New York City Landfills
Past and Present
Landfill, 1904
Tipping, 1904
Hand Cart Tipping into Scow

- Earliest recycling pre-1900s
- Rags etc. removed from hand carts prior to tipping
Loaded to Capacity
Unloading Scow, circa 1905
Sunken Scow
Empty Scow

- Next to Brooklyn Bridge
Hand Loading Scow circa 1905
Landfills in NYC

*Only 50 out of the 89 reported landfills are shown here due to incomplete data.

Source: Rovics Targeting
# Past Landfills by Borough

<table>
<thead>
<tr>
<th>Borough</th>
<th>Location 1</th>
<th>Location 2</th>
<th>Location 3</th>
<th>Location 4</th>
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<tbody>
<tr>
<td><strong>Bronx</strong></td>
<td>Baychester</td>
<td>East 117th Street</td>
<td>Fairfield</td>
<td>Bergen</td>
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<td>Fairfield</td>
<td>Ferry Point</td>
<td>Metcalf &amp; Soundview</td>
<td>Brookville</td>
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<td>Metcalf &amp; Soundview</td>
<td>O'Brien Avenue</td>
<td>Fairfield</td>
<td>Edgemere</td>
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<td>Orchard Beach</td>
<td>Pelham Bay</td>
<td>Ferry Point</td>
<td>Whitestone Pkwy.</td>
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<td>Rikers Island</td>
<td>White Plains Road</td>
<td>Bergen</td>
<td>Kissena Park</td>
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<td><strong>Brooklyn</strong></td>
<td>Flatbush Avenue</td>
<td>Floyd Bennett</td>
<td>Great Kills</td>
<td>Fresh Kills Plant #1</td>
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<td></td>
<td>Fountain Avenue</td>
<td>Jerome Avenue</td>
<td>Fresh Kills Plant #2</td>
<td>Brookfield Avenue</td>
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<td></td>
<td>Marine Park</td>
<td>Pennsylvania Avenue</td>
<td>Richmond Avenue</td>
<td>Fort Totten</td>
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<td>Ralph Avenue</td>
<td>Remsen Avenue</td>
<td>South Shore</td>
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<td><strong>Staten Island</strong></td>
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</table>
Corona Fill 1931

- 2.9 million cubic yards of ash and mixed refuse were deposited that year, making possible the site of 1963 World’s Fair
Ash Unloading at Rikers Island, circa 1905
Reclaiming Land at Rikers Island, circa 1905
Reclaiming Land at Rikers Island, circa 1905
Rikers Island 1938

- Marine Unloading Plant
- Three Marine Diggers
- 1938
  - 4,080 Scows or Barges Unloaded
  - 7,252,170 Cubic Yards
  - 3,237 Tons Coal Unloaded
North Beach Airport, 1938

• 1938 - 14,000,000 cubic yards of old fill were removed for the expansion of the North Beach Airport (Laguardia Airport)
Rikers Island, 1964
Rikers Island
Spring Creek Landfill, 1956

- Located in Queens
- 17.8 acres of swamp land filled in 1956
Ferry Point Landfill, 1956
Ferry Point Park
Ferry Point Park

- Located near Whitestone Bridge
- In 1998 was used as a compost facility
- Compost facility has been moved due to planned golf course
Pelham Bay Landfill

- Opened 1963
- Located in the Borough of the Bronx
- Material primarily from the Bronx
- Truckfill only
Pelham Bay Landfill, 1973

- Accepted municipal, commercial and C&D wastes
- 81 acres
- 40,000 tons per month
Queueing at Pelham
Dumping at Pelham
Bulldozer Clearing at Pelham
Spreading Cover at Pelham
Pelham Bay Landfill

- 1963-1979
- Final Elevation 160 feet
- Listed as a Superfund site
- Now zoned as park land
Early Aerial Photo of Fountain & Pennsylvania Ave. Landfills
Fountain Avenue

• Opened 1961 in Brooklyn
• Closed 1985
• Served boroughs of Brooklyn and Queens
• 8700 tons per day average
• Peak elevation 160 feet
• Now part of Gateway National Park
Fountain & Pennsylvania Avenues 1952

- Pre-Landfill
Fountain & Pennsylvania Avenues 1973

- Man-Made Peninsulas
- Both served Brooklyn, Queens
- Fountain
  - 300 Acres
  - Municipal, commercial, asbestos & C&D wastes, incinerator ash
- Penn
  - 110 acres
  - Municipal, C&D waste, sewage sludge at different times
Edgemere Landfill

- Opened in 1938 and closed in 1991
- Located in the Borough of Queens
- Approximately 173 acres
- One of the oldest sanitary landfills in New York City
Edgemere 2000
Edgemere Active Bank

Primarily served the borough of Queens

- Truckfill only
- Daily tonnage 900
- Final elevation 65 feet
Edgemere

- Closed early due to airport concerns
- Bird sanctuary
- Now closed and capped
Unloading Final Cover at Edgemere

- Closure 1996
- All final cover material delivered by barge – no trucks
Edgemere Offloading Facility
Offloading Cover Material at Edgemere
Geomembrane Cap at Edgemere

- 1997
Landfill Gas Flare at Edgemere

- First New York City Landfill to use flaring for odor control
Fresh Kills, 1943

- Pre-landfill
Fresh Kills Landfill Opens, 1948
Fresh Kills Landfill, 1954

- By 1955, the world’s largest landfill
- FK remained the largest until 1999
Fresh Kills Landfill, 1961
1951

- Early Cable Crane
Cable Crane Unloading Barge
Unloading – Pre-1990

- Cable Cranes
- Tractor – Athey Wagons
- Dirt -- Refuse Roads
- Round Trip 1.6 Miles -- 50 Minutes
Unloading Into Athey Wagon
Cable Crane Bucket
Athey Wagons
Athey Wagons
Athey Wagons (Cont’d)
Athey Wagons
Athey Wagons (Cont’d)

• Along a dirt/garbage road to active bank
• 1980s
Athey Wagons On Haul Road
Athey Wagons Tipping
Active Bank
Bank Shanty

- Supervisor station
Compactors
Fresh Kills Landfill, 1972
Charge Per Cubic Yard
1976 - Present

<table>
<thead>
<tr>
<th>Year</th>
<th>Landfill</th>
<th>MTS</th>
<th>Incinerators</th>
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<tr>
<td>1976</td>
<td>$3.25</td>
<td>$5.00</td>
<td>$5.00</td>
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<tr>
<td>1982</td>
<td>$6.00</td>
<td>$12.00</td>
<td>$12.00</td>
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<td>1983</td>
<td>$7.00</td>
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<td>1985</td>
<td>$9.25</td>
<td>$15.25</td>
<td>$17.50</td>
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<tr>
<td>1986</td>
<td>$11.75</td>
<td>$17.50</td>
<td>$20.00</td>
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<tr>
<td>1987</td>
<td>$18.50</td>
<td>$24.00</td>
<td>$28.00</td>
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<tr>
<td>1988 to present</td>
<td>$40.00</td>
<td>$44.00</td>
<td>$53.00</td>
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</table>
General Overview

- 13,000 tons of Residential Waste per Day
  - 2500 tpd Recycled
  - 8 Marine Transfer Stations
- 59 Sanitation Districts
Disposal Facilities

- Marine Transfer Stations
- Private Transfer Stations
- Landfills
Marine Transfer Stations

• Locations
• Capacity
  – Permitted at 4800 tpd
  – Average Use in Full Operation = 1800 TPD
• Rehab/Redesign
Hamilton Avenue MTS
Daily Operations

• Truck weighed at entrance
• Proceeds to tipping floor (inside station)
• Barges staged outside
  – Hand shifting
  – Tug shifting
Refuse Arrival

- Peak in 1987-88 at 28,000 TPD
  - 19,000 by barge
  - 9,000 by truck
- 13,000 TPD at closure
  - 11,000 by barge
  - 2,000 by truck
DOS Barge Fleet

• Dimensions
  – L 150 ft,
  – W 37 ft
  – Depth 17.6
  – Loaded draft approx 8.5 ft

• Capacity 620 tons
Marine Transportation

- Tower Dispatcher
  - Coordinates barge and tug movements
- Towing
  - Up to 4 barges
  - Up to 27 nautical miles
Marine Transportation (Cont’d)

• Barge Maintenance Unit
  – Emergency Response
  – Soundings
  – Shipyard Readiness
Clean Water Procedures

- Dip Netting
- Containment Booms
- Barge Netting
- Barge Deck Cleaning
Barge Staging Area

- Stores approximately 50 barges along west catwalk
Boom System

- Outer Boom
- Range Boom
- Super Boom
Super Boom
Super Boom (Cont’d)

- Mechanical refuse barrier
- Fully automated
- Opens only on incoming tide to prevent escape of floatables
- $8 million
Water Quality

- Sweeper Boats
- Dipnets
- Canvas
- Monitors
- Clean Decks
- Shore Line Cleaning
Water Quality (Cont’d)

- Marine containment fence throughout landfill
Super Boom & Range
Boom
Fresh Kills Landfill
Unloading Plants

- Plants 1 & 2
- Pads
Unloading – Post 1990

• Hydraulic Cranes
  – 10 Yard Bucket
  – 992 FEL – 20 Yard Bucket
  – Pit Area 150 x 60 Feet
• Payhauler Trucks
  – 80 cubic yard capacity
  – Covers
Unloading -- Post 1990 (Cont’d)
Unloading -- Post 1990 (Cont’d)
Unloading -- Post 1990 (Cont’d)

- Paved Roads
- Round Trip 1.6 Miles – 18 Minutes
Fresh Kills – Post 1990

• Average Tonnage 13,000 TPD
• Active Bank 250 x 60 Feet
• Split Bank – Top, Bottom
• Compaction
Fresh Kills – Post 1990 (Cont’d)
1990 - 2001: Modernizing
Loaded O & K Crane Bucket
Loading Pay Hauler
Odor Control

- Flushers
- Atomizers
- String line misters
Active Bank
Active Bank
Fresh Kills – Post 1990, Cont’d

- Side Slopes 3 to 1
- Slope Stability
- Litter Control
Compacting
Miscellaneous

- High Wind Procedures
- Seagull Deterrents
Litter Control
30-foot Litter Fencing

- Surrounds perimeter of landfill
Compactor
Erosion Control (Cont’d)

- Building series of storm water runoff culverts
Erosion Control
Final Cover

- Sections 3/4, 2/8, 6/7 completed
- Section 1/9
Beautification

• Richmond Avenue 1987
• Landfill perimeter
Beautification

- 1987
Beautification

• Richmond Avenue Today
Beautification

• Richmond Avenue Today
Fresh Kills Landfill, 1997
Fresh Kills Landfill, 1998
Fresh Kills Landfill, 1999
Fresh Kills Landfill, 2000
Last Barge
Fresh Kills Landfill is Closed
<table>
<thead>
<tr>
<th>Section</th>
<th>Acreage</th>
<th>Elevation</th>
<th>Closure Date</th>
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<tbody>
<tr>
<td>3 &amp; 4</td>
<td>131</td>
<td>160</td>
<td>11/92</td>
</tr>
<tr>
<td>2 &amp; 8 North</td>
<td>147</td>
<td>107</td>
<td>6/94</td>
</tr>
<tr>
<td>2 &amp; 8 South</td>
<td>147</td>
<td>148</td>
<td>5/93</td>
</tr>
<tr>
<td>6 &amp; 7 North</td>
<td>346</td>
<td>130</td>
<td>6/97</td>
</tr>
<tr>
<td>6 &amp; 7 South</td>
<td>346</td>
<td>95</td>
<td>6/99</td>
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<tr>
<td>11 &amp; 12</td>
<td>272</td>
<td>50</td>
<td>8/80</td>
</tr>
<tr>
<td>10</td>
<td>70</td>
<td>25</td>
<td>1966</td>
</tr>
<tr>
<td>1 &amp; 9</td>
<td>460</td>
<td>182</td>
<td>3/01</td>
</tr>
<tr>
<td><strong>Total Acres</strong></td>
<td><strong>1,416</strong></td>
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</table>
Landfill Gas Recovery at Fresh Kills Landfill
Fresh Kills Landfill

- Approximately 3000 acres
- Gas collection in place
Flares

- Six flares
- 5000 cfm each
Phase I Status

- 6 flares have been installed
- Permits
  - In place for flares
Flare Schematic
Stack Emissions

- Emissions limited by permits
Landfill Gas Recovery

- Existing plant began commercial operations in 1982
- 10 MMSCFD Processing Capacity (Selexol)
- Upgraded to 14 MMSCFD capacity in 2000
Well Locations
Section 6/7
What is Leachate?
REDUCTION OF LEACHATE

- Active Face
- Stormwater Drainage
- Intermediate Cover
- Final Cover
DATA

• Characterize Material under the Landfill
• Describe the Chemical Makeup of the Leachate
• Estimate the Quantity
• Discover the pathways of leachate flowing into the underlying groundwater and adjacent surface waters
FINDINGS

• Types of Geologic Material Found; three distinct layers
  – Garbage
  – Natural Soils and Sediments
  – Bedrock
LEACHATE FLOW

• Flows through the garbage and shallow underlying sands into adjacent surface water

• Detection:
  – Ammonia
  – Organic Matter
  – Some Metals
Collection & Containment System

- Collection trench
  - 39,000 linear feet (7.4 miles)
  - Up to 38 feet deep
- Cutoff wall
  - To prevent migration beyond landfill boundary
- 32 collection wells
Collection System (cont’d)

• Perimeter access road
  – 38,500 feet (7.3 miles) of paved road

• Transmission of collected leachate
  – Dual-wall force main
  – 11,500 feet (2.2 miles)

• Supervisory control 7 data acquisition system (SCADA)
Slurry Wall

- Surrounds landfill perimeter
- Typical depth 20 – 50 feet
Cutoff Wall

- Slurry wall construction
- 1.4 million vertical square feet
- 3 feet wide
Perimeter Access Roads

- Cutoff wall runs adjacent to perimeter road around Sections 1/9 & 6/7
Collection Vault
Leachate Collection Overview
Incoming Leachate

- Leachate from all sections enters here
- Anti-foam agent added at this stage
Leachate Treatment

- Capacity 1.2 million gallons per day
- Average processing 600,000 - 800,000 gallons per day
Leachate Treatment

• Capacity of 1 million gallons per day
  – 100,000 on line 1994
  – Remainder on line 1997

• Sequencing batch reactors & chemical precipitation to remove
  – Ammonia
  – BOD
  – Metals (Primarily iron)
Leachate Management Overview

• 4 Systems
  – Cover system to prevent infiltration
  – Containment system to prevent escape of leachate from landfill
  – Collection system to transport leachate for treatment
  – Treatment system
A Landfill Storm Water System
Storm Water Drainage

• Collection and Conveyance
  – Diversion swales constructed to collect and convey storm water
  – Bench storm drains & down chutes
  – Perimeter conveyance system
  – Storm water control basins
Storm Water Drainage (cont’d)

- Reduced benching to 50 vertical feet
- Drainage channels designed to convey 100-year storm
- All drainage channels designed are routed to a storm water control basin
Collection Basin
Fresh Kills Today
Fresh Kills Today
Fresh Kills Today
A New Beginning