

Broward County East Coast Protective Levee Technical Evaluation



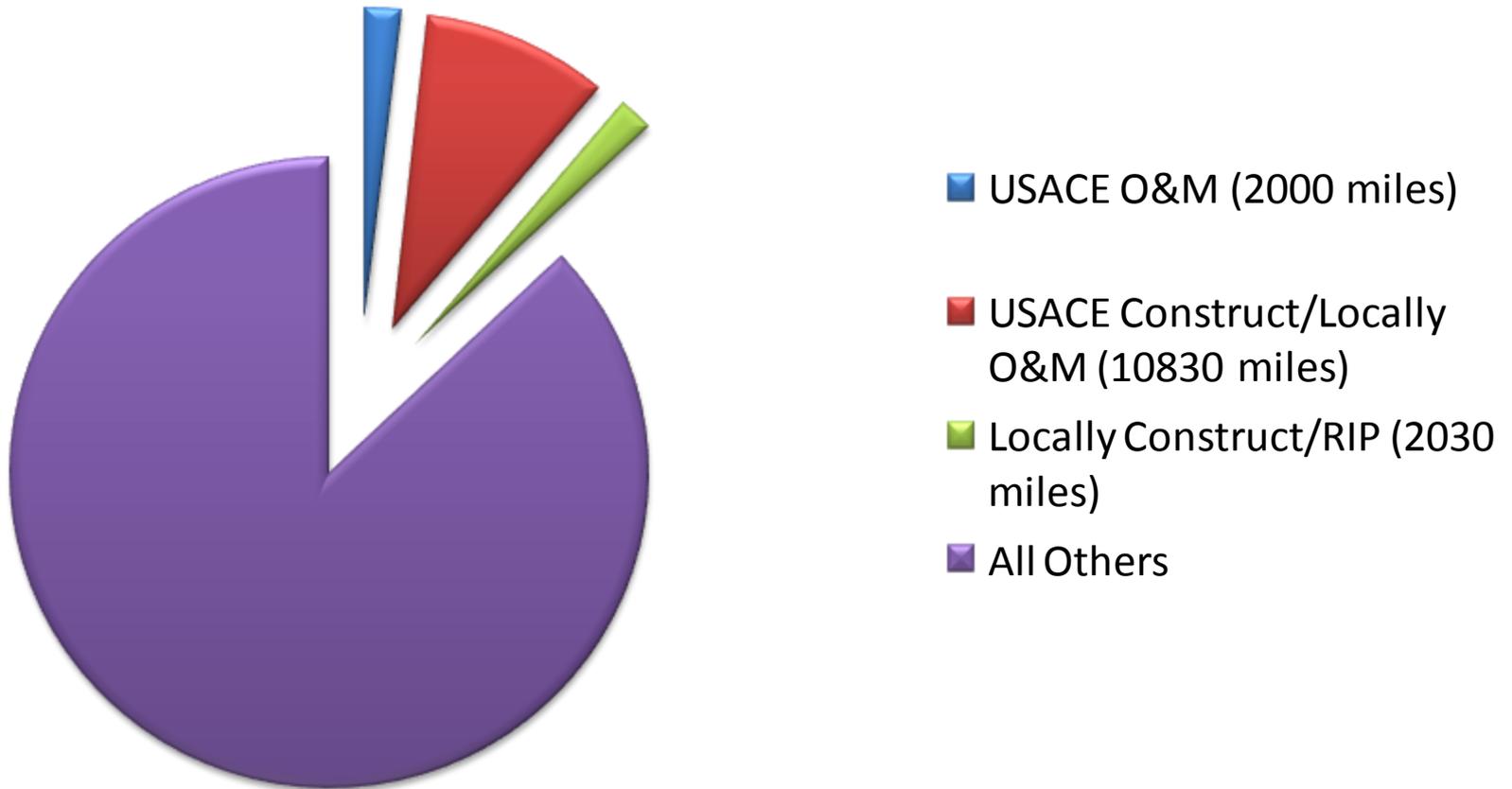
Tommy B. Strowd, P.E.
Deputy Executive Director

Project & Lands Committee Meeting
January 12, 2011

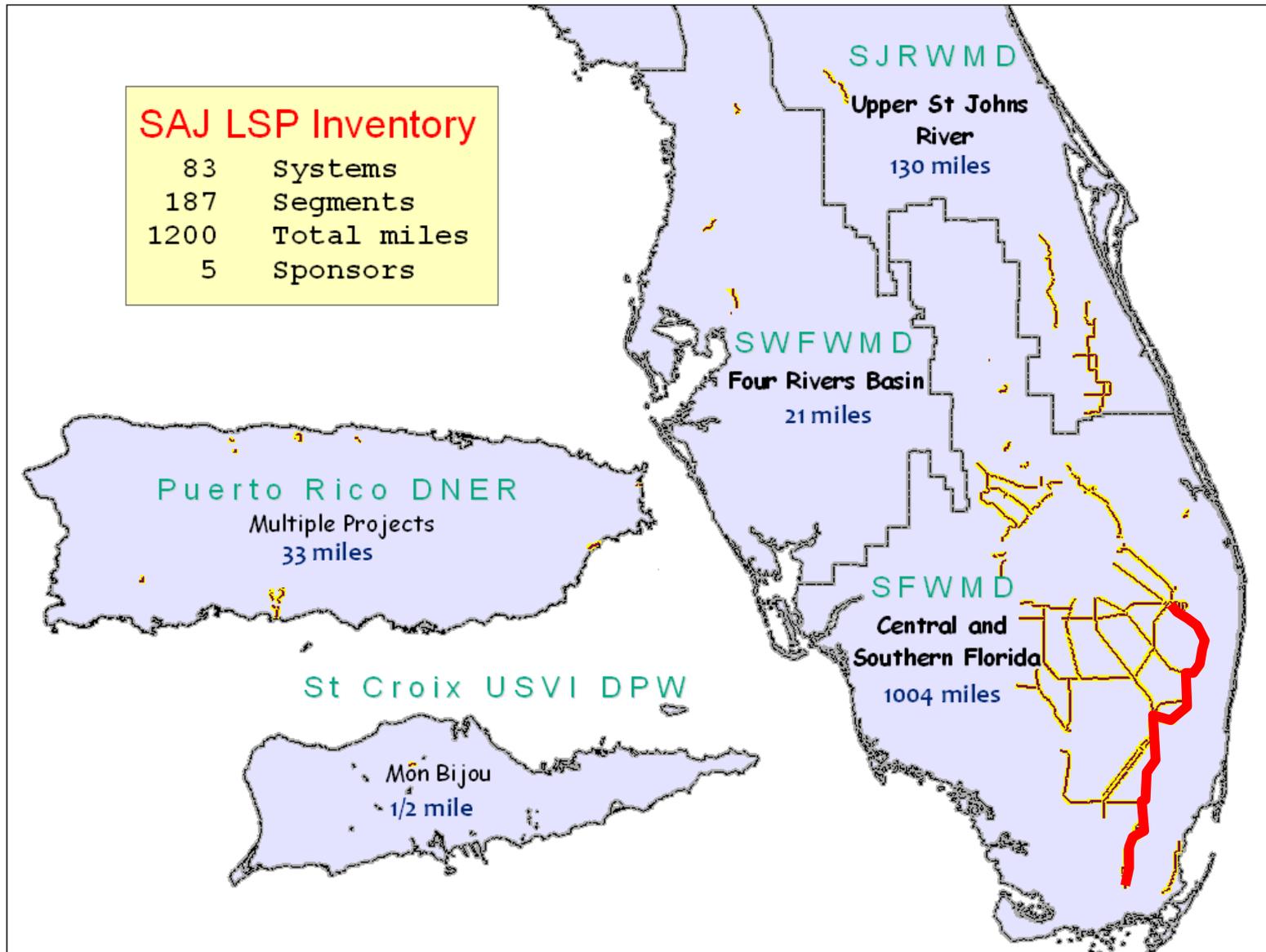


USACE Levee Safety Program

Miles of Levees in the Nation



USACE Jacksonville District Levee Inventory



Project Location



East Coast Protective Levee



- Authorized by Congress in 1949
- Constructed between 1952 and 1954
- Basic design consisted of locally dredged limestone placed on top of a thin layer of organic peat.
 - Levee and adjacent borrow canal.
 - In the 1950's peat was considered a suitable material to reduce seepage

East Coast Protective Levee



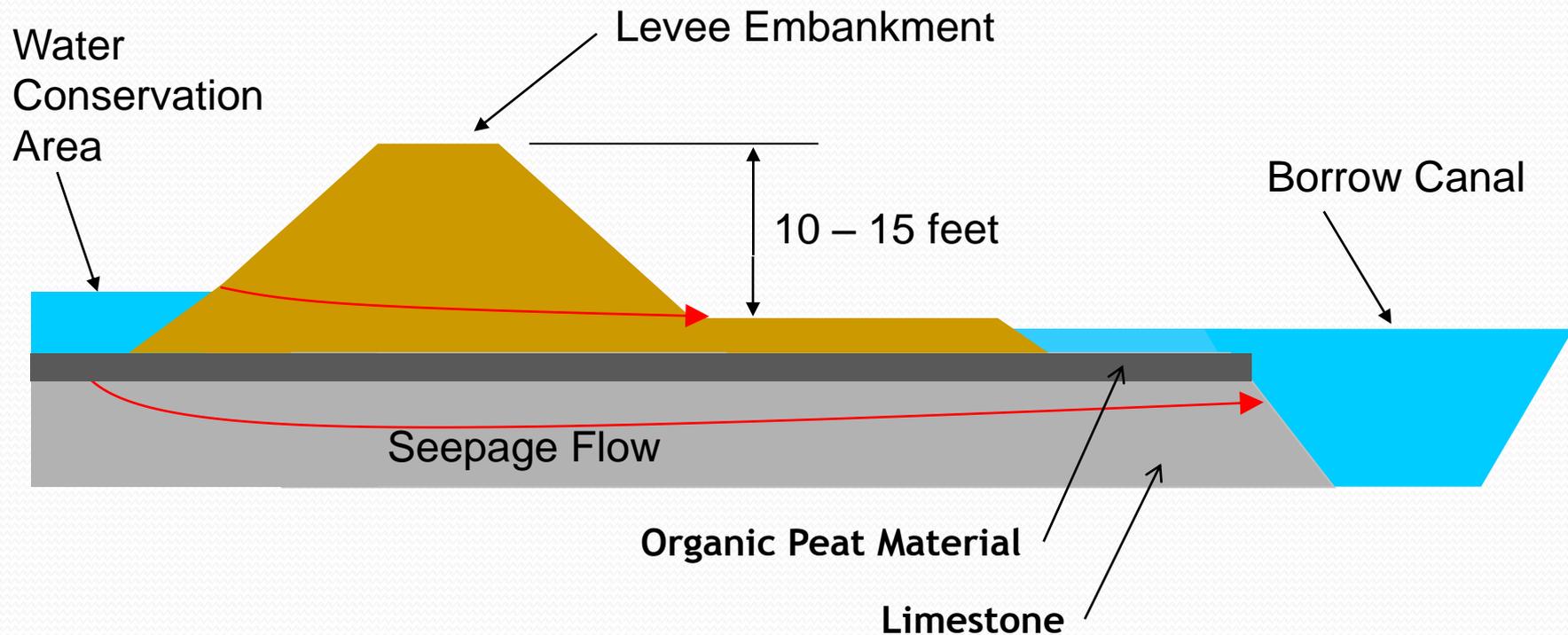
- Local land use has intensified dramatically
 - Transitioned from pasture to high density residential



East Coast Protective Levee

- Maintenance inspections jointly conducted annually by SFWMD & USACE since construction was completed.
 - Mandated by C&SF Project agreements
- Isolated areas of seepage have been observed
 - Many instances already repaired
- No evidence of conditions approaching overtopping
 - Experienced several 100-yr rainfall events in the past 30 years
- No imminent threat of structural failure

Typical Levee Cross Section







Levee Issues

- USACE Maintenance Performance Inspections
 - National inventory (Post-Katrina)
- National Levee Safety Commission Recommendations
 - Will recommend a national levee safety program to Congress and the President in 2011
- FEMA Flood Map Modernization
 - Current effort by Broward County
 - Post-Katrina requirements include structural certification by levee owners

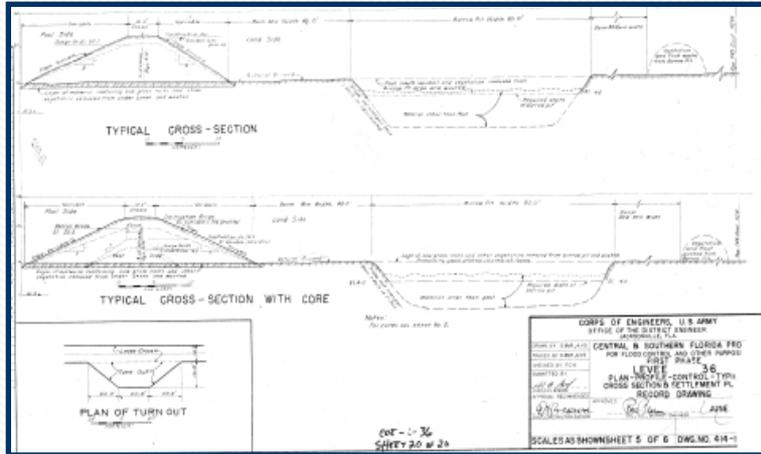
Broward County FEMA Mapping

- Broward County is working with FEMA to update the county's Flood Insurance Rate Maps
- FEMA requires that any levee owners certify that the structure can withstand a 100-Year Storm Event
- If the structures cannot be certified, then the mapping analysis will consider that the levee does not exist
 - This would result in a significant increase in flood insurance rates for existing policy owners and
 - would require flood insurance for property owners within the expanded flood plain

FEMA Mapping – Sequence of Events

- Participating County requests levee certification
- If the levee owner believes that the structure is certifiable, then they can obtain a Provisional Accreditation from FEMA
- Allows up to 2 years for the levee owner to provide a certification to FEMA
- During this period, no changes occur to existing flood insurance rates or flood plain extent
- SFWMD contracted BCI Engineers, Inc. to provide a hydrologic and geotechnical analysis of the ECPL toward certification

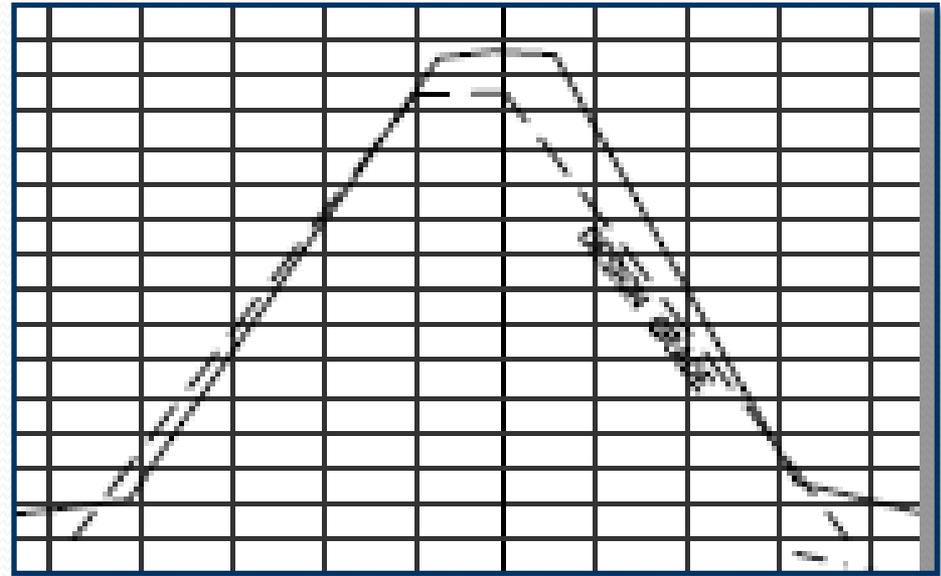
BCI Levee Evaluation Objectives



- Review Existing Records
- Determine Current Condition
- Complete Engineering Analyses using Current Design Standards
- Confirm FEMA Requirements
- If found, Note Deficiencies and Possible Remediation
- Provide Certification per 44 CFR 65.10

Levee Assessment

- Freeboard
- Structures
- Levee Embankment
 - Seepage
 - Stability
 - Settlement
- Interior Drainage
- Adjacent Drainage Systems

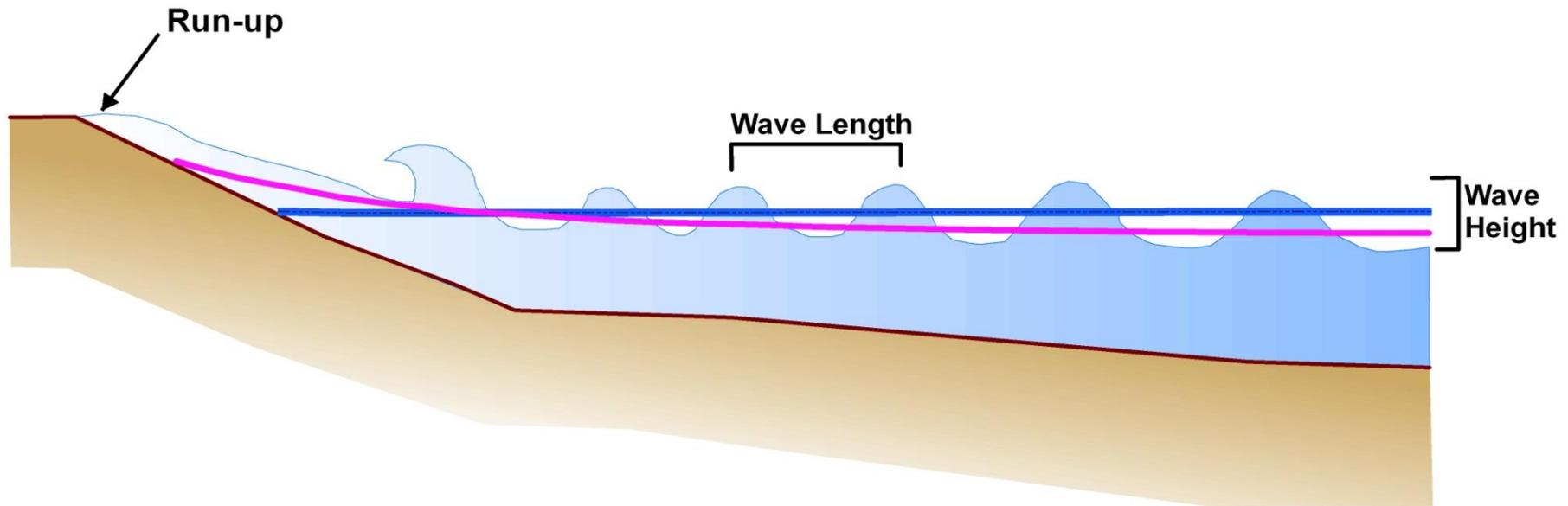


Assessment of Freeboard and Embankment Protection

- Calculate Static Water Level: Water Budget Model
- Calculate Wind Tide Height
- Calculate Significant Wave Height, and Wave Period
- Calculate Run-up Height

Criteria for Freeboard Assessment

A levee crest will be deemed to meet the freeboard criteria described in CFR 44 Ch.1 §65.10 if its elevation is at least a foot higher than the height of maximum wave run-up associated with the computed 100-year static water level.



Dense Vegetation Reduces Winds and Waves



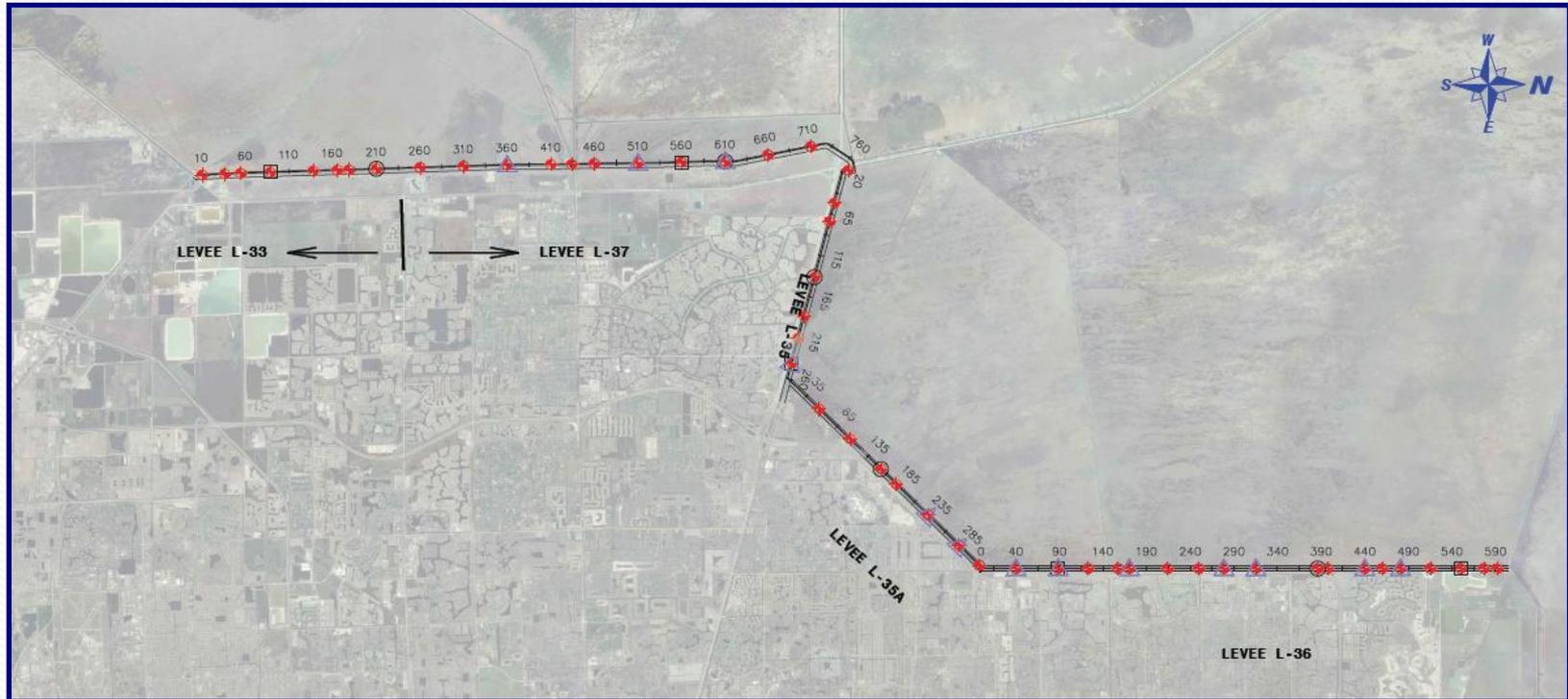
Freeboard Results

- The crest elevations for the embankments of the ECPL in Broward County exceed the 100-year flood elevations (including runup with a one-foot freeboard).
- One area of exception is approximately 1000 linear feet of the L-36 in the vicinity of S-38B

Geotechnical Investigation

- Site Investigation
- Seepage Modeling
- Internal Erosion
- Stability Analysis
- Settlement Analysis

Site Investigation Plan



- 59 SPT borings
- 22 Shelby tubes attempted
- 5 levee bulk samples
- 10 In-Situ Hydraulic Conductivity Tests

Settlement Analyses Results

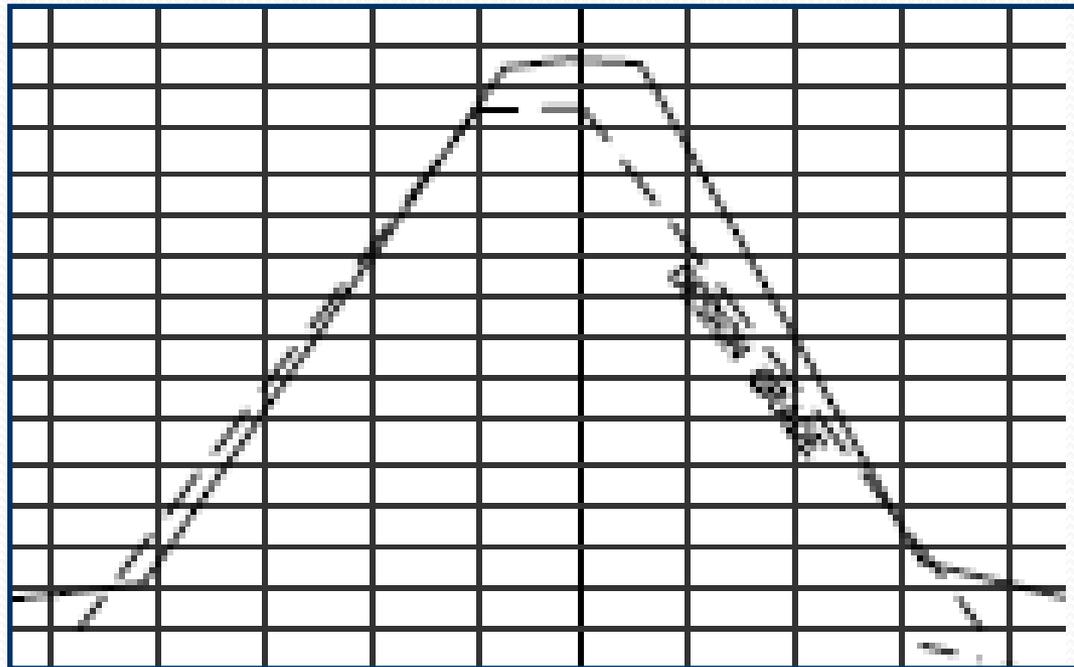
- Modeled Each Boring Location with Peat Layer
- Primary Consolidation Typically Completed within 1 Year of Construction
- Estimate Average Settlement of 0.15 feet (0.40 feet max.) over Next 50 Years

Seepage Analyses Results

- Normal Operating Level
 - Results Generally Match Observed Levee Conditions
 - Seepage Increases from North to South
 - Found Isolated High Exit Gradients (0.2 to 0.4),
 - Could generate internal erosion
 - Which can be controlled with Toe Berm or managed thru other solutions
- 100-Year Storm Level
 - Flow Similar To Normal Operating Level
 - Maximum Exit Gradients Increase Substantially (Often 0.2 to 0.75)
 - Toe Berm Would Act as Positive Cut Off for Piping thru Peat Layer

Stability Analysis Results

- Portions of the east Coast Protective Levee have side slopes that are steeper than designed
- This could create slope stability issues



Geotechnical Conclusions

- Raise crest of about 1000 feet of L-36 in the vicinity of S-38B
- Recommend Construction of Downstream Toe Berm along Levee Alignments
 - Engineering design will determine;
 - Most appropriate areas for remediation and their priority
 - Cost & schedule
- Flatten Upstream Slope; parts of L-36
- Perform additional geo-tech analysis in specific areas

Community Outreach

- Directly informed a network of Broward County community leaders, elected officials and media using ECPL outreach materials (talking points, fact sheet, written media responses).
 - Coordinating web page development with Broward County
- Coordinated several interviews with senior staff for major South Florida media outlets to ensure accurate information delivered to the public.
- Coordinating with Broward County and affected communities as the District moves forward

Next Steps

- Develop engineering design for physical improvements
 - Environmental permitting – Mitigation Issues
 - USACE 408 Approval for modifying a federal facility
 - Cost estimates
 - Construction schedule
- Develop monitoring and inspection plan
 - Piezometer installation
 - Enhanced periodic field inspections with stage triggers

Next Steps

- Continue maintenance activities
 - Vegetation management for enhanced inspection
 - Construction of additional 'Ring Dikes' to address high priority areas as they are identified
- Continue close coordination with...
 - Participating communities
 - USACE
 - FEMA
- Intent to provide certification to FEMA in 2013

Discussion



FEMA Certification vs. USACE Inspection

FEMA Certification

- Ability to store **100-year storm** with CAT 1 winds
- Compliance with current design standards
- Verify original design and construction
- Geotech & Wave Run-up Analysis

USACE Inspection

- Percentage of the **Standard Project Flood (SPF)**
- Physical integrity of levees and control structures
- Proper operations/maintenance program
- Visual inspections

