Conceptual Nature-Based and Gray Infrastructure for Flood Resiliency at Oakwood Beach, NY
Project Area

Figure 2: Study Streams within Project Area

Source: Aerial Imagery from ESRI server

NOTES/KEY MAP

LEGEND
- Oakwood Beach Study Area
- Streams
- Outfall Locations

Project Name: Oakwood Beach Flood Attenuation Feasibility Study, New York
Contract: OGS Project - SA319
Date: December 23, 2013
Hurricane Sandy Impacts
Post-Sandy Elevation Differences

2011 LiDAR

POST SANDY

DIFFERENCE

Legend

2010 LiDAR Elevation Range
- 0
- 2
- 4
- 6
- 8
- 10
- 12
- 14
- 16
- 18
- 20

Legend

Post Sandy LiDAR Elevation Range
- 0
- 2
- 4
- 6
- 8
- 10
- 12
- 14
- 16
- 18
- 20

Legend

Difference
(+) Erosion, (-) Accretion
- 9 - 10
- 7 - 8
- 5 - 6
- 3 - 4
- 1 - 2
- 1 - 0
- 3 - 2
- 5 - 4
- 7 - 6
- 9 - 8
- 31 - 10
Status of Property Acquisition
Objectives

• Project Objectives
  – Evaluate natural infrastructure solutions in addition to NYC DEP’s proposed Best Management Practices (BMPs), the USACE rock revetment structure, and The Nature Conservancy Plan
  – Develop Alternatives based on 3 footprints
  – Environmental, Coastal modeling, H&H modeling

Project Methodology → Conceptual Design in 6 months
Recorded Tide Cycles

Tidal Datum Relationships - Fort Wadsworth
in feet relative to NAVD (USACE)

<table>
<thead>
<tr>
<th>Datum</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Higher High Water (MHHW)</td>
<td>2.21</td>
</tr>
<tr>
<td>Mean High Water (MHW)</td>
<td>1.87</td>
</tr>
<tr>
<td>Mean Tide Level (MTL)</td>
<td>-1.8</td>
</tr>
<tr>
<td>Mean Low Water (MLW)</td>
<td>-2.68</td>
</tr>
<tr>
<td>Mean Lower Low Water (MLLW)</td>
<td>-2.89</td>
</tr>
</tbody>
</table>
SLR Scenarios

Gauge: 8518750, NY, The Battery: 151 yrs

All values are in feet

<table>
<thead>
<tr>
<th>Year</th>
<th>Low</th>
<th>Int</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>0.17</td>
<td>0.2</td>
<td>0.29</td>
</tr>
<tr>
<td>2015</td>
<td>0.22</td>
<td>0.27</td>
<td>0.42</td>
</tr>
<tr>
<td>2020</td>
<td>0.27</td>
<td>0.34</td>
<td>0.56</td>
</tr>
<tr>
<td>2025</td>
<td>0.32</td>
<td>0.41</td>
<td>0.72</td>
</tr>
<tr>
<td>2030</td>
<td>0.36</td>
<td>0.49</td>
<td>0.9</td>
</tr>
<tr>
<td>2035</td>
<td>0.41</td>
<td>0.58</td>
<td>1.1</td>
</tr>
<tr>
<td>2040</td>
<td>0.46</td>
<td>0.66</td>
<td>1.31</td>
</tr>
<tr>
<td>2045</td>
<td>0.51</td>
<td>0.76</td>
<td>1.55</td>
</tr>
<tr>
<td>2050</td>
<td>0.56</td>
<td>0.85</td>
<td>1.8</td>
</tr>
<tr>
<td>2055</td>
<td>0.6</td>
<td>0.96</td>
<td>2.07</td>
</tr>
<tr>
<td>2060</td>
<td>0.65</td>
<td>1.06</td>
<td>2.37</td>
</tr>
<tr>
<td>2065</td>
<td>0.7</td>
<td>1.17</td>
<td>2.67</td>
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<tr>
<td>2070</td>
<td>0.75</td>
<td>1.29</td>
<td>3</td>
</tr>
<tr>
<td>2075</td>
<td>0.8</td>
<td>1.41</td>
<td>3.35</td>
</tr>
<tr>
<td>2080</td>
<td>0.84</td>
<td>1.53</td>
<td>3.71</td>
</tr>
<tr>
<td>2085</td>
<td>0.89</td>
<td>1.66</td>
<td>4.1</td>
</tr>
<tr>
<td>2090</td>
<td>0.94</td>
<td>1.79</td>
<td>4.5</td>
</tr>
<tr>
<td>2095</td>
<td>0.99</td>
<td>1.93</td>
<td>4.92</td>
</tr>
<tr>
<td>2100</td>
<td>1.03</td>
<td>2.07</td>
<td>5.36</td>
</tr>
</tbody>
</table>

Sea level rise Baseline (2000-2004) 0 inches

<table>
<thead>
<tr>
<th></th>
<th>Low-estimate (10th percentile)</th>
<th>Middle range (25th to 75th percentile)</th>
<th>High-estimate (90th percentile)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020s</td>
<td>2 inches</td>
<td>4 to 8 inches</td>
<td>11 inches</td>
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<tr>
<td>2050s</td>
<td>7 inches</td>
<td>11 to 24 inches</td>
<td>31 inches</td>
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### PRELIMINARY PEAK FLOWS (CFS)

<table>
<thead>
<tr>
<th>Location</th>
<th>5-year Original</th>
<th>Calibrated</th>
<th>10-year Original</th>
<th>Calibrated</th>
<th>50-year Original</th>
<th>Calibrated</th>
<th>100-year Original</th>
<th>Calibrated</th>
<th>500-year Original</th>
<th>Calibrated</th>
</tr>
</thead>
<tbody>
<tr>
<td>OB-1</td>
<td>26.4</td>
<td>185.3</td>
<td>41.8</td>
<td>228</td>
<td>79.9</td>
<td>317.7</td>
<td>103.8</td>
<td>367.9</td>
<td>157.7</td>
<td>472.3</td>
</tr>
<tr>
<td>OB-2</td>
<td>330</td>
<td>682.9</td>
<td>424.2</td>
<td>830.6</td>
<td>626.5</td>
<td>1139.1</td>
<td>741.6</td>
<td>1311.4</td>
<td>982.3</td>
<td>1668.2</td>
</tr>
<tr>
<td>OB-3 and OB-4</td>
<td>255.1</td>
<td>570.2</td>
<td>334.7</td>
<td>696.1</td>
<td>510.6</td>
<td>959.3</td>
<td>612.7</td>
<td>1106.2</td>
<td>830.5</td>
<td>1410.6</td>
</tr>
</tbody>
</table>
2D Model Setup – Existing Conditions

Grid Development

- Minimum resolution of 2 meters
- 90,000 active cells
- 5 different sources of bathymetric/topographic data

Telescoping (quadtree) grid
Coastal Morphology

- Stable Streams
- Protected Back Bay Wetlands/Beaches
- Stream Patterns
- Barrier Shallows
- Prior Extent WLS Coastal Shallows/Beach
Develop Conceptual Model Using Historic/Natural Conditions:
- Drainage patterns
- Wetlands
- Tidal systems
- Soil/Hydrologic

Mill Dam
Mill
1924 – Channel Patterns
1947 – Coastal Changes

Post WWII
Converted Wetlands
- Filling
- Ditching
- Draining
- Culverts

Beach Development & Filling
1966 – Coastal Sediment Accretion Area
Field Data Collection Locations
Kissam Ave. North End

Monitoring Well KA-4, Soil Boring Three (SB-3), and Wetland Assessment Area (WA-2)
Exposed peat layer seepage zone
(south end/east side of Kissam Ave)
<table>
<thead>
<tr>
<th>Benefits</th>
<th>Alternative 1</th>
<th>Alternative 2</th>
<th>Alternative 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Houses Protected from Coastal Storm Surge</td>
<td>1,840</td>
<td>2,146</td>
<td>2,044</td>
</tr>
<tr>
<td>Wetland Area Restored</td>
<td>Freshwater/Brackish – 63 acres Tidal - 51 acres</td>
<td>Freshwater/Brackish – 54 acres Tidal - 31 acres</td>
<td>Freshwater/Brackish -- 72 acres Tidal - 36 acres</td>
</tr>
<tr>
<td>Level of Protection</td>
<td>500-year Coastal Storm Surge . Storage capacity for 100-year rainfall</td>
<td>500-year Coastal Storm Surge . Storage capacity for 100-year rainfall</td>
<td>500-year Coastal Storm Surge . Storage capacity for 100-year rainfall</td>
</tr>
<tr>
<td>Public Access Components</td>
<td>2 miles of trails 10 observation points</td>
<td>1.5 miles of trails 7 observation points</td>
<td>2 miles of trails 10 observation points</td>
</tr>
<tr>
<td>Volume of Stormwater contained in Restored Storage Areas</td>
<td>516 Acre-feet/168 Million Gallons</td>
<td>424 acre-feet/138 Million Gallons</td>
<td>444 acre-feet/145 Million Gallons</td>
</tr>
</tbody>
</table>
Upland/freshwater wetlands

- 10' Wide Walking Trail
- Palustrine Emergent Wetland (PEM)
- Palustrine Scrub/Shrub (PSS) Fringe Planting
- Palustrine Forested Wetland (PFO)
- SLOPED AREA MEET EXISTING GRADE

Figure 47C - SECTION C-C'

Project Name: Oakwood Beach Flood Attenuation Feasibility Study, New York
Contract: OGS Project - SA319
Date: January 31, 2014

Dewberry
Freshwater/tidal wetlands

NOTE: ALL ELEVATIONS ARE IN HAVEN METHOD UNLESS OTHERWISE INDICATED.
Final Conceptual Alternative Highlights

- **Coastal Flood Protection**
  - Rock revetment, sheetpile wall, floodwall

- **Stormwater Management**
  - Storage Areas/Extended BMPs
  - Tide gates, additional outfalls
  - Channel modifications

- **Nature-based/Green infrastructure**
  - Freshwater/tidal wetland restoration and creation
  - Natural channel and riparian restoration
  - Coastal stabilization
  - Public Access Points
  - Combined Sanitary Sewer Maintenance Access Trail/Bikeway and Walkway;
  - Footpath Walking Trails and Wetland Boardwalk Crossings;
  - Park Open Space and Passive Recreational Areas;
Final Conceptual Renders

Looking from North towards Waste Water Treatment Plant (WWTP)
Final Conceptual Renders

Looking from Ocean towards Storage Detention Area OB-2
Questions?

Special recognition and thanks to NYSOGS, NYSDEC, NYCDEP and the USACE

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