Hurricane Sandy

Overview of Subway and Bus preparations, impact and recovery
NYCT Committee Meeting
November 26, 2012
Agenda

**Storm preparations**

Storm event and immediate recovery

Longer term recovery and preparing for future
Storm preparations were guided by extensive table top exercises and established plans

**Pre Sandy event (business as usual)**

- Extensive table top exercises internally and with state and city

**Sandy event**

<table>
<thead>
<tr>
<th>Date</th>
<th>Event Description</th>
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<tbody>
<tr>
<td>Mon Oct 22</td>
<td>Internal storm preparation procedures begin</td>
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<tr>
<td>Tue Oct 23</td>
<td>Physical protection of system begins with sandbags etc</td>
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<td>Wed Oct 24</td>
<td>Regular coordination calls begin with external partners</td>
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<tr>
<td>Thur Oct 25</td>
<td>Physical protection of system complete</td>
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<tr>
<td>Fri Oct 26</td>
<td>Storm peaks</td>
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- MTA coordination with Governor Cuomo and his staff
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**MTA coordination with Governor Cuomo and his staff**

New York City Transit
Storm preparations - subways

Coney Island Yard, Stillwell Yard, Lenox Terminal, Bowling Green
Storm preparations - buses

- Buses staged for evacuation (City Island) at Castleton depot
- Buses relocated to higher ground (Gun Hill depot) at Quill depot
Agenda

Storm preparations

**Storm event and immediate recovery**

Longer term recovery and preparing for future
A record storm surge hit New York City on the evening of Mon Oct 29
Sandy caused major flood damage across the system

8 stations with major flood damage – South Ferry, Whitehall, 148th St, 207th St, Dyckman, Beach 116th Station, 86th St Sea Beach, Stillwell

8 flooded under-river tubes

Train yards and bus depot with significant flood damage

Staten Island Railway maintenance shop major flood damage

Rockaways track washout

Numerous other locations with moderate flooding and wind damage including:
- Downed trees
- Roof / canopy / sidings damages
- Communication systems damages
- Signal system damages

NOT EXHAUSTIVE
Flooded stations – South Ferry
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New York City Transit
Flooded stations – South Ferry
Flooded stations – 86th St Sea Beach line
Flooded stations – 148th St Harlem
Flooded stations – 148th St Harlem
Flooded under-river tubes - Cranberry
Rockaways track washout
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Rockaways track washout
Bus routes impassable
Facilities operated on local generator power
Bus depot flooding – Far Rockaway
Bus depot flooding – 126th St
Bus depot flooding – Quill
Flooded Staten Island Railway shop
Throughout storm event Subways and Buses deployed an established 3 tiered emergency management structure

- **Strategic direction and oversight from senior leadership**
- **Coordination with MTA HQ and external partners**
- **Tactical decision making and monitoring**
- **Operational decision making and monitoring**
Bus service restoration began ~ 7 hours after storm and supported restored subway service with an unprecedented ‘bus bridge’

Buses operating on modified routes initially due to routes blocked by trees, cars, boats etc

‘Bus bridge’ shuttle between Manhattan and Brooklyn – Buses also added extra service to Lower Manhattan where there was initially no power and subway service

Buses also contributed to broader city recovery efforts through election day shuttle bus specials and ongoing OEM ‘Warming Bus’ deployment
Most subway service was recovered within a week of the storm

<table>
<thead>
<tr>
<th>2 days after storm end</th>
<th>3 days after storm</th>
<th>4 days after storm</th>
<th>5 days after storm</th>
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<tbody>
<tr>
<td><img src="image1.png" alt="Map" /></td>
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<td><img src="image3.png" alt="Map" /></td>
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<tr>
<td>6 days after storm</td>
<td>7 days after storm</td>
<td>8 days after storm</td>
<td>9 days after storm</td>
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<td><img src="image5.png" alt="Map" /></td>
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- Storm preparations
- Storm event and immediate recovery
- Longer term recovery and preparing for future
### Important system elements that remain out of service are being worked on with high priority

<table>
<thead>
<tr>
<th>Service Route</th>
<th>Current status</th>
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| **A S** To Far Rockaway and Rockaway Park | • Work underway to restore washed out track sections over Jamaica Bay  
• Work underway to assess and repair signal system at Rockaway Park  
• HS shuttle operating on peninsula with bus shuttle connection to Howard Beach |
| **1** South Ferry Station | • Extensive flood damage to all systems  
• Assessment and restoration work ongoing  
• Operating to/from Rector St at normal frequencies, using the old South Ferry loop to reverse direction |
| **R** Between Manhattan and Brooklyn | • Operating in 2 sections – no service between 34 St – Herald Sq and Jay St Metrotech  
• Significant damage to electrical systems in Montague tube – restoration work underway  
• Flood damage to Whitehall Station  
• Expect to extend service from 34th St to Whitehall St as next step in restoration |
| **J Z** Between Chambers St and Broad St | • Signal and third rail damage  
• Repairs well advanced and entering testing phase |
| **Far Rockaway bus depot** | • Evaluation and assessment of plans for Far Rockaway Depot  
• Buses being run out of JFK depot |

*NOT EXHAUSTIVE*
Reconstruction work - Rockaways
Beyond known issues, general failure rates are expected to accelerate in system elements that experienced flooding.

**Corrosion**
- Metallic components that were exposed to salt water will experience accelerated corrosion
- Particularly problematic for electro-mechanical and electronic systems
- Long term deterioration of huge number of small gauge electrical connections

**Trash / sediment ingress and water damage**
- Despite extensive clean up efforts, system has absorbed more trash and sediment that can cause track fires, foul drains etc
- Useful life of some system elements reduced due to water submersion, eg cloth cable sheathings
Operations Planning is helping to manage increased uncertainty in system

Increased uncertainty in system due to
• Unknown negative impacts of flooding
• Evolving restoration timelines
• Potential for changing external factors due to storm aftermath (e.g. demand levels in local areas)

Operations Planning response
• Optimize service delivery with available assets
• Facilitate service restoration with service plans to accommodate repair work
• Develop and assess potential scenarios ahead of time
• React quickly with updated plans, timetables, work programs and approaches as circumstances change
• Develop and post customer information signs, and deploy staff resources to assist customers at critical locations
Increasing frequency of extreme weather events means a comprehensive approach to protection is required

Coordinated multi-party effort to protect vulnerable zones
- Federal
- State
- City
- Real Estate community

MTA level asset hardening
- Raising ingresses
- Removable water barriers
- More powerful and resilient water evacuation systems
Specific concepts for MTA level asset hardening are being investigated

**NOT EXHAUSTIVE & NOT PRIORITIZED**

- Stair closures
- Vent closures
- Elevator hardening
- Bladders and/or floodgates
- Pre-engineering and site mobilization for temporary mitigation structures
- Hardening of line equipment
- Discharge lines
- Upsizing of pumps
- Power redundancy for pumps
- Communications, EDR, & relay room hardening
- Hardening of signal equipment
- Additional deep wells
- Hardening of power supply systems
- Backflow preventers
- Flood mitigation measures at low lying depots
- Additional generators
- Additional pump trains
Lessons from Sandy are being captured across disciplines and levels of organization

- Storm preparation
- Storm event
- Storm recovery
  - Infrastructure repairs
  - Service restoration
- What worked well?
- What could we have done better?
- What are improvement ideas for future extreme events?
- Face to face debriefs
- Written materials

Organizational learning process