How a Landfill Works:

Landfill Gas Management System

- **Vertical Gas Well**
- **Horizontal Gas Well**
- **Sulfatreat Units**
- **Landfill Gas Flares**

- **Landfill Leachate Management System**

- **Leachate Transfer Chamber**
- **Leachate Storage Tank**
- **Leachate Truck Loading Area**
The increase in complaints was due to odors attributed primarily to cutting and grading of the waste mass, to prepare the landfill for the Phase F capping project.

DEC required the Town to identify all odor sources, evaluate management practices, and propose a Corrective Action Plan (CAP), which was submitted in 2015.

Implementation of corrective actions listed in the CAP commenced in 2015. See following poster for pictures.
The Phase G capping project was significantly set back by an extremely wet season, causing a delay in connecting the gas extraction wells, and resulting in gas emissions from the area which was being capped.

The three-month delay in completing the Phase G cap led to an increase in odor complaints during the months of November and December 2018, and January 2019.

DEC issued a Notice of Violation in March 2019. A Consent Order with implementation schedule was signed on September 3, 2019.
The Corrective Action Plan listed five (5) major sources of odor identified during the investigation. The Town has taken the following corrective steps:

I. Inactive uncapped areas of the landfill - Accelerated capping of approximately 48 acres of inactive uncapped landfilled areas

II. Side riser pumps of the landfill leachate collection system - Resealed all 18 Cells 5&6 side riser pump chambers, installed industrial odor control spraying system, and improved scheduled maintenance of all chambers and pipes

III. Pumping stations used for transferring leachate to the storage tanks - Revamped all three (3) Cells 5&6 force main pump stations by replacing existing pumps with new more robust ones

IV. Landfill gas condensate - Resealed all six condensate pump vaults

V. Leachate storage tanks - Installed a hydrogen peroxide dosing system to reduce sulfur compounds in the leachate

To further implement the CAP, the Town has also upgraded all landfill gas and leachate management infrastructure as follows:

1. Redesigned the gas collection and control system (GCCS), including gas header design of the horizontal gas extraction wells, and design of the gas extraction wells, from the gas venting layer just beneath the final cap’s geosynthetic liner

2. Revised procedures for balancing the GCCS

3. Modified condensate collection vaults at the SulfateTreat facility and elsewhere to better control odorous releases

4. Repaired minor gas leaks at the SulfateTreat facility and throughout the GCCS

5. Redesigned the leachate collection and transfer system

6. Installed additional vertical wells to better control odor releases from uncapped waste

DEC started a rigorous monitoring program to verify the effectiveness of the CAP measures implemented:

1. On-site H2S monitoring - Three times a week, using a Jerome meter, Town consultants measure on-site H2S levels at the 5 major sources of odor identified in the CAP

2. Off-site H2S monitoring - DEC uses Acrulog instruments to continuously monitor off-site H2S levels. One instrument is placed at the Frank P Long Intermediate School, and the second at Pallets-R-Us, on East Woodside Avenue, across from the leachate tanks
2015/2016 - The increase in complaints was related to landfill gas emissions during the cutting and grading of the waste mass to prepare that section of landfill for the Phase F capping project. See following posters for additional details and DEC response.

2018/2019 - DEC’s investigation concluded that this increase in complaints was related to stalled construction activities caused by the extremely wet season during the Phase G capping project. This resulted in a three-month delay in connecting the newly-installed gas extraction wells to the gas collection and control system designed to safely manage landfill gas emissions. See following posters for details.
Sources & Causes of Odor Episodes at the Landfill

Landfill Cap Construction Issues

Unusually Wet Weather
Issue:
- Washouts
- Damage to gas pipes
- Delay in activating gas collection system

Limited Preventive measures, as weather conditions are unpredictable

Landfill Fine Grading
Issue:
- Old waste disturbed

Limited Preventive measures include:
- Re-cover exposed waste with soil the same workday

Trench For Liner Anchor
Issue:
- Old waste disturbed

Limited Preventive measures include:
- Re-cover exposed waste with soil the same workday

Landfill Infrastructure Issues

Barrier protection layer washout after an unseasonably wet weather and heavy rains delaying completion of cap construction

Gas Management
Issue:
- Power failure
- Equipment breakdown

Main flare

Contingency measures include:
- Auto flare re-ignition
- Auto dialing standby personnel
- Using back-up flares

Leachate Management
Issue:
- Power failure
- Equipment breakdown

Leachate storage tank with H₂O₂ dosing tank & equipment in foreground

Contingency measures include:
- Manual H₂O₂ dosing if needed
- Continuous H₂S monitoring in storage tank
- Automatic adjustment of H₂O₂ dosage

Cutting and fine grading the side slopes before placement of cap system (water spraying is for dust control)

Anchor trench for geomembrane is made by digging into the old waste

Dump truck placing soil on the side slopes to cover the waste that was disturbed during fine grading before placement of the landfill cap

Landfill geomembrane is anchored by filling the anchor trench with soil

Dozer spreading soil cover on the waste mass that was disturbed for fine grading before placement of landfill cap

Hydrogen peroxide (H₂O₂) dosing equipment at the leachate transfer chamber

Backup flares with main flare in background

Contingency measures include:
- Auto flare re-ignition
- Auto dialing standby personnel
- Using back-up flares
Special Off-Hour Monitoring for Hydrogen Sulfide by DEC

Monitoring in spring & winter 2018

- DEC staff used a handheld instrument called a Jerome meter
- The Jerome can detect low concentrations of hydrogen sulfide around the level that most people smell
- DEC staff sampled for hydrogen sulfide late night and early morning during periods of possible temperature inversions

Enforcement

- The Jerome is used to measure violations of the New York State hydrogen sulfide standard, which is 10 parts per billion (ppb) for 1 hour
- Staff conducted 23 monitoring events on 17 dates
- Hydrogen sulfide was detected but not under conditions for violation of the standard

Temperature inversion – A layer of warm air traps a layer of cool air close to the ground, preventing air mixing and keeping emissions close to the ground
Continuous measurements of hydrogen sulfide

- In 2017, 2018, and 2019, DEC installed instruments that record hydrogen sulfide (H$_2$S) every 10 minutes
- These instruments (OdaLog and Acrulog) only work during the warmer months
- During the cooler months, staff use a handheld Jerome meter
- OdaLogs and Acrulogs are effective screening tools because they operate on a continuous basis; however, they cannot be used as an enforcement tool because of potential interference with other gases (such as vehicle emissions)

### Frank P Long H$_2$S Results (OdaLogs and Acrulogs)

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<thead>
<tr>
<th>Year</th>
<th>Number of Readings</th>
<th>Number of H$_2$S Detections</th>
<th>Percentage of H$_2$S Detections (%)</th>
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<tbody>
<tr>
<td>2017</td>
<td>17,465</td>
<td>47</td>
<td>0.27</td>
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<tr>
<td>2018</td>
<td>21,100</td>
<td>2</td>
<td>0.009</td>
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<tr>
<td>2019 (as of 7/25)</td>
<td>11,056</td>
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### Pallets-R-Us H$_2$S Results (OdaLogs and Acrulogs)

<table>
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<tr>
<th>Year</th>
<th>Number of Readings</th>
<th>Number of H$_2$S Detections</th>
<th>Percentage of H$_2$S Detections (%)</th>
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</thead>
<tbody>
<tr>
<td>2017</td>
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<tr>
<td>2018</td>
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<td>2019 (as of 7/25)</td>
<td>12,451</td>
<td>162</td>
<td>1.4</td>
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Other Recent Studies & Monitoring Conducted around the Brookhaven Landfill

2011/2014: Modeling by USEPA
USEPA modeled ambient air concentrations for hazardous air pollutants for every census tract in the US from all possible sources. The results for the two most recent modeling years (2011 and 2014) for known human carcinogens were evaluated. The cancer risk estimates for 1,3-butadiene, acetaldehyde, benzene, and formaldehyde, for the census tract containing the Brookhaven Landfill, for both modeling years, were below the average risk estimate for Suffolk County and New York State. The estimates for carbon tetrachloride are the same across all areas of the State.

2014/2018: Community Air Screen Program by Community and DEC
DEC developed a community-based screening program for toxic air pollutants. Participants collected 1-hour air samples using SUMMA canisters during each round of sampling. The samples were analyzed by DEC’s laboratory using USEPA’s TO-15 method. The community around the landfill participated in 2013/2014 and 2018. The results were within an acceptable range of DEC health-based comparison values or within range commonly found in New York State.

2015-2017: Indoor and Outdoor Air, Groundwater by SCSD
The South Country School District hired EnviroScience to evaluate groundwater and indoor and outdoor air quality at Frank P. Long Intermediate School. The investigation found the levels of all parameters assessed at the time of sampling to be within acceptable range. EnviroScience’s report concluded there were no recommendations for corrective action at the time. The results were reviewed by New York State Department of Health.

2019: Hydrocarbon and Volatile Organic Compound by DEC
DEC staff used a FLIR GF320 infrared camera to investigate potential leaks from above-ground components of the landfill’s gas collection and control system. The optical gas imaging camera is capable of detecting emission of hydrocarbon and volatile organic compounds. The components checked were found to be in good condition, except for minor leaks at the flare pumps/blowers. DEC staff notified landfill personnel of the leaks so they would repair them. Additionally, the Town informed DEC that all existing components of the flare system will be replaced when the new flare is installed.

Ongoing Monitoring: Landfill Operations, Odors, etc. by DEC
DEC staff routinely inspect the landfill, investigate complaints, and check conditions at the landfill and in surrounding neighborhoods. The results are discussed with the Town for follow-up and any corrective action required.
Main Mitigation Goals at the Brookhaven Landfill

• Minimize potential for nuisance conditions
• Optimize infrastructure design and operation
• Minimize equipment downtime
• Enhance hydrogen sulfide monitoring on-site and off-site
• Accelerate covering and capping inactive areas
• Improve cover material quality and placement
• Improve waste management
• Optimize system maintenance
Future Actions as Required by the Order on Consent

Executed on September 3, 2019

- The Town will complete an expedited holistic evaluation of the landfill during peak odor-producing conditions to identify any new or previously unidentified landfill odor sources.

- The Town will provide an addendum to the Corrective Action Plan that will include, but not be limited to, the following items:
  - Enhanced operating and intermediate cover material protocol
  - Design details for improved $\text{H}_2\text{O}_2$ dosing equipment at the leachate tanks, feed pumps, etc. and complete construction of final design
  - Investigation of secondary $\text{H}_2\text{O}_2$ pretreatment system for the west side Cell 5 pump station
  - Amendments to the landfill Operation and Maintenance Manual to include: intense waste screening, revised cover material plan, and reduced active landfilling areas
  - Alternative daily cover material (ADCM) reduction plan
  - Enhanced ADCM testing and screening protocol, including strict sulfur parameter guidelines
  - Enhanced air monitoring plan, including intensified testing at the active Cell 6 fill area and off-site
  - Conceptual design details for replacement of the existing flare
  - Conceptual design details for updating the landfill gas collection and control system