Designing for Resilience – JEA’s Response to Hurricane’s Matthew and Irma – Relevance to Site Cleanup

Relative Sea Level Rise: 2050 (6-18 in; 2100 (18-60 in)

Laurens van der Tak, PE, D.WRE
Agenda

• JEA – Description of the Jacksonville FL Utility
• Climate Scenarios
  • Climate projections
  • Flood modeling
• Risk Assessment
• Relevance to Site Cleanup
JEA Operates over 1,700 Facilities across a 4-County Region with nearly 500,000 Customers in Northeast Florida

- Water Reclamation Facilities – 11
- Wastewater Pump Stations:
  - Class 3 and 4 – 130
  - Class 1 and 2 – 1,293
- Water Treatment Plants – 38
- Wells – 160
- Potable Water Booster Stations – 3
- Reclaimed Booster Stations – 3
- Chilled Water Plants – 4
- Water Intertie Stations – 3
JEAs Resiliency Program Activities

- Establish Future Extreme Weather Scenarios
- Perform Vulnerability Assessment and Risk Analysis of JEA Facilities
- Develop Mitigation and Adaptation Strategies
- Perform Economic Cost-Benefit Analysis
- Prioritize Strategies
- Update Design and Construction Standards
- Develop Resiliency Plan and Implementation Roadmap
Sea Level Rise and Precipitation Projections, and Recommended Climate Scenarios

• Current and Projected Sea Level Rise Conditions for JEA’s Service area

• Current and Projected Rainfall Intensity, Duration, and Frequency (IDF) Distributions

• Projections for Recommended Climate Scenarios for Flood Modeling:
  • Bracket storm and sea level conditions range, based on range of factors:
    • Planning Time Horizons - Short, mid and long-term planning
    • Greenhouse Gas (GHG) scenarios: RCP8.5 and RCP6.0
    • Global Climate Model (GCM) summaries: 50% and 90% non-exceedance
  • Identify probabilities to consider in defining current and future risk to JEA’s assets
2017 Updated SLR Projections (2000 baseline)

- 2040: 1-2 feet
- 2070: 2-4.5 feet
- 2100: 4-9 feet
Rainfall Intensity Duration Frequency Projections
Median of Global Climate Model Projection Ensemble

NOAA Atlas 14, Updated Historical 13-Station Median and SimCLIM Projected
Median 24-hr Precipitation Amounts For 2040, 2070, 2100 From a 30 GCM Ensemble
Using RCP6.0 and RCP8.5 Emissions Scenarios

SimCLIM-Projected % Change in 13-Station Median 24-hr Precipitation Amounts from
Updated IDF Baseline for 2040, 2070, 2100 using a 30 GCM Ensemble and RCP6.0 and
RCP8.5 Emissions Scenarios

2019 Design and Construction Issues at Hazardous Waste Sites
Flood Modeling Methodology Development

• Model Calibration/Validation to Current Conditions:
  • Hurricane Irma
  • FEMA 100-year and 500-year elevations at selected transects
  • FEMA 100-year and 500-year flood maps

• Model Results for 8 Climate Scenarios
  • Comparison of extent of 100- and 500-year floodplain
  • Depth of flooding at select JEA facilities

Source: www.s.w-x.co/wu/jax-flooding-sheriff-9.11.17
Surge Modeling Performed of Historical Hurricane Events

Hurricane Matthew, 2016
- Measured Peak WL = 5.15 ft NAVD
- Predicted Tide = 1.72 ft NAVD
- Peak surge height = 3.43 ft

Hurricane Irma, 2017
- Measured Peak WL = 5.58 ft NAVD
- Predicted Tide = 0.76 ft NAVD
- Peak surge height = 4.82 ft

Note: “Predicted Tide” refers to NOAA prediction of astronomical tide based on harmonic analysis of measured water level data, without meteorological disturbances such as surge.

Bathymetry of Gulf of Mexico, Caribbean and Eastern Atlantic, with Hurricane Matthew and Irma tracks.
Calibration – Hurricane Matthew
100-year Storm: Base Scenario versus Scenario 1
2040, Rain (lower emissions – RCP6.0), SLR (NOAA intermediate), and Storm Surge

Facilities in Floodplain

All JEA Facilities:
  Current: 210 (12.6%)
  Scenario 1: 288 (16.9%)

Priority JEA Facilities:
  Current: 90 (50%)
  Scenario 1: 91 (50%)
Overview of Risk Assessment/Alternatives Development Process

Monetize the benefits of protecting facilities by weighting annual cost of replacement with the time varying probability of floods

1. Determine Level of Service (LOS) of all assets at risk.
Overview of Risk Assessment/Alternatives Development Process

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2. Identify all assets at risk below recommended design flood elevation (DFE).
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3. Calculate benefit of adaptation: probability-weighted damage costs avoided, asset by asset.
Overview of Risk Assessment/Alternatives Development Process

1. Determine Level of Service (LOS) of all assets at risk.
2. Identify all assets at risk below recommended design flood elevation (DFE).
3. Calculate benefit of adaptation: probability-weighted damage costs avoided, asset by asset.
4. For high LOS assets under the DFE, develop asset-level strategy.
5. For all buildings at risk, develop building-level strategies.

### Adaptation Strategy

<table>
<thead>
<tr>
<th>Adaptation Strategy</th>
<th>Resiliency/Effectiveness</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevate Equipment</td>
<td>Medium</td>
<td>$</td>
</tr>
<tr>
<td>Flood-Proof Equipment</td>
<td>Medium</td>
<td>$</td>
</tr>
<tr>
<td>Install Static Barrier</td>
<td>Medium</td>
<td>$</td>
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<tr>
<td>Seal Building</td>
<td>Medium</td>
<td>$</td>
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<tr>
<td>Sandbag Temporarily</td>
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<td>$</td>
</tr>
<tr>
<td>Install Backup Power</td>
<td>Low</td>
<td>$</td>
</tr>
</tbody>
</table>

- Elevate Equipment: on pads or platforms, to a higher floor, to the roof, or to a new elevated building.
- Flood-Proof Equipment: by replacing pumps with submersible pumps and installing watertight boxes around electrical equipment.
- Install Static Barrier: across critical flood pathways or around critical areas.
- Seal Building: with water, light doors and windows, elevating vents and secondary entrances for access during a flood event.
- Sandbag Temporarily: around doorways, vents, and windows before a surge event.
- Install Backup Power: via generators nearby or a plug for a portable generator.
Overview of Risk Assessment/Alternatives Development Process

1. Determine Level of Service (LOS) of all assets at risk.

2. Identify all assets at risk below recommended design flood elevation (DFE).

3. Calculate benefit of adaptation: probability-weighted damage costs avoided, asset by asset.

4. For high LOS assets under the DFE, develop asset-level strategy.

5. For all buildings at risk, develop building-level strategies.

6. For all facilities at risk, develop facility-level strategies.

7. Compare benefits to cost of floodproofing alternatives.
Sample Mitigation Strategies

**Temporary Movable Barriers**

- Source: www.floodstopbarrier.com
- Source: http://usfloodcontrol.com/tiger-dam-products/

**Manual Flood Panels/Gates**

- Source: www.floodbarriers.com
- Source: www.floodpanel.com
- Source: www.floodcontrolinternational.com

**Automated Flood Gates**

- Source: www.floodcontrolinternational.com
- Source: www.floodbreak.com

- **Near-term (0-5 years)**
  - Map out critical operational components, equipment, and supply chain elements
  - Floodproof low-lying electrical equipment
  - Enhance redundant power supply
  - Incorporate higher performing and adaptive designs into guidelines
  - Develop business case for a larger investment to protect the facility

- **Mid-to-long-term (5-20 years)**
  - Identify and implement new technology and higher design standards for new components
  - Elevate low-lying portion of the site and possibly the entire site above the flood elevation
Thank You!

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