiling has been decreasing for the past three years. The decrease of stockpiling of Grade A Compost stockpiling decrease is followed closely by the increase in material sold to the public, a healthy indicator for the industry. Both figures show that Mulch is most likely to be used on site than Grade A Compost (a product with a higher market value).

Figure 14 – Products created at NCDEQ DWM permitted composting facilities (in tons).

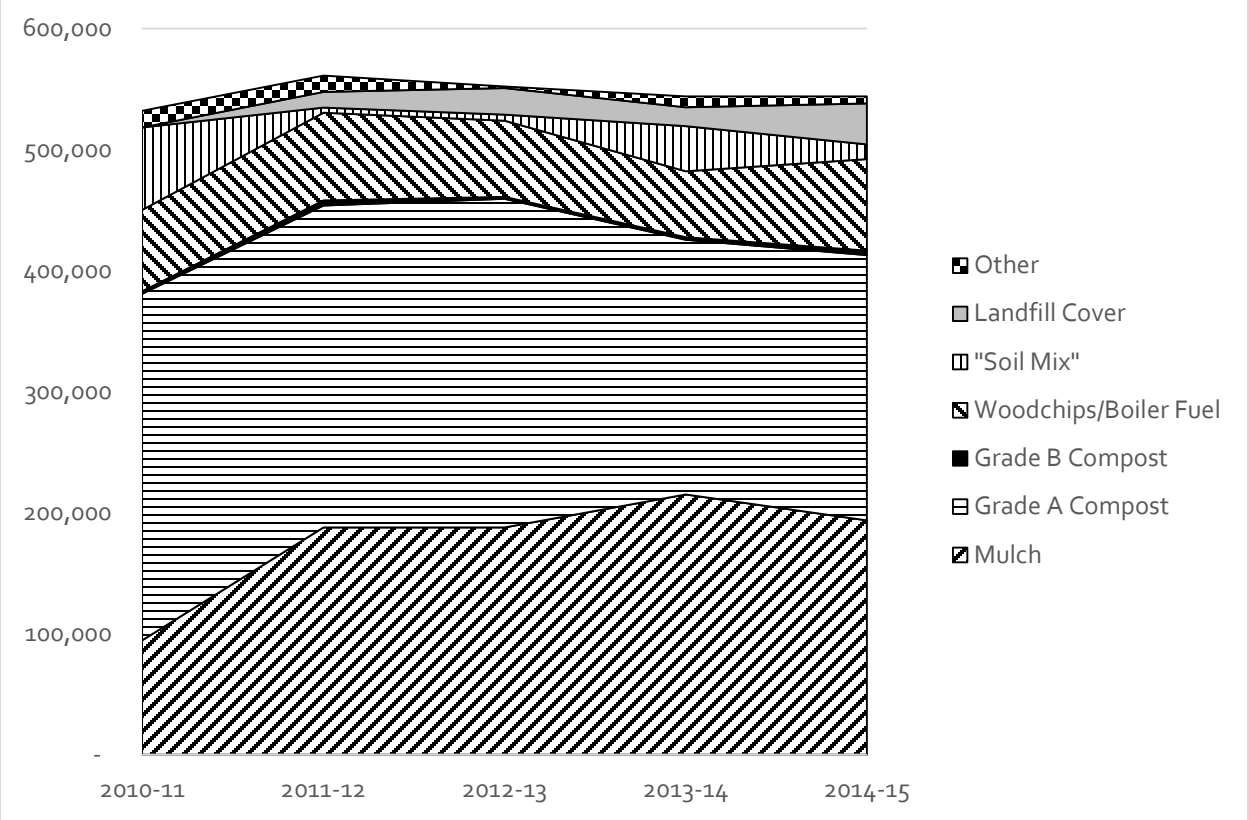


Figure 14 shows the tonnage distribution of the different products created at the state Division of Waste Management's permitted composting facilities. Mulch and Grade A Compost make up the majority of the materials manufactured. A healthy infrastructure would be evidenced by a larger amount of Grade A Compost generated compared to Mulch, mainly because Grade A Compost has a higher value in the marketplace than Mulch, and Grade A Compost also has the ability to enter more markets compared to Grade B Compost. Facilities manufacturing mulch should consider converting Mulch into Grade A Compost to increase their revenue as long as they have a market developing.

Figure 15 – Stacked comparative distribution of types of products created at NCDEQ DWM permitted composting facilities (by percentage relative to their year of production).

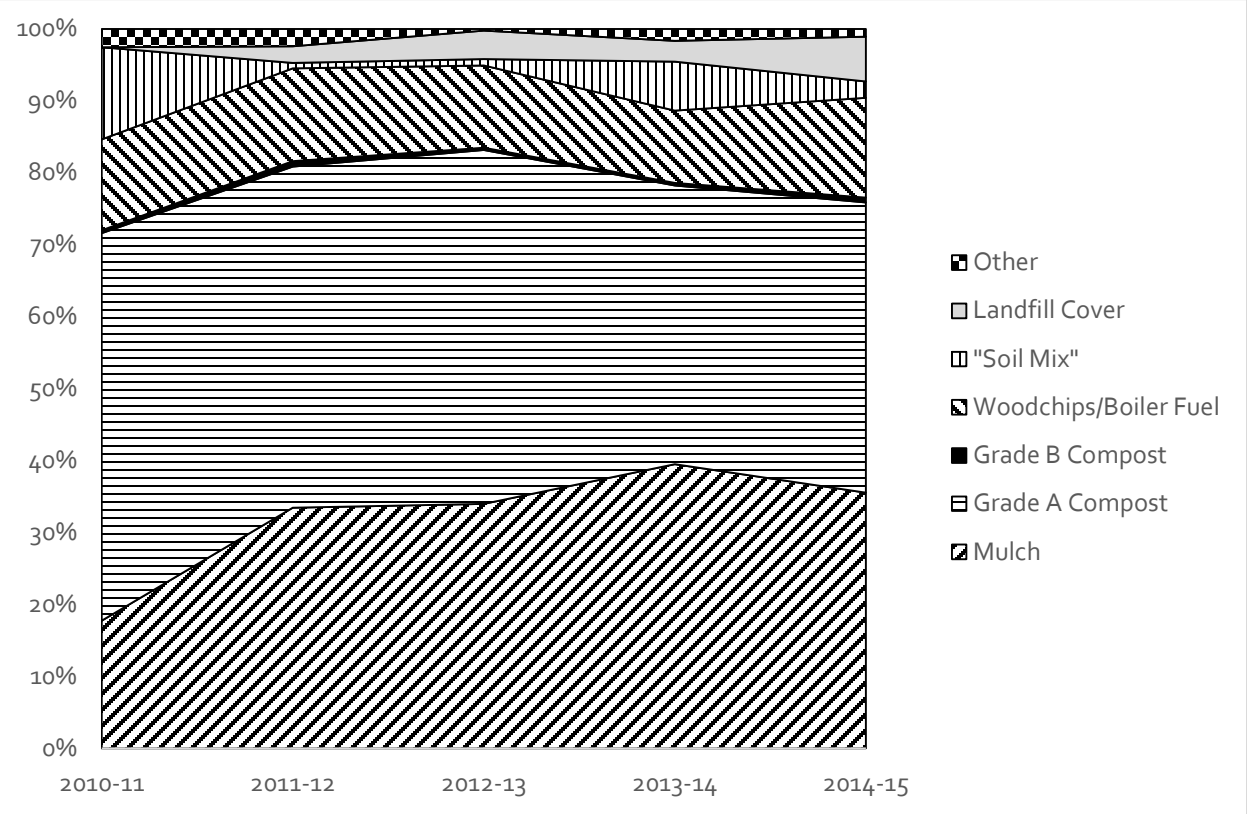


Figure 15 shows a percentage comparison contrasting each year which allows us to understand the relative production of the different finished products created from year to year. Some obvious trends are the increase of Mulch and a general decrease of Grade A Compost from fiscal 2013-14 to 2014-15. It is also shown that the relative combined generation of Woodchips/Boiler Fuel and "Landfill Cover" products have remained somewhat constant with a slight increase in the past year. Lastly, Grade B Compost, shown by the thick dark line, is generally a small percentage of what is generated at composting facilities, perhaps because the use of this product is *"restricted to distribution for land and mine reclamation, viticulture, and agriculture (on non-food chain crops) projects"* as per NCDEQ Section .1400 rules.

Food Recovery

The FOOD RECOVERY section focuses on food rescue, anaerobic digestion, animal feeding, and commercial composting. For purposes of this study, food is defined as excess food from different generators (edible and inedible), such as grocery stores, catering companies, restaurants, and food manufacturing facilities. **Figure 16** shows the breakdown of the excess food that was diverted from landfilling, through food rescue organizations, animal feeding, and anaerobic digesters in 2015, and NCDEQ composting facilities in fiscal 2014-2015. The additional two figures (**Figures 17 and 18**) focus on the 5-year trend of food scraps being composted at the state Division of Waste Management's permitted composting facilities and one facility permitted under Division of Water Resources. These composting facilities are operated by private companies and higher education institutions and the figures are broken down by those that received more than 100 tons of food scraps per year and those that received less than 100 tons per year. None of North Carolina's local governments (counties, cities, nor towns) operating composting facilities accept food scraps at this moment.

Food Rescue in the Community

There are five food rescue non-profit organizations that serve all 100 counties in North Carolina, and consist of the following:

- MANNA Food Bank of Western NC;
- Second Harvest Food Bank (Northwest NC, Metrolina, and Southeast NC);
- Inter-Faith Food Shuttle;
- Food Bank of Central & Eastern NC; and
- Food Bank of the Albemarle.

Food Rescue at College Campuses

In addition to these efforts, the Food Recovery Network (FRN) unites students on college campuses to fight food waste and hunger by recovering perishable food that would otherwise go to waste from their campuses and donating it to people in need. To date, North Carolina chapters have diverted 58,935 pounds (29 tons). North Carolina has nine active FRN chapters:

- Belmont Abbey College;
- Duke University;
- High Point University;
- North Carolina State University;
- Pfeiffer University;
- Salem College;
- UNC – Chapel Hill;
- UNC – Greensboro; and
- UNC – Pembroke.

Composting at Educational Institutions

There are two school districts actively diverting food scraps through composting, Charlotte-Mecklenburg Schools (piloting a program at a couple of schools) and Chapel Hill-Carrboro City Schools (as of March 2016 they had ran a cost neutral program, diverted 128 tons, and reduced their garbage bags by 90%—from 155 to 18). Additionally, there are 14 public and seven private higher educational institutions actively collecting food scraps at sports venues, dining facilities (pre- and/or post-consumer) and at special events. They are either composting on-site or partnering with private composters to process their organic materials[5]:

Public Higher Educational Institutions

1. Alamance Community College;
2. Appalachian State University;
3. Central Piedmont Community College;
4. Guilford Technical Community College;
5. NC State University;
6. UNC Asheville;
7. UNC Chapel Hill;
8. UNC Charlotte;
9. UNC Greensboro;
10. UNC Pembroke;
11. UNC School of Arts;
12. Wake Technical Community College;
13. Wilson Community College; and
14. Winston-Salem State University.

Private Higher Educational Institutions

1. Davidson College;
2. Duke University;
3. Elon University;
4. Guilford College;
5. Meredith College;
6. Penland School of Crafts; and
7. Warren Wilson University.

Commercial Composting by Local Governments

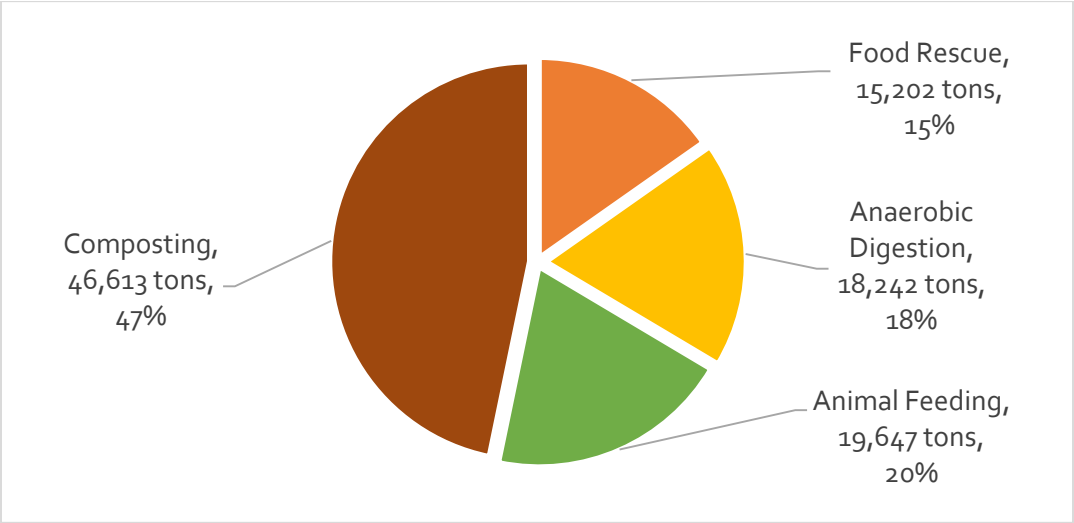
In the public composting sector, Orange County, in partnership with Brooks Compost, has continued its subsidized commercial food scraps collection program and provided a drop off location at one of its residential solid waste convenience centers. Wake County started a pilot program in 2015 to collect residential food scraps at two convenience centers in partnership with SMART Recycling. Wake County's preliminary 6-month results include 2,000 pounds (1 ton) of food waste being collected each month at the two sites and over 7 tons diverted since August. Having spent a total of $2,790 on the 6-month pilot program, Wake County is going to continue to a full year prior to evaluating and improving their program. There are no publicly operated residential curbside food scraps collection programs operating in North Carolina.

[5] North Carolina Public Community College & University Annual Recycling Report, NCDEQ DEACS 2016

Food Scraps Collection by Private Collection Companies

In the private sector, there are two food scraps collection companies focusing on both residential and commercial areas: CompostNow (Triangle and Asheville) and Tilthy Rich (downtown Durham). Focusing exclusively on commercial food scraps, there are four hauling companies: SMART Recycling (statewide), Food FWD (Triangle), Organix Recycling (statewide), and Valley Proteins (statewide). In addition to these haulers, five composting facilities offer food scraps collection services: Brooks Compost (Chatham County), McGill Compost (Chatham and Sampson counties), Earth Farms Organics (Gaston County), Danny's Dumpster (Buncombe County), and Gallins Family Farms (Davie County). It is important to note that Gallins Family Farm was operating under an approved demonstration site until this year (2016), and Danny's Dumpster is moving from a demonstration site to a full permit. Sites approved for composting demonstration are not required to report annually; because of this, their yearly composting tonnages are not taken into account in the initial part of the study (Inputs/Feedstocks Section); however, with the exception of the food scraps composted at these two demonstration sites this past year (2015) is taken into account on **Figure 16**. Lastly, at least two waste management companies partner with composting facilities to haul food scraps: Republic Services and Waste Management. This is driven by businesses requesting food scraps collection services.

Figure 16 – 2015 Food diverted from the landfill through food rescue/donations, anaerobic digestion, animal feeding, and permitted commercial composting facilities (total 99,704 tons diverted).



Note: This aggregated data was compiled from reports, surveys, phone conversations, and limited information from various statewide organizations, businesses, and state governmental offices.

Figure 16 shows the breakdown of the general destinations of the 99,704 tons of food scraps that were diverted from the landfill in 2015. This breakdown is roughly 15% food rescue, 20% animal feeding, 20% anaerobic digestion, and 45% composting (15-20-20-45). In 2012, the state Division of Environmental Assistance and Customer Service (DEACS) published a food waste

study[6] estimating 1.2 million tons of food are wasted from residential and commercial areas each year. That number does not include food losses at agricultural fields (point of production). At this point, there are no estimates of agricultural food losses for North Carolina. The food recovered by the food rescue organizations consists of perishable foods (produce from farmers markets and grocery stores, excess food from catered events, restaurants, and grocery deli shops). Based on the limited information available, it can be assumed that North Carolina generated 1.2 million tons of food waste per year (not taking into account agricultural losses), and last year North Carolina diverted 99,704 tons, meaning that North Carolina was able to divert 8.3 percent of excess food destined to the landfill through these four strategies. This leaves 1.1 million tons of food destined for the landfill. The following **Figures 17 and 18** explore where food scraps are being composted, and **Table 3** describes briefly the infrastructure required to expand each effort to reach the EPA/USDA goal to reduce food waste by 50 percent by 2030.

Figure 17 – Food scraps received (more than 100 tons) at NCDEQ permitted composting facilities.

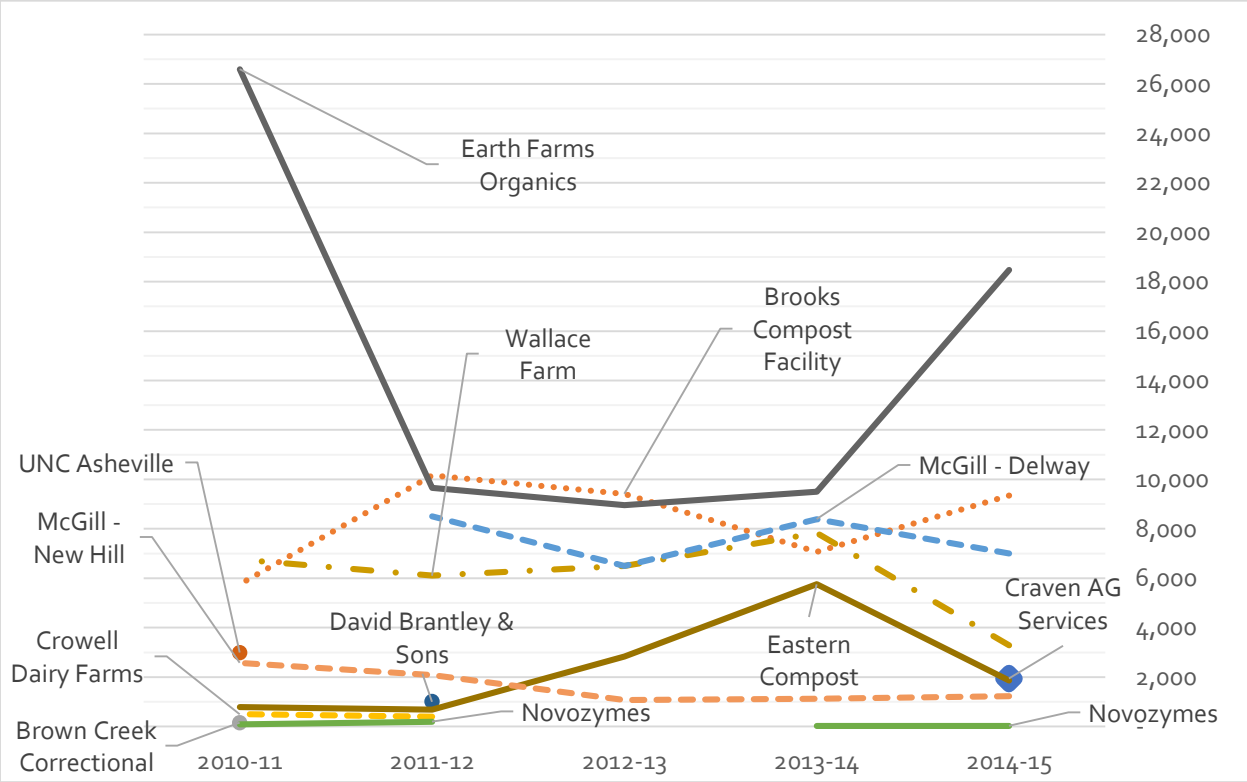


Figure 17 shows 12 NCDEQ composting facilities the reported receiving more than 100 tons of food scraps per year. These facilities compost 99% of the total food scraps received at the NCDEQ permitted composting facilities, compared to 1% composted by the small facilities (less than 100 tons per year) presented on **Figure 18**. The facilities on **Figure 17** are from both DWM and DWR (McGill-Delway was the only DWR permitted composting facility that received

[6] NC DEACS – North Carolina 2012 Food Waste Generation Study

food scraps). In fiscal 2014-15, Earth Farms Organics received the most food scraps, followed by Brooks Compost, McGill-Delway, Wallace Farm, Eastern Compost, Craven AG, and McGill – New Hill. It is important to note that in 2015, the Novozymes composting facility ended its operations. Any missing data points indicate to the potential that the composting facility did not submit a report. From 2013 on, Earth Farms Organics shows a significant increase in food scraps, Brooks Compost shows a moderate increase, and both Wallace Farm and Eastern Compost show a significant decrease in food scraps composted. McGill-Delway shows a relatively steady collection of food scraps. As shown on **Figure 6**, there has been a slight increase in food scraps received overall. Earth Farms Organics and Brooks Compost appear to be the major contributors to this increase.

Figure 18 – Food scraps (less than 100 tons) received at NCDEQ DWM permitted composting facilities.

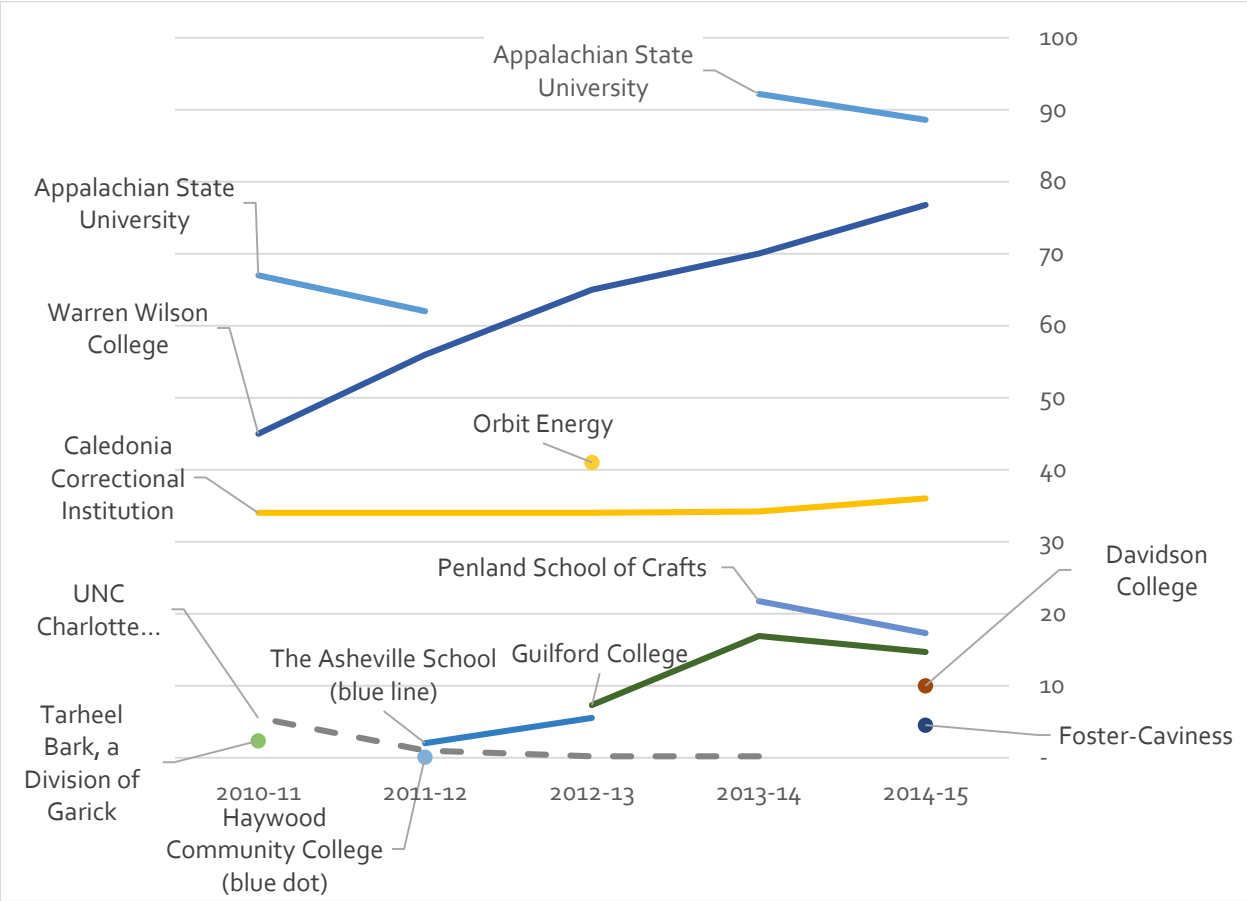


Figure 18 shows 12 NCDEQ composting facilities that reported receiving less than 100 tons of food scraps per year. These facilities compost 1% of the total food scraps received at the NCDEQ permitted composting facilities. The eight higher education composting facilities are included in this data, and even though they process small quantities, the influence that college composting programs have on future generations and leaders is unquantifiable. Through the students, these programs have the potential to create future demand for food scraps collection and composting services in the areas where the students decide to settle after graduation.

In order for North Carolina to achieve the federal government's goal to decrease food waste by 50 percent by 2030, the state must take into account the infrastructure required to manage approximately 550,000 tons of excess food (this is 50% of 1.1 million food scraps destined for landfilling). Based on the rough 15-20-20-45 breakdown (food rescue-animal feeding-anaerobic digestion-composting breakdown as shown by **Figure 16**), each one of the entities recovering and repurposing food would have to increase their operations by 5.5 times to manage half the food currently destined to landfills in North Carolina and reach the goal set by the EPA and the USDA. **Table 3** shows a rough outline of the infrastructure required to expand each strategy.

Table 3 – Infrastructure to meet 50 percent food waste reduction goal (divert 1.1 million tons).

FOOD RESCUE: 82,500 tons (15%) Expansion of refrigerated vehicles, refrigerated storage, and pickup locations.
ANIMAL FEEDING OPERATIONS: 110,000 tons (20%) Expansion of vehicles and pickup locations.
ANAEROBIC DIGESTION: 110,000 tons (20%) A permitted food scraps-based anaerobic digester (Blue Sphere in Charlotte, Mecklenburg County) is currently under construction with enough design capacity (500 tons per day of food scraps) to meet the Anaerobic Digestion share of the 50% reduction goal. Also, the only anaerobic digester that is processing food scraps at this moment (Full Circle Recycling in Zebulon, Johnston County) has available capacity. Unlike composting facilities that are spread throughout the state, these two anaerobic digesters are located next to two large urban metropolitan areas and will need well-developed collection routes and clusters of food scraps generators to make it economically feasible to reach the adjacent areas.
COMMERCIAL COMPOSTING: 247,500 tons (45%) **Figure 2** shows there are approximately 1.2 million tons of permitted composting capacity currently available at commercial composting facilities. This should be enough to accommodate 246,500 tons of food scraps in addition to the necessary high-carbon material to effectively compost the food scraps. Even though the available permitted capacity to process organic materials exists, it would help to have the major publicly operated commercial composting facilities integrate food scraps into their operations and permits. Additionally, collection clusters of food scraps generators will be needed to make it economically feasible to reach areas that fall outside of the normal 25-40 mile radius range to collect food scraps. Lastly, medium sized food scraps composting operations will be necessary in areas that are farther than 50 miles away from existing composting facilities. This further decentralization would make it economically feasible for composting to be cost-competitive with landfilling at these farther places, and it would also decrease the carbon footprint of hauling food scraps.

These goals are based on the assumption that the existing infrastructure recovering food will continue with the 15-20-20-45 breakdown. Additionally, this goal would be met faster if food waste reduction strategies were implemented, such as improvements in food purchasing and procurement methods, storage techniques, customer habits and more. For additional information on food waste reduction strategies and additional details on the economics of other food recovery strategies, please refer to the ReFED report (Rethinking Food Waste through Economics and Data: A Roadmap to Reduce Food Waste, published March 2016).

KEY FINDINGS

General

1. The overall number of permitted commercial composting facilities is stable (**Figure 1**).
2. 24 private, 23 public, and five higher education commercial composting facilities reported materials managed fiscal 2014-15 (**Figure 1**).
3. There is an available permitted capacity of 65 percent (able to process 1.2 million tons of material) at existing composting facilities, enough to meet the assumed commercial composting share of the EPA/USDA food waste reduction goal — 50 percent decrease by 2030 (refer to **Figure 2** and **Table 3** for details).
4. 5-year average tipping fee has remained stable at $26 per ton (**Figure 3**).
5. Limited data signals that composting operations create 3.7 jobs per 10,000 tons of material composted per year.

Inputs / Feedstocks

6. Yard waste received is approximately half of the total materials received overall (**Figure 4**).
7. The supply of clean wood, as a non-yard waste high-carbon feedstock, has been increasing since 2011 (**Figure 5**).
8. Biosolids have increased by 57 percent since 2010, or 11 percent per year (**Figure 6**).
9. Grease trap waste has increased by 43 percent since 2010, or 9 percent per year (**Figure 6**).
10. Animal waste has decreased by 12 percent since 2010, or 2.4 percent per year (**Figure 6**).
11. Food scraps have increased by 25 percent since 2012, or 8.7 percent per year (**Figure 6**).
12. Out of the total materials received, high carbon feedstocks consists of roughly 66 percent and high nitrogen feedstocks roughly 32 percent (**Figure 7**).
13. Out of the 11 facilities that received the majority of the materials in fiscal 2014-15, four are public Type 1 (woody waste) composting facilities and seven are private Type 3 and 4 (multi-feedstock) composting facilities (**Figure 8**).
14. 54 percent of materials received at the 52 NCDEQ DWM permitted composting facilities originated from Wake, Mecklenburg, Guilford, and Forsyth counties (**Figure 8**).

Outputs / Products

15. Composting facilities sold an average of 58 percent of the material created (**Figure 9**).
16. Stockpiling of finished product has decreased since 2012 (**Figure 10**).
17. Low percentage and steady trends are shown for finished products used on site (2 percent) and given to the public (8 percent) (**Figure 11**).
18. Mulch and Grade A Compost are mostly sold to the public (**Figures 12 and 13**).
19. Overall production of Mulch and Grade A Compost have been relatively similar in the past two fiscal years (**Figure 14**).

20. Mulch production has increased while Grade A Compost production has decreased during the past five years (**Figure 15**).

Food Recovery

21. The North Carolina Association of Feeding America Food Banks consists of five major non-profit organizations that rescued approximately 15,000 tons of wholesome food through farmers, restaurants, catering companies and grocery stores.
22. Nine colleges are North Carolina chapters of the national Food Recovery Network and have rescued 29 tons of wholesome food to date.
23. Only two counties (Orange and Wake) offer food scraps collection programs.
24. No local governments offer residential curbside collection of food scraps.
25. Six hauling companies are exclusively dedicated to food scraps collection (for composting and/or animal feeding), and two waste companies offer food scraps collection services.
26. In 2015, 99,704 tons of food were diverted from the landfill through food rescue organizations (15 percent), anaerobic digestion (18%), animal feeding (20 percent), and commercial composting (47 percent) (**Figure 16**).
27. 15 permitted composting facilities accepted food scraps last year: eight of them accepted more than 100 tons per year and composted 99% of total food scraps (one is no longer in operation), and seven accepted less than 100 tons in 2015 (1% of total food scraps composted) (**Figures 17 and 18**).
28. 14 public higher education institutions are collecting food scraps from sport venues, dining facilities (pre- and/or post-consumer), and/or at special events.
29. Five higher education permitted composting facilities are actively composting food scraps: Appalachian State University, Warren Wilson College, Davidson College, Penland School of Crafts and Guilford College (**Figure 18**).
30. Each existing entity recovery and diverting food would have to expand their operations by 5.5 times to reach the federal food waste reduction goal.

FUTURE RESEARCH AREAS

Many questions remain that need to be addressed in order to expand organic waste recycling, increase the services to reduce the production of excess food, and move any excess food to plates, farms, soils and the electricity grid. Some future research areas include:

1. Quantify the current transportation capacity by the different food recovery strategies;
2. Identify the location and amount of excess food generated to improve collection routes;
3. Quantify the capital costs required to expand the various diversion efforts;
4. Evaluate higher-end markets for final compost products to make these services more cost-competitive with landfilling or boiler fuel plants; and
5. Compare job creation between landfilling and private and public composting operations.

CONCLUSIONS

The N.C. Department of Environmental Quality annual composting facility reporting requirement was essential to developing this study. Through the analysis of the data, it can be seen that the composting industry in N. C. has shown healthy signs through the past five years, including a stable amount of overall organic material received, a consistent number of facilities spread throughout the state, available permitted capacity to handle more material, steady product demand, and competitive tipping fees.

Within the available permitted capacity, the composting industry has the ability to compost most of the excess food that is currently landfilled with only a few N.C. Department of Environmental Quality permit and facility changes needed to allow existing composting operations to process food scraps. Additional small food scraps composting operations are needed in some area of the state to decrease the distance gap between existing composting facilities and generators. The ability of composting facilities to handle excess food should not overshadow the ability to expand existing food rescue, animal feeding, and anaerobic digestion operations.

The biggest challenge remains the collection of organic waste material, specifically agricultural food losses, excess prepared food, food scraps, and food manufacturing byproducts. The distance between the generators of excess food and the users is a key factor in making the economics of the system work. These distances can increase costs to the point of making the aforementioned landfill alternatives cost-prohibitive. The creation of dense collection service routes, often times anchored by a few large generators, is also critical to improving system economics and reducing collection service costs to all generators. Many food waste generating businesses are willing to evaluate savings on waste disposal and shift those funds towards landfill alternatives, and sometimes even pay more for the services. The creation of these business commitments are driven by customers and citizens and are shown through corporate and institutional zero waste goals—crucial steps towards the advancement of organics recycling in North Carolina.

Unlike other states with active food waste bans from landfills (such as California, Connecticut, Vermont, Massachusetts, and Rhode Island) or local governments with supportive food diversion ordinances or programs (such as Austin, San Antonio, Madison, Los Angeles, New York City, San Francisco, Seattle, Denver, Portland, Ann Arbor, and many others), North Carolina and most of its local governments do not have a landfill ban or recycling mandates on food waste food (Orange and Wake counties do provide some level of organics recycling support, through voluntary participation). N. C. does have a supportive state government recycling program that provides technical assistance and grant funding for the diversion of organic material (through NCDEQ DEACS Recycling and Materials Management Section), as well as local government recycling offices that offer technical advice or funding. It also has active networks of compost professionals and a growing commitment to zero waste in its industrial sector.

The combination of public/private partnerships—support from state and local governments as well as corporate commitments coupled with non-profit and private sector diversion services—is critical to diverting organic materials from landfills, creating jobs, improving soil health, reducing hunger, and meeting the EPA/USDA food waste reduction goal.