Keeping the Lights On:

Energy Facility Flood Mitigation and Resilience Takeaways for Protecting Critical Assets and Infrastructure

Proactive By Design.
Our Company Commitment

Presented by: **Jennifer Burke, P.E.**

Topics

- Background
- Flood Resilience Options
- GZA's Work
  - Permanent Flood Control Solutions
  - Temporary and Mobilized Solutions
  - Testing
- Conclusions/Takeaways

Background

- Climate change/sea level rise/larger events
- Super Storm Sandy
  - 8.1M homes without power in 17 states
  - 57k utility workers assist in returning power to NYC
- Post-Super Storm Sandy Lessons
  - Restoring power can be:

Time consuming

Costly

A public relations nightmare

Flood Resilience Options

- Physical Options
  - No Flooding
  - Controlled Flooding
- What gets protected?
- Longevity of Solution
  - Long-term
  - Interim
  - Mobilized

Floodwall protects Our Lady of Lourdes Hospital in Binghampton, NY along Susquehanna River in 2011 during Tropical Storm Lee

Photo Source: fema.gov

Flood Risk Mitigation – Substation Specific Issues

- Security
- Safety
- Accessibility and Space Limitations
- Underground Penetrations

Plus typical issues:

- Cost
- Maintenance
- Schedule
- Compatibility with future projects
- Site constraints
- Permitting – comp. storage
- Risks/benefits
- Adaptability to climate change

Flood Resilience - Option 1
No Flooding

Re-Build above Design Flood Elevation

Permanent Barrier

Mobilized Barrier

Interim Barrier

Interim and Mobilized Flood Control Barriers


Sand Bag (Big Bag)


Invisible Wall


Floodstop


Reinforced Barrier (HESCO)


Sand Bag


Aquafence

Flood Resilience - Option 2 Controlled Flooding

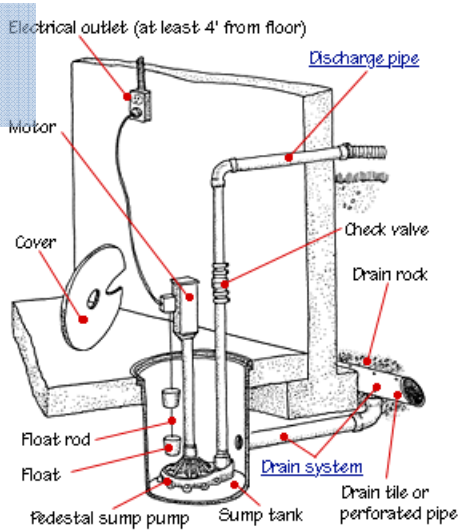
Raise Panels / Equipment

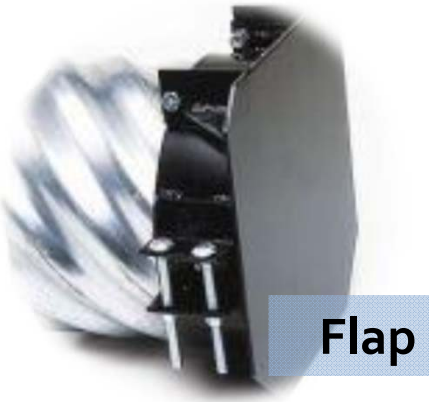
Dry Floodproofing

Flood Control Barriers
Control of Water

Duck bill

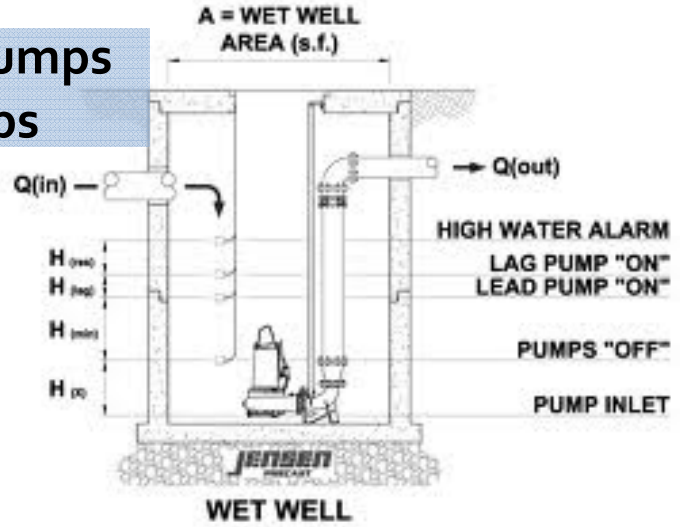
Interior Sump & Pump





Flap gates

Exterior Sumps & Pumps




GEOTECHNICAL
ENVIRONMENTAL
ECOLOGICAL
WATER
CONSTRUCTION MANAGEMENT

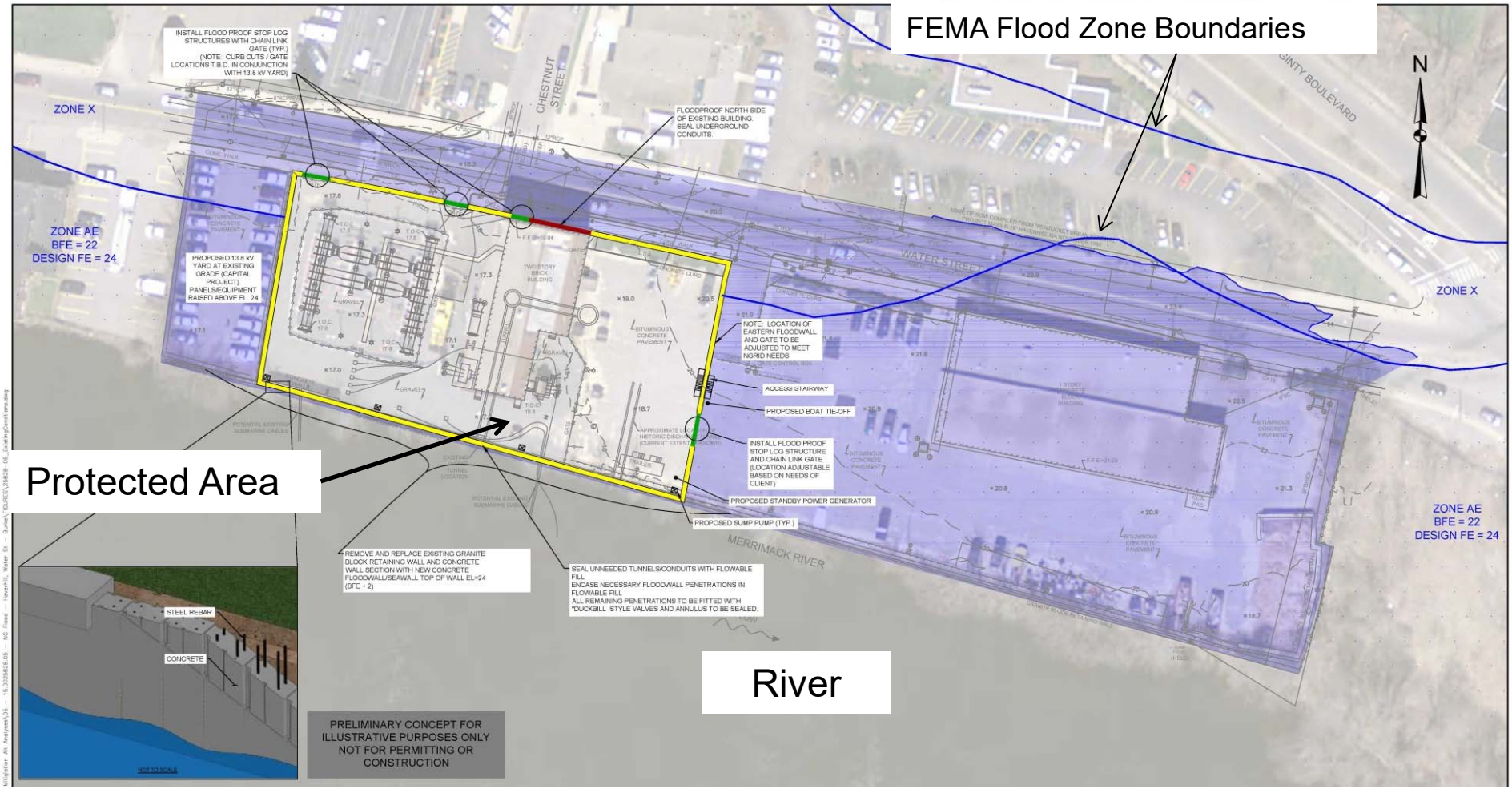
THE PROJECT

Project Overview

- Permanent flood control concepts
  - 11 substations in New England
  - Design Flood Elevation (DFE)
    - Set based on ASCE 24-14
    - Base Flood Elevation (BFE) +2 (or +3)

- Interim flood control concepts
  - 22 substations in New England
  - Flood Contingency Plans (FCPs)
    - Temporary controls (2-3 years)
    - Mobilized controls

Permanent Flood Control Concept Plans



Permanent Concepts – Site Specific Realties

Property constraints

Aging seawall

Historical structures, tunnels/conduits

Flood Contingency Plans/ Mobilized Concepts

PHASE 2: 35-INCH FLOODSTOP BARRIER SYSTEM MIN EL. 101.5' (SEE DETAIL) COORDINATE FENCE AND EQUIPMENT CLEARANCES

PHASE 2: PROPOSED 200 GPM PUMP

PHASE 1: SEAL CONDUITS

PHASE 2: PROPOSED 100 GPM PUMP

Flood Contingency Plans/ Mobilized Concepts

Floodstops around control house with onsite supplies for Phase 2 closures

Phase 2 closures

Pumps/sumps

INTERIM SOLUTION TESTING

Flood Contingency Plans/ Mobilized Concepts Testing

Geotextile between cells

Geotextile not folded under

Mock-Up #1 HESCO Testing

End dumped fill

Mock-Up #1
HESCO Testing

Excessive Internal Seepage

Increasing Flow, Piping

Flood Contingency Plans/ Mobilized Concepts Testing

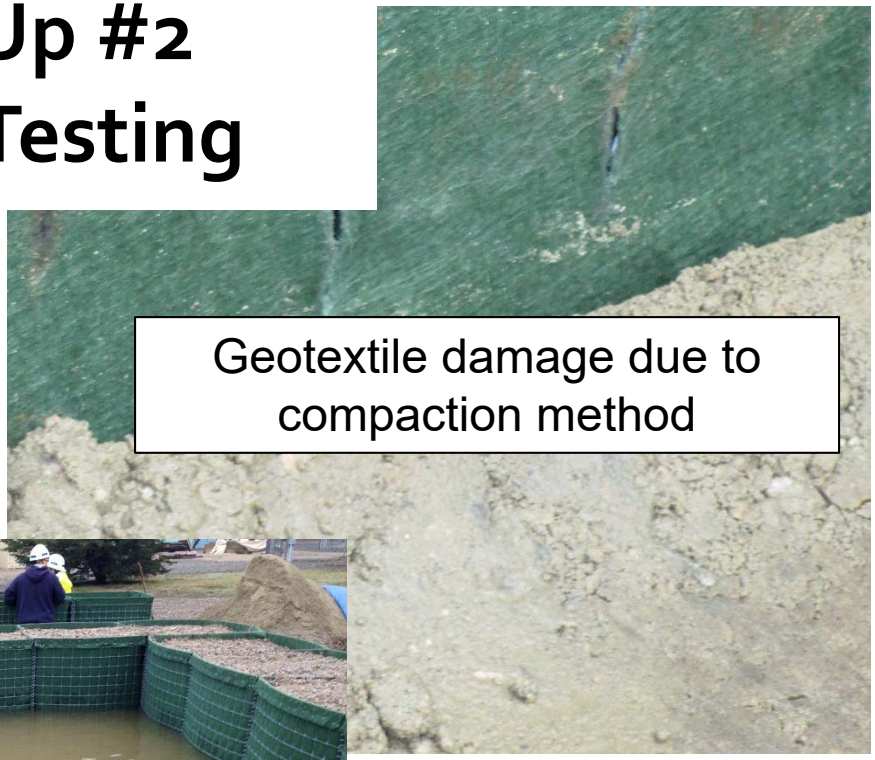
Loss of Strength – Potential Failure of Multiple Cells

Mock-Up #1 HESCO Testing

Loss of Fill – Imminent Failure of Cell

Mock-Up #2
HESCO Testing

Geotextile folded under this time



Geotextile damage due to compaction method

Conclusions/Takeaways

1. Need to listen and understand Client needs
    - Facility – past, present, and future
    - Operations and capabilities
    - What needs protection?

2. Thorough design development is key

3. Proper installation, training, and execution are <u>essential</u>

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