BEYOND THE SOUTH WAKE LANDFILL STUDY

Phase 1 Summary Report

The South Wake Landfill (SWLF), located where Holly Springs meets Apex, has been in operation since 2008. It receives approximately 500,000 tons per year (or approximately 1,600 tons per day) of municipal solid waste (MSW) from residents and businesses across Wake County. Current projections estimate that the SWLF will reach capacity between 2040 and 2045. While expanding efforts to reduce, reuse, recycle, and divert waste may help preserve capacity and extend its lifespan, a new long-term MSW management and disposal solution will ultimately be required.

Because developing a new MSW disposal option could take 7 to 10 years, proactive planning is essential. To address this need, Wake County launched the **Beyond the SWLF Study** in late 2024. The study aims to:

- ★ **Evaluate long-term solid waste disposal options.**
- ★ **Engage stakeholders and the public in the decision-making process.**
- ★ **Strengthen local partnerships and explore regional collaboration opportunities.**
- ★ **Develop an implementation plan for the preferred disposal solution.**

This report presents the findings from **Phase 1** of the study, which focused on assessing the technical, financial, and environmental aspects of potential MSW disposal methods. It also lays the groundwork for additional evaluation, stakeholder engagement, and collaboration in **Phase 2**.

The four MSW management and disposal options evaluated include:

1. **Establishing a new MSW landfill within Wake County.**
2. **Transporting and disposing of waste at one or more regional MSW landfills outside Wake County.**
3. **Constructing a waste-to-energy (WTE) facility in Wake County.**
4. **Implementing one or more alternative MSW management technologies.**

WAKE COUNTY
NORTH CAROLINA

TECHNICAL EVALUATION OF MSW DISPOSAL OPTIONS

OPTION 1

Development of a New MSW Landfill in Wake County

Option 1 involves siting, permitting, construction, and operation of a new publicly owned MSW landfill in Wake County. A screening-level evaluation was performed to identify land that could potentially be suitable for the development of a new MSW landfill. The following initial screening criteria were used:

- ★ Incorporated areas (cities and towns) and their extraterritorial jurisdictions (ETJs) were excluded.
- ★ Areas with significant development, whether residential or commercial, were excluded.
- ★ Existing and planned county parks and conservancies were excluded.

The North Carolina Landfill Siting Regulations prohibit landfills within specified distances from airports and geologic fault areas; seismic impact zones; 100-year floodplains, wetlands, and water supply watersheds; sites listed in the National Register of Historic Places or protected by North Carolina Department of Natural and Cultural Resources; and critical habitat of threatened or endangered species. Areas of Wake County meeting the initial screening criteria were subject to further analysis to identify contiguous properties of at least 400 acres with appropriate dimensions and geometry for landfill development (i.e., not too narrow or irregularly shaped). More rigorous investigations are necessary to explore the suitability of specific areas before being further considered. A new landfill in eastern Wake County would likely require construction and operation of a new MSW transfer station in western Wake County to facilitate waste hauling from residents and businesses.

OPTION 2

Hauling and Disposal at Regional MSW Landfills Outside of Wake County

Option 2 involves the transfer of waste at existing and new transfer stations in Wake County and hauling the waste to one or more regional landfills for disposal. Regional MSW landfills are privately-owned facilities that accept waste from outside their county of residence. There are five active, regional MSW landfills in North Carolina located within 100 miles of Wake County. Their location and estimated remaining permitted capacity are shown in **Figure 1**.

Based on data reported to the North Carolina Department of Environmental Quality (NCDEQ), three of the regional landfills (Sampson County, Uwharrie Environmental, and East Carolina) will reach their permitted capacity prior to, or around the same time as the SWLF. Remaining life estimates for regional landfills have a high degree of uncertainty due to the cascading effect of landfill closures, fluctuations in disposal rates, and the potential for expansion beyond their currently permitted disposal areas. Review of parcel ownership at the regional landfills suggests there is the potential for expansion at all five regional facilities, allowing them to continue operating beyond their currently estimated lifespans. Still, expansions could face roadblocks such as site suitability, availability of borrow materials, permitting obstacles, county approval, and other factors which were not examined as part of this study.

Hauling to a regional landfill would require siting, permitting, construction, and operation of a new transfer station in Wake County, supplementing the existing East Wake Transfer Station.

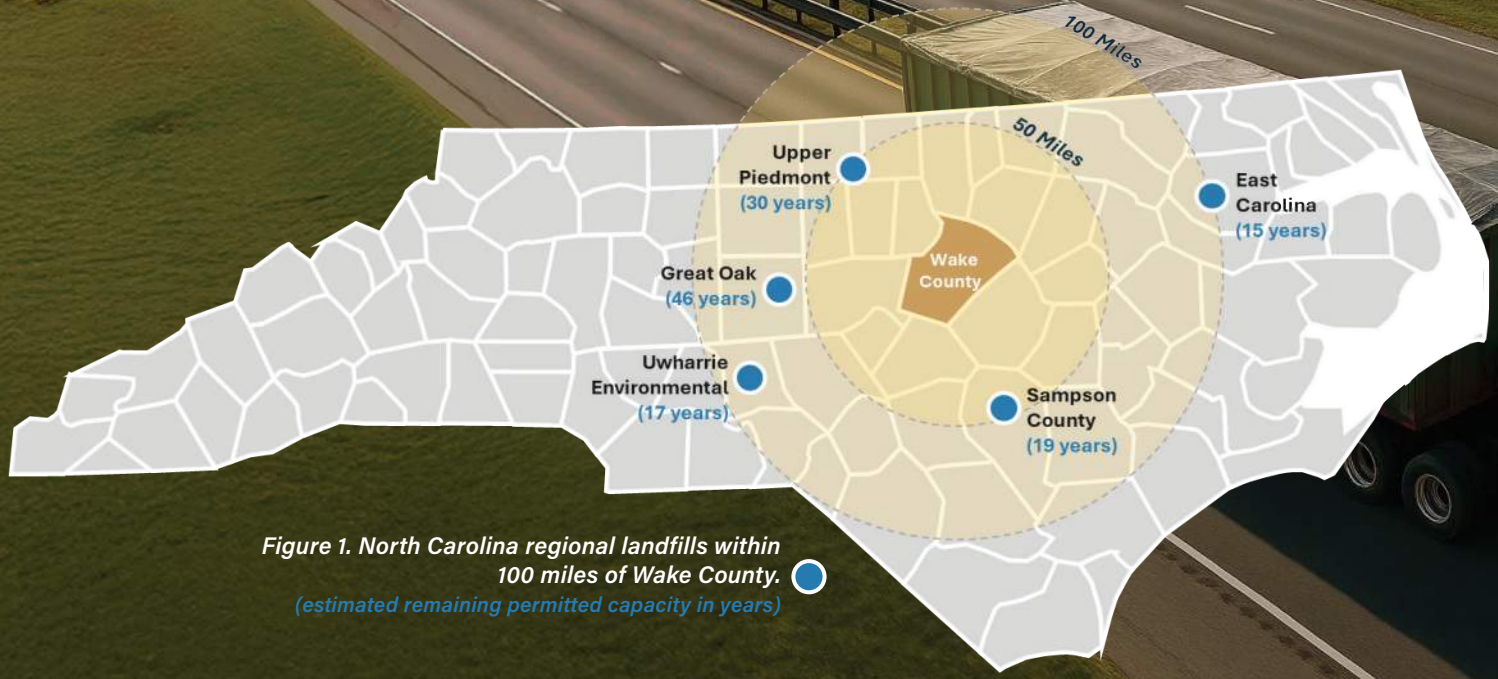


Figure 1. North Carolina regional landfills within 100 miles of Wake County.
(estimated remaining permitted capacity in years)

OPTION 3

Development of a Waste-to-Energy Facility in Wake County

WTE facilities combust waste to generate electricity. In comparison to landfill gas-to-energy facilities at MSW landfills, WTE facilities generate 6 to 8 times more power. There are approximately 2,800 WTE facilities operating worldwide including about 60 in the United States (US). In the European Union (EU), over 40 percent of waste is processed at WTE facilities, while in the US only 13 percent of waste is combusted for power generation. The most recently constructed WTE facility in the US is the *Renewable Energy Facility 2 (REF 2)*, built in 2015 in Palm Beach County, Florida (**Figure 2**). The REF 2 can process up to 3,000 tons of MSW per day.

The WTE combustion process reduces the volume of waste by 90 percent, thereby providing a ten-fold increase in landfill life over conventional landfilling. WTE facilities are subject to strict air quality requirements and use advanced air pollution controls to remove particulate matter, acid gases, metals, sulfur dioxides, and other pollutants from the flue gases. Significant quantities of metal can be recovered from the ash for recycling including iron, steel, copper, aluminum, zinc, and lead.

Power produced by the WTE facility could either be sold or used by the WTE facility owner (i.e., self- generation). If the power is sold it must be sold to Duke Energy Progress (DEP) at the avoided cost rate (i.e., the incremental cost avoided by DEP not producing the power). A power purchase agreement with DEP would need to be renewed every five years, which is the current maximum term length allowed in North Carolina. As avoided cost rates are considerably lower than retail rates, the County and/or local government partners could benefit more from self-generation than from selling power to DEP. Power generated by the WTE facility could be used by an adjacent facility owned by Wake County or a partnering local government, such as a water treatment plant (as is being done in Hillsborough County, Florida), to offset power purchased at the retail rate.

A substantial amount of heat is lost in power production. Additional revenue could be gained by designing the WTE facility as a combined heat and power facility. This entails capturing the waste heat and selling it to an industrial customer, in the form of steam or hot water, for use other than electrical generation.

Another potential revenue source is the sale of renewable energy certificates (RECs) for the percentage of energy generated from conversion of biomass to energy under North Carolina's Clean Energy and Energy Efficiency Portfolio Standard (CEPS). The feasibility of this revenue source requires further evaluation since the North Carolina Utilities Commission has not determined whether, or how much of, MSW can be considered biomass and be eligible for the generation and sale of RECs.

WTE facilities typically range in processing size from 1,000 to 3,000 tons of MSW per day. A 3,000 ton per day facility would provide the greatest economy of scale and opportunity for collaboration with surrounding counties. A facility of this size would generate approximately 100 megawatts of electricity – enough to power approximately 74,000 North Carolina homes on an average day.

Figure 2. The Palm Beach County Renewable Energy Facility 2.

OPTION 4

Alternative MSW Disposal Technologies

An evaluation of alternative waste conversion technologies to landfilling or WTE was performed using the following criteria:

- ★ *Reliability* of the technology to treat MSW as demonstrated by a record of successful operation at commercial scale in the US.
- ★ *Scalability* to meet Wake County's increasing disposal needs as reflected in long-term waste generation projections.
- ★ *Suitability* to Wake County's current collection program (i.e., one bin for single stream recycling and one bin for trash). The treatment technology must be capable of processing trash as collected.

The technologies evaluated, based on previous studies and a literature search, included:

- ★ **Mechanical biological treatment (MBT)**, which sorts and processes trash to recover recyclables and produce compost or refuse-derived fuel.
- ★ **Gasification and pyrolysis**, which are thermochemical technologies that convert organic waste into synthetic gas and char and differ from combustion by their limited-to-no use of oxygen.
- ★ **Composting**, a biological process that converts organic waste into a soil enhancement material. The incoming waste must be preprocessed to screen out inorganic materials.
- ★ **Anaerobic digestion**, which involves the breakdown of organic material using microorganisms in a sealed, oxygen-free environment called a digester. Like composting, gasification, and pyrolysis, anaerobic digestion requires preprocessing as it only treat the organic fraction of MSW.

Despite there being over 550 operating **MBT** facilities in Europe, there are currently none operating in the US. An MBT facility located in Martinsburg, West Virginia started operating in 2008 but permanently closed in 2022 due to financial issues. MBT in Europe is successful because the EU Landfill Directive bans disposal of untreated organic waste in landfills. MBT is too expensive to operate in locations that allow untreated organics to be disposed in landfills. Additionally, MBT generates a significant amount of residual waste (approximately 30 to 50 percent) that requires disposal at a landfill or WTE facility.

While **Gasification and Pyrolysis** have demonstrated reliability for treating homogeneous waste streams such as plastics or wastewater treatment biomass, they have not proven to be effective for processing heterogeneous waste such as MSW. There are no known, successful large/commercial scale operations using gasification or pyrolysis to process MSW in the US or abroad.

Composting of trash at a large scale was attempted in the US by several European companies in 1990s with no success. Problems with odor complaints, mechanical difficulties, inability to market the product and other environmental factors resulted in the shuttering of these plants. The only composting facilities processing trash in the US include two small-scale facilities, one in Sevier County, Tennessee and one on Nantucket Island in Massachusetts, which process less than 50 tons of MSW per day.

Similar to composting, **Anaerobic digestion** of organic waste is a proven technology but requires implementation of a separate collection system for yard waste and food scraps. It also does not address the inorganic components of MSW, leaving a significant fraction for disposal by other means. There are no known anaerobic digestion facilities processing mixed MSW in the US.

None of the evaluated technologies meet all of the criteria identified for this study and, therefore, are considered as nonviable disposal alternatives for Wake County.

FINANCIAL AND ENVIRONMENTAL EVALUATION OF MSW HAULING AND DISPOSAL SCENARIOS

The MSW disposal options were paired with hauling scenarios and further evaluated based on financial and environmental criteria. Their potential cost and emissions of greenhouse gases (GHGs) and criteria air pollutants (CAPs) were analyzed using existing data and models. Because the regional haul and disposal scenario involves significantly more haul miles, vehicular collisions were also estimated. The three *hypothetical* scenarios evaluated were:

SCENARIO 1 A new MSW landfill in eastern Wake County and a new waste transfer station at the SWLF.

SCENARIO 2 Hauling and disposal at an existing regional landfill. For comparison to the other scenarios, the Great Oak Landfill in Randolph County was selected because it has the most remaining permitted capacity. Two waste transfer stations would facilitate MSW hauling: the existing East Wake Transfer Station and a new transfer station at the SWLF.

SCENARIO 3 A new WTE facility at the SWLF property with residual ash disposal at the SWLF. The existing East Wake Transfer Station would continue to facilitate waste transfer and hauling.

A life cycle assessment evaluated GHG and CAP emissions for each scenario, assuming the hauling and disposal of 2,000 tons per day of MSW. GHG emissions were calculated assuming 30 years of landfilling and using a 100-year global warming potential (GWP). GWP reflects the relative warming potential of each GHG compared to carbon dioxide, enabling all GHG emissions to be expressed as metric tons of carbon dioxide equivalent ($MTCO_2e$). This 30-year operational period reflects the typical lifespan of an active landfill and captures the cumulative effect of slow-release emissions and changing landfill gas collection efficiencies. Emissions beyond the 30-year period were also included because waste decomposition and associated GHG emissions continues for decades after disposal. Air quality dispersion modeling was performed to compare potential ground-level concentrations of CAPs. The dispersion modeling results are not intended to provide a comprehensive assessment of environmental impacts but serve as a screening tool to compare estimated ground-level concentrations of CAPs.

Planning-level costs were developed for each scenario to account for sensitivity to various factors and the potential for changing conditions. Hauling and landfill disposal costs were estimated based on existing hauling and disposal data from Wake County and the surrounding region. WTE planning-level costs were estimated using a WTE financial model that uses existing cost data from operating WTE facilities. It accounts for capital and operating costs, revenue from the sale of electricity and recovered metals, and other factors.

The results of the evaluation are shown in **Table 1** and summarized below.

- ★ Hauling and disposal at a regional landfill (Scenario 2) nearly doubles the expected vehicle collisions compared to Scenarios 1 and 3 and results in slightly more GHG emissions.
- ★ MSW disposal accounts for 73 to 86 percent of total GHG emissions across the scenarios, with hauling accounting for the rest.
- ★ Sensitivity testing suggests that MSW composition has considerable influence on GHG emissions when combusted at the WTE facility (Scenario 3). For example, MSW with a higher percentage of plastics results in greater GHG emissions for Scenario 3.

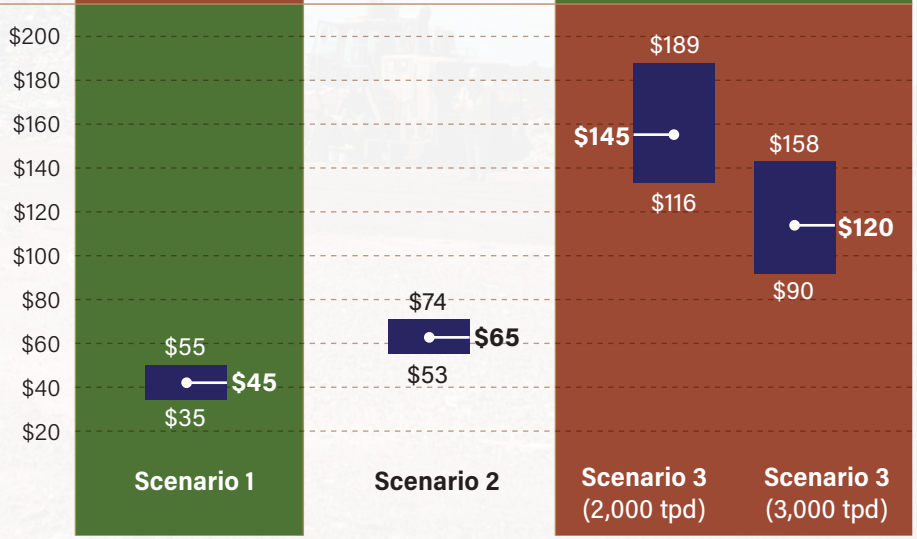
- ★ Hauling and disposal at a WTE facility (Scenario 3) achieves the lowest predicted ground-level CAP concentrations primarily due to effective dispersion from its tall stack, with additional benefit from lower emissions of certain pollutants such as particulate matter, carbon monoxide, and volatile organic compounds.
- ★ Estimated average hauling and disposal costs are $45 per ton for Scenario 1, $65 per ton for Scenario 2, and $145 per ton for Scenario 3 (not including the $2 per ton state tax). For comparison, the current cost of disposal ranges from $35 to $47 per ton, depending on whether the MSW is delivered directly to the SWLF or transferred from the East Wake Transfer Station. Scenario 3 has a wider range of potential costs due to potential variation in capital and operating costs, revenue from energy sales, and other factors. A 3,000 ton per day WTE facility would have a lower cost than a 2,000 ton per day facility, averaging $120 per ton. This size of a facility would receive waste from outside of Wake County.

Table 1. Comparison of Financial and Environmental Elements.

Compared Criteria	Units	Scenario 1 New Landfill in Wake County	Scenario 2 Hauling and Disposal at a Regional Landfill	Scenarion 3 WTE Facility in Wake County
MSW Hauling Vehicle Collisions	miles/day number/yr	11,000 6.9	19,200 11.2	10,000 6.2
Greenhouse Gas (GHG) Net Emissions (100-yr Global Warming Potential)	MTCO2e	1.55 Million	1.71 Million	1.54 Million
Criteria Air-Pollutants (CAPs) Dispersion Modeling Peak Results	**Averaging Period**	**Modeled Peak Concentrations as a Percent of National Ambient Air Quality Standards**		
Carbon Monoxide (CO)	1-hr	1.0%	3.6%	0.01%
Nitrogen Dioxide (NO_2)	1-hr	42%	68%	1.4%
Sulfer Dioxide (SO_2)	1-hr	4.9%	15.2%	0.4%
Fine Particulate Matter 2.5 (PM2.5)	24-hr	26%	19%	0.02%
Inhalable Particulate Matter (PM10)	24-hr	111%	83%	0.09%

Planning Level Cost Range ($/ton)

Combined hauling and disposal costs for each scenario are presented as an expected range, accounting for variations in cost factors. For Scenario 3, cost ranges are presented for 2,000 and 3,000 ton per day facilities. A 3,000 ton per day facility represents a regional option for converting waste-to-energy.



Color Key: ■ Most Favorable □ Less Favorable ■ Least Favorable

NEXT STEPS

Phase 2 activities for the **Beyond the SWLF Study** are intended to build on the **Phase 1** results. The previously developed Public Engagement Plan (PEP) provides a structured approach for engaging stakeholders in the decision-making process. The purposes of the engagement effort are to:

- ★ Educate stakeholders on the County's waste management challenges and potential solutions.
- ★ Promote broad participation by reaching Wake County's diverse communities.
- ★ Collect meaningful feedback to inform decision-making.
- ★ Build trust and transparency through open communication about study findings and decisions.
- ★ Measure engagement success to refine outreach strategies as needed.

This PEP emphasizes the importance of community voices in shaping sustainable and equitable waste management solutions so that decisions reflect the needs and priorities of Wake County's residents and other stakeholders.

During **Phase 2**, Wake County will be soliciting feedback from a diverse group of stakeholders including city and town managers, solid waste managers, elected officials, advisory boards and committees, waste management companies, chambers of commerce, environmental groups, community and neighborhood groups, and the general public. Initial steps in the engagement process will be to inform stakeholders of the disposal options under consideration and solicit feedback to help identify and prioritize criteria that should be considered in the decision-making process. Potential criteria to consider and prioritize include:

- ★ Minimizing greenhouse gas emissions
- ★ Maintaining local control over waste disposal
- ★ Social cost and environmental justice
- ★ Minimizing truck traffic and vehicle collisions
- ★ Minimizing cost
- ★ Producing energy
- ★ Minimizing odors
- ★ Finding a regional solution
- ★ Job creation
- ★ Recovering metals and/or other resources
- ★ Minimizing human health risks from pollutants
- ★ Minimizing ecological impacts
- ★ Maintaining flexibility to adapt to changing conditions
- ★ Stability of cost