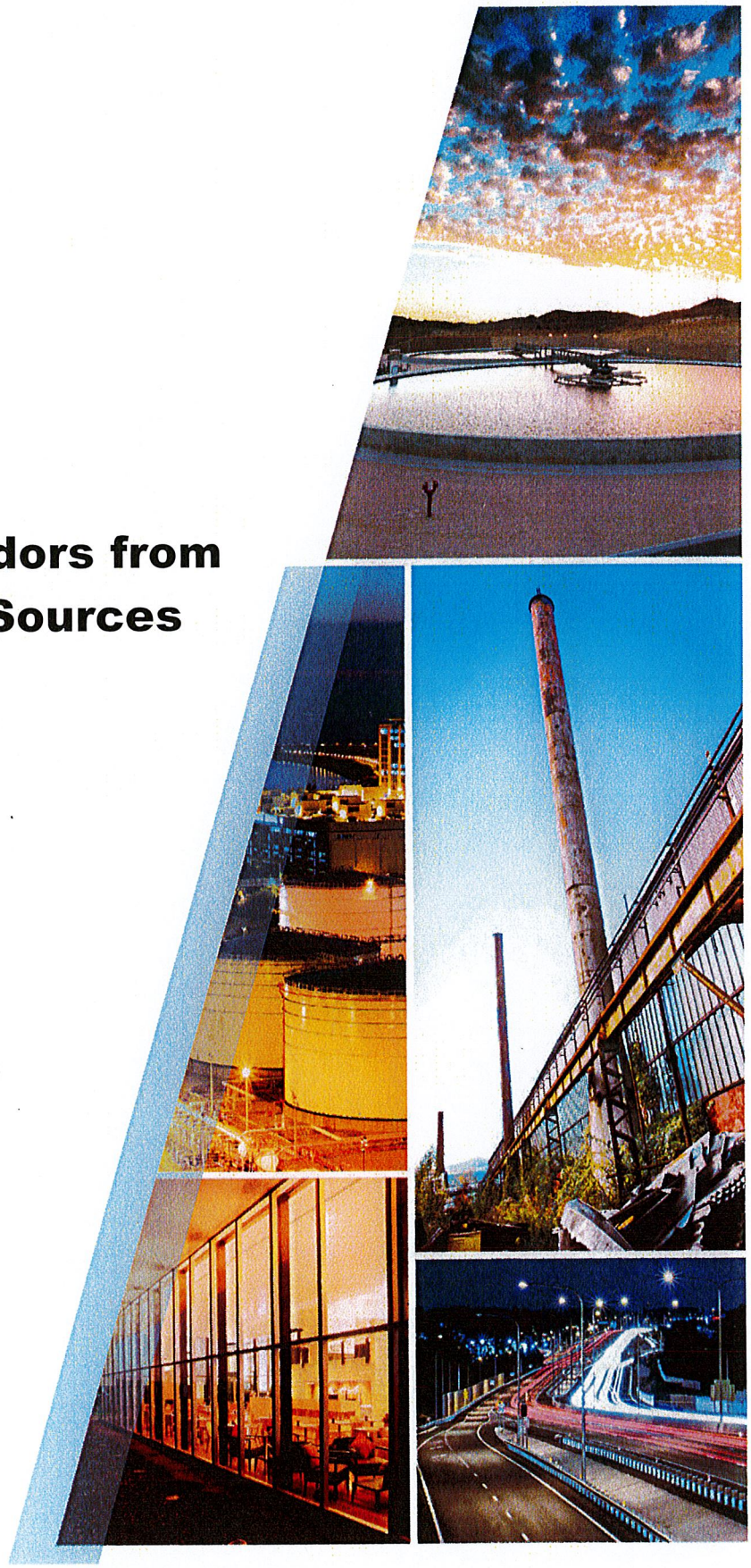

Work Plan
Evaluation of Odors from Various Waste Sources

High Acres Landfill
Fairport, New York

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1. Project Description

1.1 Background

Waste Management of New York, LLC (WMNY) has retained GHD to compile the following Work Plan for the High Acres Landfill located in Fairport, NY (Facility or Site) (refer to Figure 1 for Site Location). In accordance with the September 14, 2018 letter to the Honorable Michael G. Barker (Perinton Town Supervisor), WMNY is hereby undertaking a study of materials delivered by both truck and rail to the Facility to determine the nature and extent of undue odors, if any, contributed by the same. The study will also identify additional mitigative measures to reduce as feasible undue odors and implement those measures, to the extent practical and effective, to control odors. The overall duration of the study will be 10-12 months in order to evaluate potential seasonal effects. However, WMNY and the Town of Perinton will develop interim milestones for various phases of the study and implement recommended measures from each phase as/if it is determined they will effectively reduce odors, prior to completing the entirety of the study.

1.2 Objectives

The objectives of this work plan program are to:

1. Evaluate municipal solid waste (MSW) sources, characteristics, and relationships of MSW to odor generation prior to incorporation into an MSW landfill
2. Evaluate conditions, including odor generation, of MSW being delivered to the High Acres landfill from various sources and modes of transportation
3. Evaluate handling, transportation and storage operations and potential effect on odor generation
4. Evaluate odors from MSW prior to incorporation into the landfill from various locations and modes of transportation
5. Evaluate odors at working face
    - Stripping of daily cover
    - MSW odor long haul vs rail vs local
6. Conduct a field study to identify "typical" waste streams from various sources
7. Collect air samples associated with MSW from various sources and modes of transportation to evaluate the presence of compounds associated with odors
8. Conduct bench scale test of nitrogen purge on the generation of methane from containers
9. Research methods for recording temperature in shipping containers
10. Generate a report summarizing the activities performed and the results of the evaluations performed

1.3 Project Organization and Management

The primary contacts for this project are as follows:

WMNY Project Manager:

High Acres Landfill
425 Perinton Parkway
Fairport, NY 14450

GHD Project Manager:

2055 Niagara Falls Boulevard
Niagara Falls, NY 14304

GHD Technical Lead:

2055 Niagara Falls Boulevard
Niagara Falls, NY 14304

2. Evaluation of Municipal Solid Waste Material

2.1 MSW Sources/Characteristics

In parallel with the literature review discussed in Section 2.2, GHD will conduct an evaluation of the MSW characteristics being delivered to the High Acres Landfill, which is anticipated to include but not limited to:

- Review of sources of waste generation
- Evaluation of handling, transportation and storage operations and potential effect on odor generation
- Evaluation of the relationship between storage time and transportation time and mode in relation to odor generation
- Evaluate odor in relation to visual characteristics of MSW
- Evaluation of temperature and associated decomposition rates on odor generation

In addition, a comparison of the various regional wastes will be performed by tracking physical characteristics of the MSW during transportation to monitor the following:

- Temperature (use data loggers to track ambient air temperatures versus internal temps within containerized waste) from placement to unloading

- Moisture content
- Pressure (to see if there is pressure build up within the containers)
- CH_4, O_2 and CO_2 content using GEM (instrument is commonly used for LFG monitoring)

The results of the evaluation will be presented in the final report described in Section 6.0.

2.2 Literature Search

Following review of this work plan by NYSDEC and the Town of Perinton, GHD will conduct a literature review of peer reviewed articles/studies related to odors associated with MSW from point of curbside collection through transportation and handling at transfer stations to point of incorporation into an MSW landfill.

The literature review will include an evaluation of the use of an inert gas (such as N_2, CO_2) placed in the shipping containers at the point of loading to limit biological decomposition of the waste and, therefore, reduce odors.

The results of the literature search will be presented in the final report described in Section 6.0.

3. Methods for Evaluation of Odor Generation Mechanisms

Odors at the High Acres Landfill have been characterized as coming from two primary sources:

1. Landfill Gas
2. Waste/Trash (operational odors)

Based on historical laboratory analysis data, landfill gas at the High Acres Landfill has an average methane concentration of approximately 45-50 percent and an average concentration of hydrogen sulfide (H_2S), a common odor causing compound in landfill gas, of 370 parts per million (ppm).

Odors from landfill gas are fairly well documented. Historical sampling at the High Acres Landfill (Site) has attributed landfill gas odors to compounds including hydrogen sulfide, carbonyl sulfide and other reduced sulfur compounds, and other odor causing compounds such as limonene and a-pinene.

Much less is known about the odors associated with waste/trash. A search of available literature did not reveal a significant amount of data on the issue of waste odors compared to landfill gas odors. However, there is some information relative to composting and anaerobic digestion (AD) facilities. Based on the nature of trash, it is anticipated that many of the waste odors may be similar to odors from these types of facilities. The table below is a summary of the compounds anticipated to be contributing to waste odors and their odor detection limits..[1]

[1] Getting To Know Odor Compounds, Nora Goldstein, CioCycle Magazine, 2008

Table 3.1 Compounds Anticipated to be Contributing to Waste Odors

Compound	Detection Limit (µg/m^3)	Odor
Dimethyl disulfide	0.1	Rotten cabbage
Hydrogen sulfide	0.7	Rotten eggs
Dimethyl sulfide	2.5	Sulfur
Methane thiol	0.04	Sulfur
Ammonia	27	Medicinal smell
Trimethyl amine	0.11	Fishy odor
Indole	-0.0004	Feces
Skatole	0.0004	Feces
Propionic acid	1019	
Butyric acid	28	
Acetone	0.4-800 ppm	
Methyl ethyl ketone	0.18-0.19 ppm	Alcohol
Acetaldehyde	2	
Propylaldehyde	22	Sweet solvent
Methanol	13000	
Ethanol	342	
Limonene	200 ppb	
a-pinene	6 ppb	
Guaiacol	3-21	
Pyrans	2000	
Furans	2-50 ppm	

The work done for this study will focus on odors that emanate from waste/garbage (i.e., landfill gas odors are not part of this work study).

3.1 Odor Generation from Various Sources

This Section describes the methods to be used to identify components of the waste stream that may contribute to odors at the High Acres Landfill, based solely on composition of the waste stream for a particular area/region.

3.1.1 Local Waste Composition

GHD will conduct a search of publicly available records with regards to approximate waste composition for the local region (Monroe County, Wayne County, Rochester area, etc.). A spreadsheet will be compiled that summarizes components of the waste that are considered putrescible (or non-putrescible) and also delineate waste types that may be more likely to produce odors.

3.1.2 New York City Waste Composition

GHD will conduct a search of publicly available records with regards to approximate waste composition for the New York City area. A spreadsheet will be compiled that summarizes components of the waste that are considered putrescible (or non-putrescible) and also delineate waste types that may be more likely to produce odors.

3.2 Odor Generation from Various Modes of Transportation

This Section describes the methods to be used to identify whether a relationship exists with regards to odor generation and the different modes of transport of waste to the High Acres Landfill.

3.2.1 Local Hauling

GHD will evaluate the local hauling routes for the High Acres Landfill (defined as within 100 miles of the facility). The lifecycle, approximate residence time and conditions of the waste (temperature, moisture content, etc.) will be evaluated for the period from introduction at the curbside to entry at the High Acres Landfill property. GHD will also present truck count information and waste throughput data for local haul waste.

3.2.2 Long Hauling

GHD will evaluate the long hauling routes for the High Acres Landfill (defined as greater than 100 miles of the facility). The lifecycle, approximate residence time and conditions of the waste (temperature, moisture content, etc.) will be evaluated for the period from introduction at the curbside to entry at the High Acres Landfill property. GHD will also present truck count information and waste throughput data for long haul waste.

3.2.3 Rail Car

GHD will evaluate the rail car routes for the High Acres Landfill. The lifecycle, approximate residence time and conditions of the waste (temperature, moisture content, etc.) will be evaluated for the period from introduction at the curbside to entry at the High Acres Landfill property. GHD will also present rail count information and waste throughput data for rail car waste.

3.3 On-Site Handling, Transportation and Storage Operations and Potential Effect on Odor Generation

GHD will evaluate the on-site handling, transportation and storage of waste for the period of entry at the High Acres Landfill property to the working face area. A separate evaluation will be conducted for waste that is transported by truck versus rail.

3.4 Evaluation of Odors at Working Face

GHD will evaluate conditions at the working face area that may contribute to odors.

3.4.1 Stripping of Daily Cover

An odor evaluation using the n-Butanol scale will be conducted downwind of the working face area during the time that daily cover is stripped from the surface at the beginning of a workday. This evaluation will be compared with the results of the perimeter odor observations.

3.4.2 Evaluation of EPI Cover (Trial)

A trial evaluation of a cover system provided by EPI will be undertaken to evaluate its effectiveness in reducing odors. This is a synthetic material designed for use as daily cover. Odors will be

evaluated on the n-Butanol scale for areas with EPI cover material compared to current daily cover practices.

3.5 Evaluation of Time/Temperature Data for Odor

For rail car waste, GHD will plot the internal temperature of the containerized waste over time from initial placement in the rail car until unloading at the landfill. This data will overlay a plot of the ambient outdoor temperature.

3.6 Odor Compliant Tracking System

The odor complaint tracking system will be evaluated and compared with other data such as meteorological conditions, time of day, etc.

4. Field Testing

This Section describes the field activities that will be performed in conjunction with the methodology discussed in the previous section.

4.1 Survey of Waste Streams from Various Sources

A visual inspection of local haul, long haul and rail car waste will be conducted and the observations will be noted in a field log book. Pictures of each waste source will also be taken. While this work is undertaken, an olfactory reading using the n-Butanol scale (see Section 4.5 for further discussion) will be conducted for each waste source.

4.2 Collection of Air Samples

Air samples from waste will be collected and analysis performed for the following parameters:

- Volatile organic compounds (VOCs) via USEPA method TO-15 plus tentatively identified compounds (TICs)
- Reduced sulfur compounds via ASTM method 5504

Initially transportation containers will be scanned to determine the presence of odor emissions from the containers. Scanning will be performed by olfactory and air monitoring methods (flame ionization detector (FID) for VOCs and a TVA for methane). GHD will scan the seals of a variety of rail containers, local and long haul vehicles, and vehicles hauling sludges. Measurements will be taken along the seals within 5-10 centimeters in general accordance with EPA Method 21. Any sustained detections above background will be recorded.

GHD will evaluate the placement of waste in the landfill from the current waste streams to evaluate variations in odor during placement of MSW from various sources and modes of transportation to the landfill. Scanning will be performed using olfactory and air monitoring instruments, and visible observations of physical composition to determine "typical" loads from each source. The results of the scanning will be used to determine in what areas of the landfill air samples should be collected. The work plan will provide for the collection of up to eight air/gas samples, including the following:

- Two samples from loaded, unopened rail shipping containers
- Potentially odorous loads (based on a review of incoming waste streams)
- Transfer trailers, front-loaders, rear-loaders, compost, special wastes, etc.

Samples will be collected by either:

1. Inserting Teflon tubing into the unopened containers and tarped incoming loads and gas samples drawn under vacuum from the containers into Tedlar bags and Summa canisters
2. For freshly tipped waste, 100' x 100' tarps will be placed in the area for approximately 30 minutes to allow any emissions to accumulate before Teflon tubing is inserted under the tarp and samples are withdrawn. These tarps are designed to be utilized for daily landfill cover.

These methods would not necessarily detect all of the compounds in the above list, but are expected to indicate concentrations of odorous compounds present at detectable limits and determine if these compounds are common to more than one source or if there is a high variability between sources. The intent of collecting air samples from waste will be to determine what compounds would be similar to, and those different from, landfill gas. Samples will be analyzed for TO-15 plus tentatively identified compounds (TICs), reduced sulfur compounds and fixed gases.

While this work is undertaken, an olfactory reading using the n-Butanol scale (see Section 4.5 for further discussion) will be conducted for each sample collected.

4.3 Bench Scale Test of Nitrogen Purge

To evaluate the potential for using a nitrogen purge to prevent decomposition of waste in rail containers, a bench scale test will be conducted. Two 5-gallon containers of municipal waste will be collected from freshly tipped waste. One container will be purged with nitrogen and the other untreated. Gas samples will be extracted from each container every other day for 10 days and analyzed for methane concentration in GHD's treatability lab in Niagara Falls, New York.

4.4 Temperature Monitoring in Shipping Containers

The temperature within the rail cars will be monitored using data loggers to track ambient air temperatures versus internal temperatures within containerized waste from placement to unloading at the landfill. A Cargo Data Lightning NFC (or similar model) will be used in the study (see Appendix A for specifications).

4.5 Field Odor Testing Using n-Butanol Scale

All field staff will be trained under ASTM Method E544-10 in order to identify the magnitude of odor during an odor event. The n-Butanol scale test will be used in conjunction with the other field tests described in Section 4.0.

In addition, Odor Science and Engineering, Inc. will conduct a perimeter odor study while the sampling activities described in Section 4.2 are undertaken.

4.6 Ambient H_2S Monitoring Program

On March 2, 2018, GHD submitted a Revised Surface Emission Monitoring and Ambient Monitoring Work Plan to the New York State Department of Environmental Conservation (NYSDEC) for the High Acres Landfill. On March 6, 2018, GHD installed five Acrulog hydrogen sulfide (H_2S) monitoring units at the following locations:

- West Monitoring Station
- North Monitoring Station
- East Monitoring Station
- South Monitoring Station
- Dudley Elementary School Monitoring Station

Figure 2 presents the location of each of these stations.

The Acrulog units collect measurements of hydrogen sulfide at a frequency of every 10 minutes at each station (this work is currently ongoing). In the final report, GHD will present a summary of the monitoring program for the calendar year of 2018.

5. Schedule with Milestones

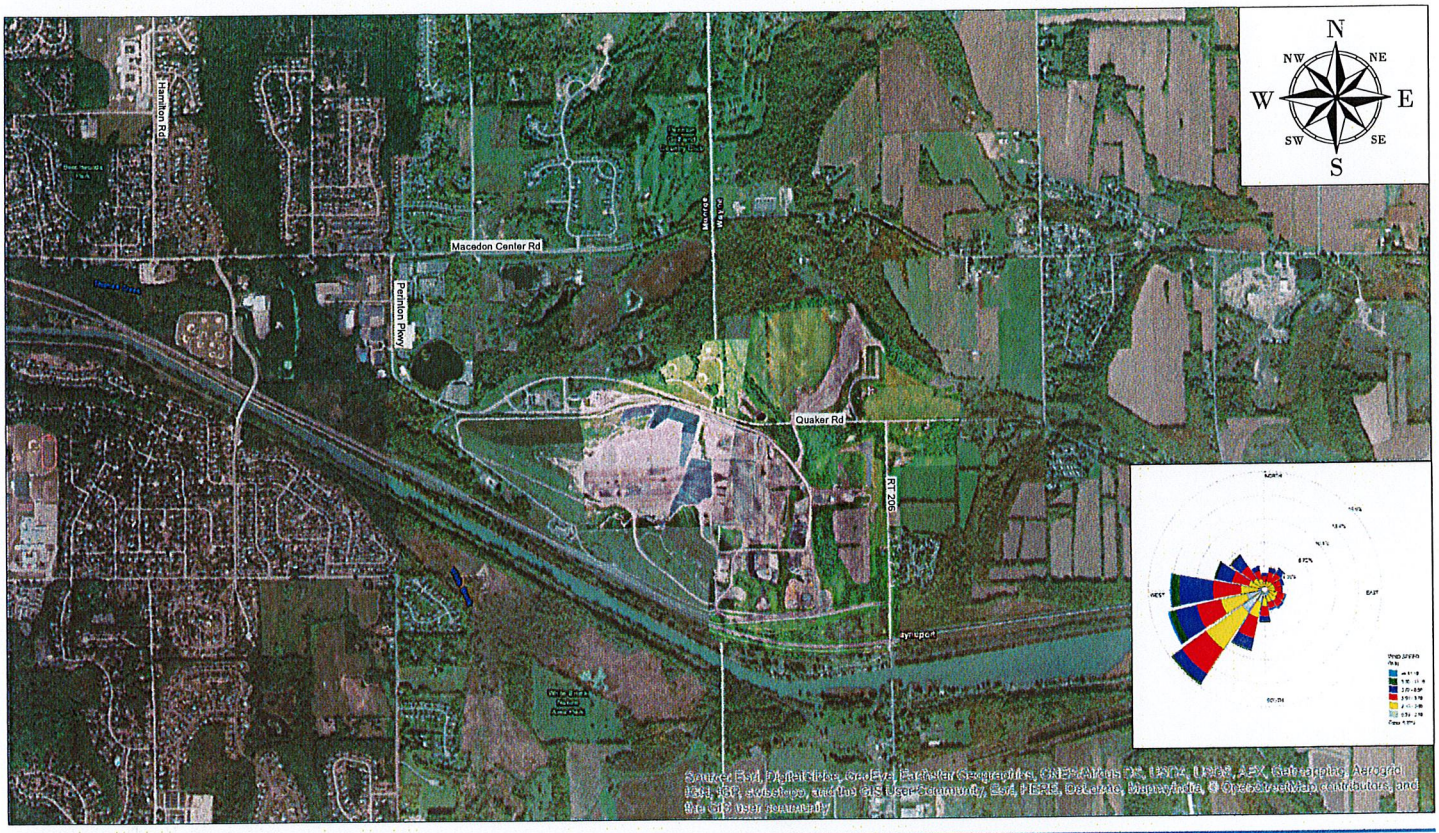
Below is the proposed work plan schedule for consideration:

Table 5.1 Proposed Project Schedule

Date	Project Milestone
Week of November 26, 2018	Work Plan Submission to NYSDEC/Town of Perinton
Week of November 26, 2018	Odor Science Training
Week of December 10, 2018	Field Testing Commences
January 2, 2019	Analytical Test Results Received From Lab/Final Report Preparation Commences
February 7, 2019	Final Report Submitted to Town of Perinton

6. Reporting

WMNY will provide a written report to the Town of Perinton detailing the data collected, findings and conclusions no later than February 7, 2019.



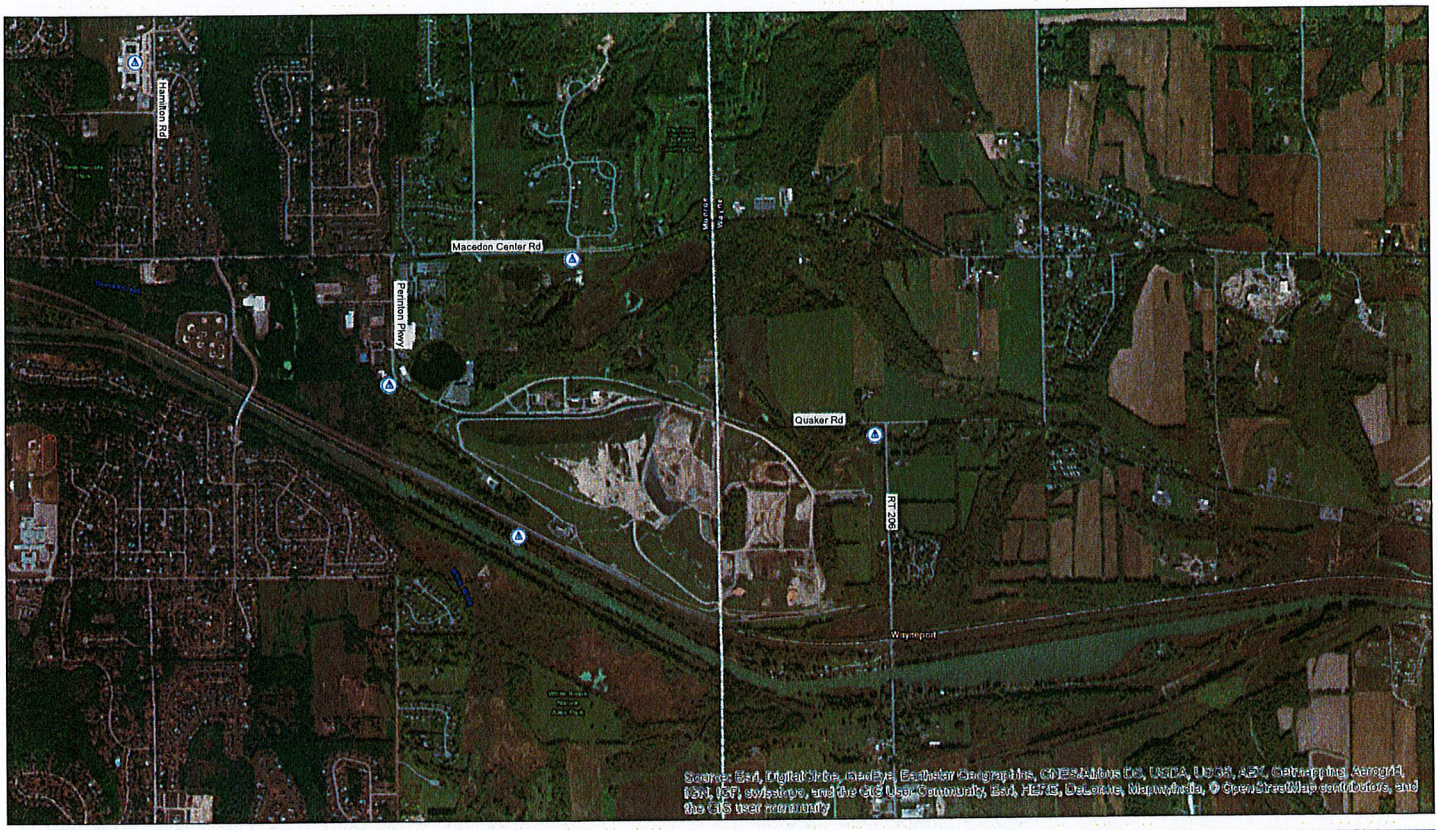
0 1500' 3000'

WASTE MANAGEMENT HGH ACRES LANDFILL
FAIRPORT, NEW YORK
AMBIENT AIR MONITORING
WIND ROSE 2013 TO 2017

89290-00
Nov 13, 2018

FIGURE 1

CAD File: P:\Drawings\89000s\89290-WM HGH ACRES\ODOR EVAL WORK PLAN\CADD\Drawings\FIGURES\89290-FIG001.dwg



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0 1500' 3000'

LEGEND

PROPOSED AMBIENT AIR MONITORING LOCATION

WASTE MANAGEMENT HGH ACRES LANDFILL
FAIRPORT, NEW YORK
AMBIENT AIR MONITORING

89290-00
Feb 26, 2018

AMBIENT AIR MONITORING LOCATIONS

FIGURE 2

CAD File: P:\Drawings\89000s\89290-WM HIGH ACRES\AMBIENT AIR MONITORING\CADD\Drawings\Civil\FIGURES\89290-FIGURE 1.dwg

Appendices

Appendix A
Temperature Monitor Specifications

CARGO DATA
Cold Chain Monitoring Made Simple

LIGHTNING FAST! Instantly review temperature data upon arrival — right at the trailer door!

CARGODATA LIGHTNING NFC

- NFC (Bluetooth-like wireless) technology eliminates the need for cords, readers, and printers.
- Perishable QA has never been easier or faster!
- Easy product quality documentation and pictures.
- No desktop computer required. Simply hold Lightning NFC back to back with you smart device for wireless download.

iPhone and Android Compatible

iPhone | Android

Lightning NFC

Features:

- Join the growing number of Quality Receivers switching to the latest technology!
- Works with all NFC enabled Android phones and iPhone 7 and higher
- Tablets provided to chains and major receivers at NO COST when full program is adopted.
- Program includes generous rebate program to help reduce costs.
- Save time/labor with faster results, more transparency, less paperwork.

As soon as **Lightning NFC** is held back-to-back with the NFC smart device, the **FREE Lightning NFC App** will display the full temperature chart for the monitored period. The user can then add useful entries for PO number, commodity type, and arrival quality. Pictures can also be added to the record.

All temperature, shipping, quality data points, and images are automatically uploaded to **Cargo Data's** secure **UpLink** cloud server for permanent archiving and online access.

Download the Free Lightning NFC App Here

Download on the App Store

GET IT ON Google Play

Complies with: ✓ FDA ✓ FDA FOOD SAFETY MODERNIZATION ACT ✓ HACCP

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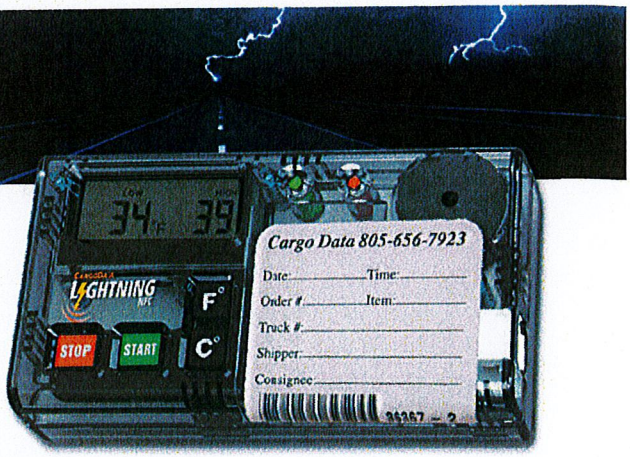
Lightning NFC

Free Smart Device Apps



Two Options:

1) Use standard **FREE Lightning NFC App** to display full temperature chart and details, select range, add PO number, commodity description, comments, and photos to the record. Collected data available for FREE online review using instrument serial number.

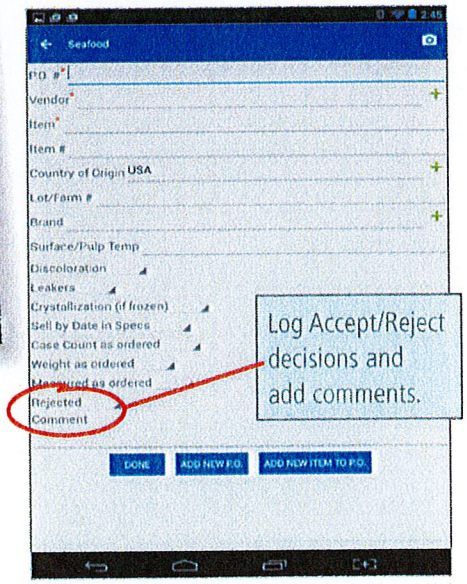
2) Users who sign-up for the full program can use our enhanced **FREE Lightning QA App** which adds support for multiple POs/items per shipment, commodity specific quality documentation screens with drop-down database driven menus, and ability to log accept/reject determinations. Full online data access and custom reporting available on secure, password-protected website.

Data entries for both Apps can be entered using keyboard or voice entry. Temperature reports with comments and photos can be emailed directly from the smart device for time-critical decision making.

Specifications :

- NFC transmission Range: Approx. 1 in
- Factory Calibrated, N.I.S.T. traceable
- On-Board LCD displays time and temperature data (Fahrenheit or Celsius)
- Monitors temperatures from -20°F to 120°F
- Range selections made within Lightning App
- Audible locating beeper (FREE option)
- Monitors up to 80 days
- Single-use instrument
- Size: 3 in x 1.75 in x .4 in
- Weight: 3 oz
- Manufactured in Certified ISO9002 CE facilities

All product features, specifications and appearances may vary due to technical advances.



Category specific attribute lists for Produce, Seafood, Meat, Deli/Dairy, Frozen and Floral.

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about GHD

GHD is one of the world's leading professional services companies operating in the global markets of water, energy and resources, environment, property and buildings, and transportation. We provide engineering, environmental, and construction services to private and public sector clients.

Steven Wilsey

[redacted]

Bryan Szalda

[redacted]

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