Coastal Flood Risk Study Project for South Florida

Storm Surge Analysis Update Meeting Palm Beach County, Florida

May ?, 2018
Agenda

- Welcome and Introductions
- Update on Coastal Flood Risk Study
- Stillwater Elevation Information
- Risk MAP Products Overview
- Open Discussion of Flood Risk Study
- Coastal Flood Risk Study Contacts
Introductions

- **Project Team**
  - FEMA Region IV
  - BakerAECOM, FEMA Mapping Partner

- **Project Stakeholders**
  - Community CEOs
  - Community FPAs
  - Political Representatives
  - Other State and Federal Agencies
  - Public
FEMA Region IV Coastal Flood Risk Studies in Florida

*FYxx indicates the fiscal year of future planned or past actual funding for the coastal surge study.
Why the Coastal Flood Risk Study Is Being Updated

- Flood risk changes over time – Effective study based on outdated hurricane modeling and topographic data
- Ability to more accurately define risk and account for significant development in project area
- To gain a complete and current picture of coastal flood risks, which helps the community:
  - Plan for the risk.
  - Communicate the risk to citizens.
  - Take action to reduce flood risk to lives and property.
  - Build smarter and safer.
Current surge analysis is 30 to 40+ years old
- SURGE – FEMA Coastal Flood Storm Surge Model, last updated 1988
- Climate data from 1975, 1978, and 1979 NOAA reports

Your risk is better defined through
- Updated elevation data (topographic data and aerial imagery)
- New climatological data based on recent storms
- Computing resources – a lot has changed in 30 years!
- Updated coastal hazard methodologies/modeling
- Improvement in Geographic Information System technologies to improve coastal mapping accuracy
Basic Elements of a Coastal Flood Risk Study

Base Flood Elevation (BFE) on FIRM includes four components:

1. Storm surge stillwater elevation (SWEL)
2. Amount of wave setup
3. Wave height above storm surge (SWEL) elevation
4. Wave runup above storm surge elevation (where present)

Determined from storm surge model
Coastal Flood Risk Study – Completed and Future Work

- Coordinated with community officials and stakeholders regarding available data
- Conducted thorough data investigation
- Conducted field investigations
- Set up hurricane model
- Calculated stillwater levels
Phase I – Collect data and set up/run hurricane model

- Set up hurricane/storm surge model - Complete
- Validate model using five historic storms - Complete
- Execute hypothetical storms - Complete

Phase II – Calculate stillwater levels

- Run statistics on millions of nodes - Complete
- Calculate 1-percent-annual-chance flood elevations - Complete
Completed and Future Work (Cont’d)

- **Phase III – Run Wave Model**
  - Use local scale land-use data for vegetation, obstructions, open fetch, sheltered fetch, dunes, etc.
  - Calculate Special Flood Hazard Areas – Zones AE and VE

- **Phase IV – Map Results**
  - Map AE and VE zones
  - Map Limit of Moderate Wave Action (LiMWA)
  - Prepare draft work maps
  - Prepare Flood Risk Products

- **Phase V – Issue Preliminary FIRMs**

- **Phase VI – Execute Due Process**
South Florida Study Area Schedule

- Phase I – Collect data and setup/run hurricane model - Complete
- Phase II – Calculate stillwater levels - Complete
- Phase III – Run WHAFIS wave model - Complete
- Phase IV – Map results - Estimated April 2019
- Phase V – Issue Preliminary FIRM - Estimated July 2019
- Phase VI – Execute Due Process – 2019-2021
Hurricane/Storm Surge Model

- **Current Study**
  - Completed early 1980s
  - Used TT Surge model
  - Used 0.5-nautical mile (nm) grid near shore and 5-nm grid offshore
  - Used USGS quadrangles

Example of 0.5-nm grid at St. Lucie Inlet
LIDAR and Bathymetric Data
LIDAR and Bathymetric Data (Cont’d)
LIDAR and Bathymetric Data (Cont’d)
The bathymetric Digital Elevation Model (DEM) is constructed from different types of data that required different construction methods:

1. Traditional sounding data (e.g., NOS survey)
2. NOS bathymetric attributed grid surveys
3. High-resolution raster data (e.g., JALBTCX topobathy LIDAR)
4. Trackline navigation channel survey data (e.g., USACE channel surveys)
5. Trackline survey data (e.g., SJRWMD IRLCPE)
6. Two-dimensional river cross-section data (FEMA FIS)
7. Engineering drawings (Ft. Pierce Marina reconstruction)
Hurricane Model Mesh Development
Mesh Development (Cont’d)

Old Mesh

New Mesh
Mesh Development (Cont’d)

30m mesh captures Elliot Cut

150m mesh does not capture Elliot Cut nor the majority of Wapoo Creek
Mesh Development (Cont’d)
SWAN+ADCIRC Mesh – Broward County

Pompano Beach
SWAN+ADCIRC Mesh – Broward County (Cont’d)

Pompano Beach
Storm Climatology

- Reviewed historical storms
- Selected five storms to validate the hurricane/surge model
- Generated hundreds of hypothetical storms
- Analyzed important storm parameters
  - Central pressure
  - Radius to maximum winds
  - Forward speed
  - Storm heading
  - Holland’s B (shape parameter)
Validation Storm Selection: Significant Surge Events, 1970-1979

Landfalling, bypassing, and exiting storms that passed near study area

Dottie 8/18 – 8/21/76

David 8/25 – 9/8/79

Gray arrows indicate direction of storm path.
Validation Storm Selection: Significant Surge Events, 2000-2010

Landfalling, bypassing, and exiting storms that passed near study area
## Validation Storm Selection: Available Water Level Data

<table>
<thead>
<tr>
<th>Station Name</th>
<th>Station ID</th>
<th>Water Level Data</th>
<th>Covered Storms</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOAA; Trident Pier, FL</td>
<td>8721604</td>
<td>Verified Hourly; 10/21/1994 10:00 – present</td>
<td>Data covers all identified storms from Oct. 1994 - 2010</td>
</tr>
<tr>
<td>NOAA; PGA Boulevard Bridge, Palm Beach, FL</td>
<td>8722548</td>
<td>Verified Hourly; 04/08/2008 11:00 – 10/13/2010 13:00</td>
<td>Tropical Storm Fay (2008)</td>
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<tr>
<td>NOAA; Port Of West Palm Beach, FL</td>
<td>8722588</td>
<td>Verified Hourly; 01/25/2008 21:00 – 10/20/2010 12:00</td>
<td>Tropical Storm Fay (2008)</td>
</tr>
<tr>
<td>FIT; Sebastian Inlet, FL</td>
<td>-</td>
<td>30 minute to 3-Hourly (with gaps) 1997 – present</td>
<td>Data covers all identified storms from 2001 – 2006</td>
</tr>
</tbody>
</table>
Validation Storm Selection: Wave Data

NOAA National Buoy Data Center (NDBC) stations with wave data
Validation Storm Selection: Selected Storms

- Five storms selected
  1. Hurricane Betsy (1965)
  2. Hurricane David (1979)
  3. Hurricane Andrew (1992)
  5. Hurricane Wilma (2005)
Validation: Historical Storms; Hurricane Andrew

Wind–waves_Frances_zoom1

20.07 days

50.00 kts

ft

0 10 20 30 40

FEMA

RiskMAP
Increasing Resilience Together
Validation: Historical Storms; Hurricane Andrew (Cont’d)

Andrew, S21_T Station

Water Surface Elevation (ft NAVD)

-3 -2 -1 0 1 2 3 4 5 6

8/14/92 0:00 8/16/92 0:00 8/18/92 0:00 8/20/92 0:00 8/22/92 0:00 8/24/92 0:00 8/26/92 0:00 8/28/92 0:00

MEASURED SWAN+ADCIRC
Validation: Historical Storms; Hurricane Wilma

Wilma, 8724580 (Key West) Station

- MEASURED
- SWAN+ADIRC

Water Surface Elevation (ft NAVD)

10/22/05 0:00 to 10/25/05 12:00
Validation: Summary

- Validation completed for tides and five historical storms
- Demonstrated model capability to reproduce water levels and waves in project area
- Comparisons to available data showed reasonable agreement for water levels and waves
Surge Modeling Gives 1-Percent Annual-Chance Flood SWELs, Broward County

- Set up “mesh” for hurricane/surge model
- Validated hurricane/surge model
- Ran hundreds of hypothetical storms
- Computed return periods for study area
- Result: storm surge stillwater elevations for 1-percent-annual-chance event
Next Phase - Overland Wave Analysis

- Perform overland wave modeling
- Prepare mapping of Special Flood Hazard Areas (VE and AE zones), Base Flood Elevations (BFEs), Limit of Moderate Wave Action (LiMWA)
- Develop draft work maps and present at Flood Risk Review Meeting
- Deliver Preliminary FIRM and FIS report for use at CCO Meeting and Flood Risk Open Houses
- Administer due process
- Develop Flood Risk Products and present at Resilience Meeting
Overland Wave Analysis (Cont’d)

Wave height ≥ 3 ft
3 ft > Wave height ≥ 1.5 ft
Wave height < 1.5 ft
BFE < 1 ft

Properly elevated (post-FIRM) building in CHHA

Best practice - Elevated building in Coastal A Zone

Improperly elevated (pre-FIRM) building

BFE = Base Flood Elevation
CHHA = Coastal High Hazard Area
SWEL = Stillwater Flood Elevation

LiMWA = Limit of Moderate Wave Action

Shoreline
Beach face

Limit of SFHA
Vegetated region

RiskMAP
Increasing Resilience Together
Base Flood Elevation (BFE) on FIRM includes 4 components:

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Basic Elements of a Coastal Flood Risk Study (Cont’d)

Normal water level  Wave setup
Storm surge level   Wave action
Basic Elements of a Coastal Flood Risk Study (Cont’d)

Dune erosion (540 ft²)
Basic Elements of a Coastal Flood Risk Study (Cont’d)

Dune erosion (removal)
Limit of Moderate Wave Action (LiMWA)

- FEMA Procedure Memorandum No. 50, 2008
- Not an NFIP regulatory requirement (at present)
- No Federal insurance requirements tied to LiMWA
- CRS benefit for communities requiring VE zone construction standards in areas defined by LiMWA or areas subject to waves greater than 1.5 feet
Primary Frontal Dune (PFD)

“a continuous or nearly continuous mound or ridge of sand with relatively steep seaward and landward slopes immediately landward and adjacent to the beach and subject to erosion and overtopping from high tides and waves during major coastal storms” – NFIP regulations
Outreach Activities

- Data Collection & Stakeholder Coordination
- Kickoff Meeting
- Discovery Meeting
- Discovery Map, Discovery Report, & Project Charter Creation/Distribution

Technical Update Meetings (As Needed)
- Storm Surge Analysis Update Meeting

- Preliminary Map Release Planning
- Flood Risk Review Meeting
- Resilience Meeting

- CCO Meeting/Open House
- Community FIRM/FIS Report Review

- Appeal Period
- Appeal/Comment Review & Resolution
- Letter of Final Determination Issuance
Flood Risk Products

- Flood Risk Map
Flood Risk Products (Cont’d)

- **Changes Since Last FIRM (CSLF)**
  - Makes it easy for communities and homeowners to identify impacts of new FIRM
  - Assists in prioritizing mitigation actions
  - Helps identify reasons for changes
Coastal Flood Risk Study Contacts

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