# LAKE OKEECHOBEE WATERSHED PROJECT

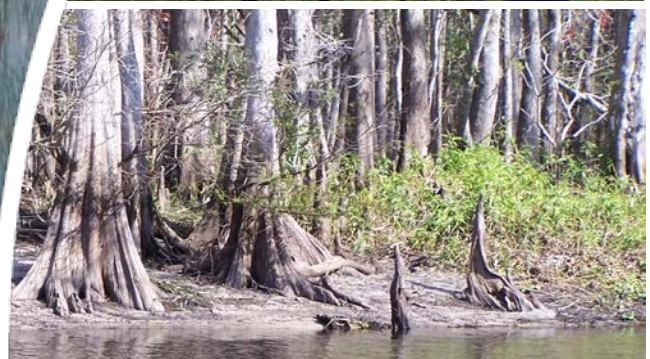
## Ecological Subteam Update

## Calculation of Ecosystem Benefits

## Project Delivery Team Meeting #4

**October 25, 2016**

**Gretchen Ehlinger (USACE)**



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# LOWP Performance Measures

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| LOWP Objective | PM 1 – Wetland Restoration | PM 2 – Lake Okeechobee Stage | PM 3 – Littoral Zone | PM 3 – Caloosahatchee Estuary Salinity | PM 4 – St. Lucie Estuary Salinity |
|---|---|---|---|---|---|
| 1. Improve timing and distribution of flows into Lake Okeechobee to maintain ecologically desired lake stage ranges | | √ | | | |
| 2. Reduce discharges from Lake Okeechobee to improve the salinity regime and the quality of oyster, SAV, and other estuarine community habitats in the northern estuaries | | | | √ | √ |
| 3. Increase spatial extent and functionality of aquatic and wildlife habitat within Lake Okeechobee and surrounding watershed | √ | | √ | | |

# LOWP Performance Measures

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**Wetland Restoration PMs**
PM 1.1 Wading Bird Support
PM 1.2 Connectivity
PM 1.3 Surface Water Connection
PM 1.4 Restoration Potential
PM 1.5 Public Access
PM 1.6 Water Storage
PM 1.7 Hydroperiod Duration

**Lake Okeechobee PMs (RECOVER Approved)**
PM 2.1 Stage Envelope
PM 2.2 Ecological Indicator

**Littoral Zone**
UMAM

**Northern Estuaries PMs (RECOVER Approved)**
**Caloosahatchee Estuary**
PM 3.1 Low Flow Targets
PM 3.2 High Flow Targets

**St. Lucie Estuary**
PM 4.1 Low Flow Targets
PM 4.2 High flow Targets

# Calculation of Ecosystem Benefits

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**Step 1**
Normalize Performance Measures to Common Scale

**Step 2**
Combine Performance Measures and Calculate Zone Scores

**Step 3**
Calculate Zone HUs for Wetlands, Lake Okeechobee, Littoral Zone and Northern Estuaries

**Step 4**
Compare HU lift (Alternative HUs – FWO HUs) of Alternatives

**Step 1:**

- Raw performance measure sub-metrics are linearly re-scaled between 0 and 100.

**Step 2:**

- Within each zone, performance measure sub-metrics are combined for each project alternative to produce a net zone benefits score (Habitat Suitability Index) between 0 and 1.

**Step 3:**

- The 0 to 1 benefits score for each zone is then multiplied by the acreage of the zone to generate a HU value for the zone.
  - Wetlands
  - Lake Okeechobee
  - Littoral Zone
  - Northern Estuaries (2 zones)

**Step 4:**

- HU Lift = Alternative – FWO Project Condition

# Wetland Habitat Unit Calculations

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- The 7 wetland performance measures will be used to separate out the top few potential restoration sites
- Habitat Unit Calculation Methodology
  1. For all habitat types within the potential restoration sites we assign a quality factor based on land use or land cover code (LULC; from the 2015 SFWMD shapefile) using best professional judgment, supplemented by limited field evaluations
  2. LULCs that are more ecologically degraded receive lower scores, but more native or natural habitats receive higher scores (on a scale of 0.0 to 1.0)
  3. Using ArcGIS, the size of each LULC polygon will be measured and multiplied by its quality factor to arrive at a HU for that polygon
  4. All polygons inside the wetland restoration site were then summed to calculate the total HUs

# Wetland Habitat Unit Calculation Example

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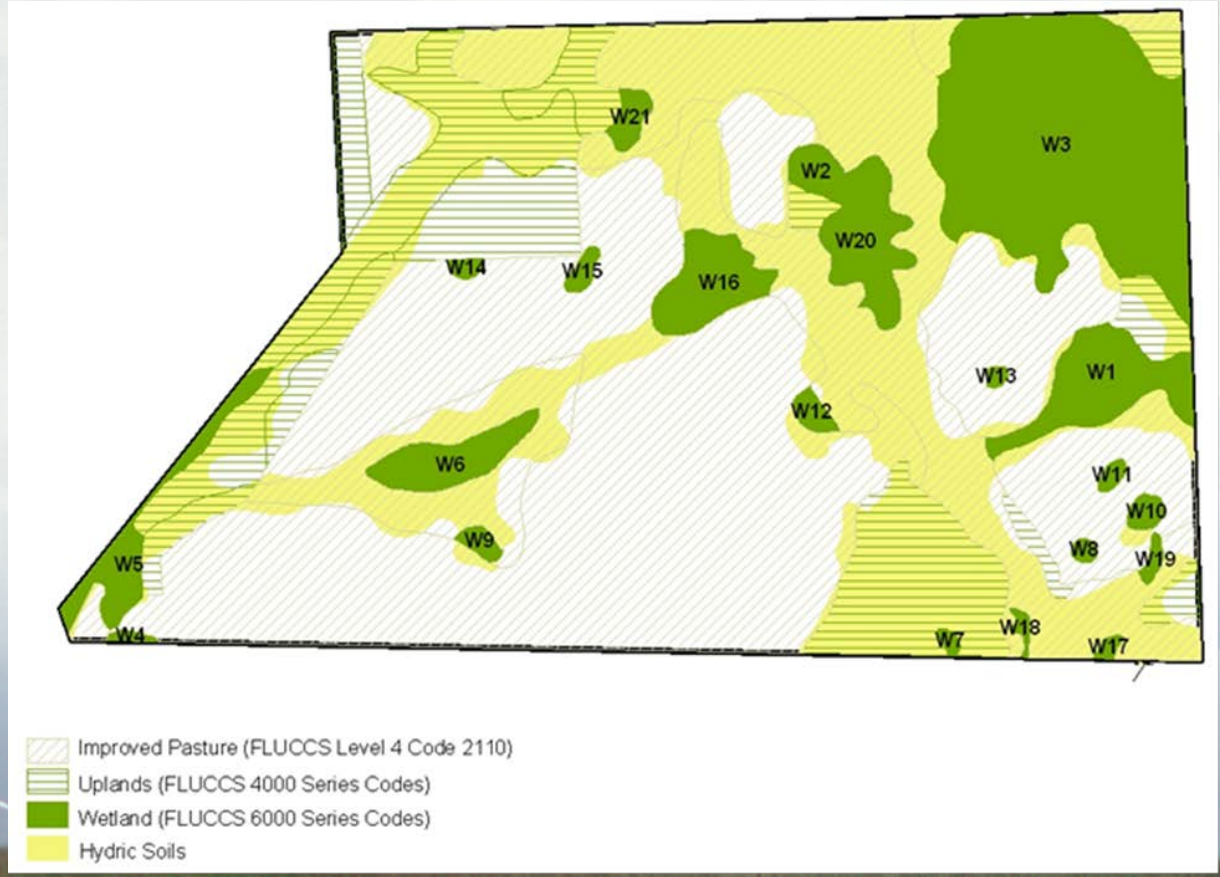
- Hypothetical restoration site with:
  - 21 existing wetlands (green; quality score = 0.5)
  - non-functioning hydric soils (yellow; quality score of 0.01)
  - forested uplands (hashed area; score of 0.7)
  - pasture uplands (white; score of 0.2)
  - Under restored conditions, all areas would receive a quality score of 1.0



# Wetland Habitat Unit Calculation Example

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Using the following acreages in the 2,500-acre site:

- Wetlands 500 acres
- Non-functioning hydric soils 800 acres
- Upland pasture 1,000 acres
- Forested uplands 200 acres

And the quality scores, the existing HUs are as follows:

- Wetlands 500 x 0.5 = 250 HUs
- Non-functioning hydric soils 800 x 0.01 = 8 HUs
- Upland pasture 1,000 x 0.2 = 200 HUs
- Forested uplands 200 x 0.7 = 140 HUs

**Total HUs (Existing) = 598 HUs**

Under restored conditions, the non-functioning hydric soils will be restored to wetlands and the HUs are calculated as follows:

| | | |
|---|---|---|
| Wetlands | 500 x 1.0 = | 500 HUs |
| Non-functioning hydric soils | 800 x 1.0 = | 800 HUs |
| Upland pasture | 1,000 x 1.0 = | 1,000 HUs |
| Forested uplands | 200 x 1.0 = | 200 HUs |
| **Total HUs (Restored) =** | | **2,500 HUs** |

Therefore, the HUs (combined upland and wetland) created by the project are 2,500 – 598 = **1,902 HUs**

# Lake Stage PMs

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- Standard Scores Based On The Length of Time and Distance Above and Below the Ecologically Beneficial Stage Envelope - 12.5 ft – 15.5 ft
- Standard Scores Based On Length of Time and Distance Stage is >17 ft and <10 ft

| Stage | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 19 | 3.5 | 4.0 | 4.5 | 5.0 | 6.0 | 6.5 | 6.5 | 6.0 | 5.0 | 4.0 | 3.5 | 3.5 |
| 18.5 | 3.0 | 3.5 | 4.0 | 4.5 | 5.5 | 6.0 | 6.0 | 5.5 | 4.5 | 3.5 | 3.0 | 3.0 |
| 18 | 2.5 | 3.0 | 3.5 | 4.0 | 5.0 | 5.5 | 5.5 | 5.0 | 4.0 | 3.0 | 2.5 | 2.5 |
| 17.5 | 2.0 | 2.5 | 3.0 | 3.5 | 4.5 | 5.0 | 5.0 | 4.5 | 3.5 | 2.5 | 2.0 | 2.0 |
| 17 | 1.5 | 2.0 | 2.5 | 3.0 | 4.0 | 4.5 | 4.5 | 4.0 | 3.0 | 2.0 | 1.5 | 1.5 |
| 16.5 | 1.0 | 1.5 | 2.0 | 2.5 | 3.5 | 4.0 | 4.0 | 3.5 | 2.5 | 1.5 | 1.0 | 1.0 |
| 16 | 0.5 | 1.0 | 1.5 | 2.0 | 3.0 | 3.5 | 3.5 | 3.0 | 2.0 | 1.0 | 0.5 | 0.5 |
| 15.5 | 0.0 | 0.5 | 1.0 | 1.5 | 2.5 | 3.0 | 3.0 | 2.5 | 1.5 | 0.5 | 0.0 | 0.0 |
| 15 | 0.0 | 0.0 | 0.5 | 1.0 | 2.0 | 2.5 | 2.5 | 2.0 | 1.0 | 0.0 | 0.0 | 0.0 |
| 14.5 | 0.0 | 0.0 | 0.0 | 0.5 | 1.5 | 2.0 | 2.0 | 1.5 | 0.5 | 0.0 | 0.0 | 0.0 |
| 14 | 0.5 | 0.0 | 0.0 | 0.0 | 1.0 | 1.5 | 1.5 | 1.0 | 0.0 | 0.0 | 0.5 | 0.5 |
| 13.5 | 1.0 | 0.5 | 0.0 | 0.0 | 0.5 | 1.0 | 1.0 | 0.5 | 0.0 | 0.0 | 1.0 | 1.0 |
| 13 | 1.5 | 1.0 | 0.5 | 0.0 | 0.0 | 0.5 | 0.5 | 0.0 | 0.0 | 0.5 | 1.5 | 1.5 |
| 12.5 | 2.0 | 1.5 | 1.0 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 2.0 | 2.0 |
| 12 | 2.5 | 2.0 | 1.5 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 1.5 | 2.5 | 2.5 |
| 11.5 | 3.0 | 2.5 | 2.0 | 1.5 | 0.5 | 0.5 | 0.5 | 0.5 | 1.0 | 2.0 | 3.0 | 3.0 |
| 11 | 3.5 | 3.0 | 2.5 | 2.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.5 | 2.5 | 3.5 | 3.5 |
| 10.5 | 4.0 | 3.5 | 3.0 | 2.5 | 1.5 | 1.5 | 1.5 | 1.5 | 2.0 | 3.0 | 4.0 | 4.0 |
| 10 | 4.5 | 4.0 | 3.5 | 3.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.5 | 3.5 | 4.5 | 4.5 |
| 9.5 | 5.0 | 4.5 | 4.0 | 3.5 | 2.5 | 2.5 | 2.5 | 2.5 | 3.0 | 4.0 | 5.0 | 5.0 |
| 9 | 5.5 | 5.0 | 4.5 | 4.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.5 | 4.5 | 5.5 | 5.5 |
| 8.5 | 6.0 | 5.5 | 5.0 | 4.5 | 3.5 | 3.5 | 3.5 | 3.5 | 4.0 | 5.0 | 6.0 | 6.0 |
| 8 | 6.5 | 6.0 | 5.5 | 5.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.5 | 5.5 | 6.5 | 6.5 |
| 7.5 | 7.0 | 6.5 | 6.0 | 5.5 | 4.5 | 4.5 | 4.5 | 4.5 | 5.0 | 6.0 | 7.0 | 7.0 |

A

B

# Ecological Indicator Score PM

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- Based on Strongest Statistically Significant Correlations With Lake Stage Based on Long Term Environmental Monitoring Data Sets.
- Results Used To Develop Indicator Scoring As Follows.
  - Summer Chara : 2 pts (<12ft), 1 pt (12ft-15.5ft), 0 pt (>15.5ft)
  - Summer Cyanobacteria : 2 pts (<12ft), 1 pt (12ft-14ft), 0 pt (>14ft)
  - Epipelon Spring+Fall : 2 pts (<12ft), 1 pt (12ft-15ft), 0 pt (>15ft)
  - Epiphyte Spring+Fall : 2 pts (<14ft), 1 pt (14ft-15ft), 0 pt (>15ft)
  - Winter Panfish Creel Data: 2 pts (12ft-15ft), 1 pt (<12ft or 15ft-16ft), 0 pt (>16ft)
  - Summer Vascular SAV : 2 pts (12ft-15.5ft), 1 pt (10ft-<12ft or >15.5ft-<18ft), 0 pt (<10ft or $\geq$18ft)
- Performance Measure Has Completed RECOVER Review

# Lake Stage Habitat Unit Calculation

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- Habitat Unit Calculation is Based on a Maximum Score of 1.
- Scoring is apportioned as follows:
  - 45% (0.45) stage envelope PM
  - 45% (0.45) Combined Ecological PM
  - 10% > 17 ft, <10 ft PM (7.5% (0.075) for excessive high, 2.5% (0.025) excessive low).
- HU Percentages Based on Sensitivity Analysis Which Indicated This Distribution Provided the Combination of the Greatest Number of Habitat Acre Units and the Maximum Lift
- Overall Score is based on 200k acres, the Combined Area of The Lake Okeechobee Littoral and Nearshore Zones

# Lake Stage Habitat Unit (HU) Calculation Example

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- Above and Below Envelope Score:

  0.775 x 0.225 + 0.331 x 0.225 = 0.249 pts
- Ecological Indicator Score:

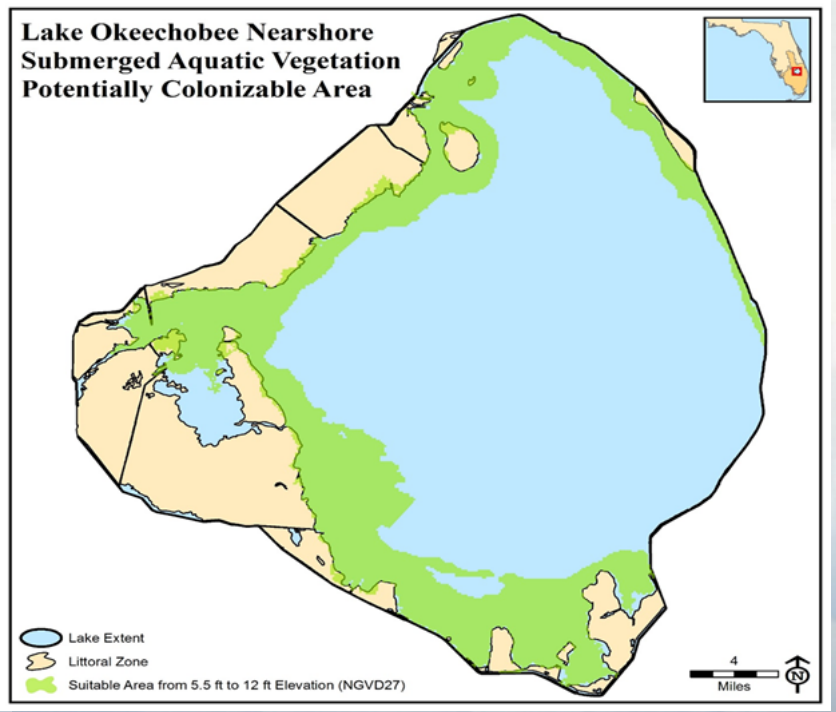
  (0.73 x 0.45) = 0.33 pts
- Stage Score:

  >17 ft Score <10 ft Score:

  0.95 x 0.025 = 0.024 pt

  0.99 x 0.075 = 0.074 pts
- Habitat Units = Total of 0.677 pts

  0.677 x 200k acres = 135k habitat units



# Littoral Zone Habitat Calculation



**Uniform Mitigation Assessment Method (UMAM)**

- Certified model by USACE – may be used to assess baseline condition for CERP projects
- Assess the area under **current condition** and the "with" vision to determine the ecological lift

**Part I – Qualitative Characterization**

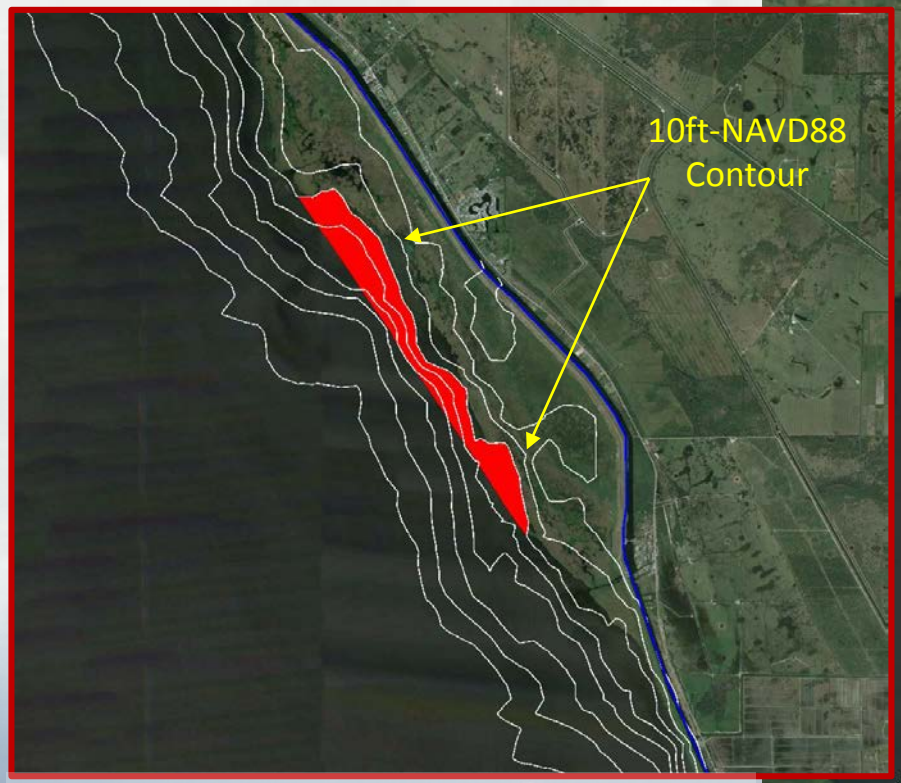
- What are you looking at?
- Impact or mitigation site?
- What are the surroundings?
- What type of community is it?
- What would you expect to see in this type of community?

**Part II – Quantification of Assessment Area**

- How well does the assessment area compare to the optimal community of this type, considering
  - location and landscape support,
  - water environment,
  - and community structure?
- Scored 0 (no function) – 10 (optimal)
  - Current condition
  - "with impact" or "with mitigation"
  - Delta = difference between current and "with"

# Chancey Point – RSM

Habitat Enhancement and Creation

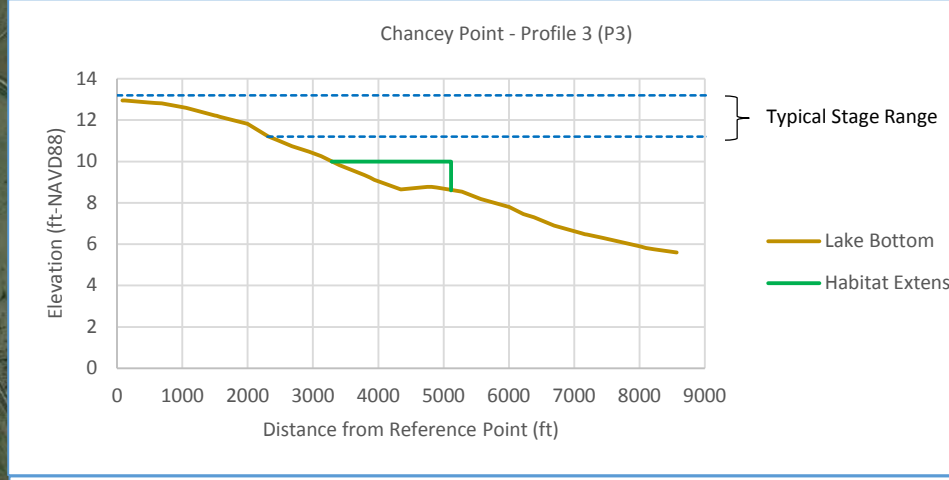


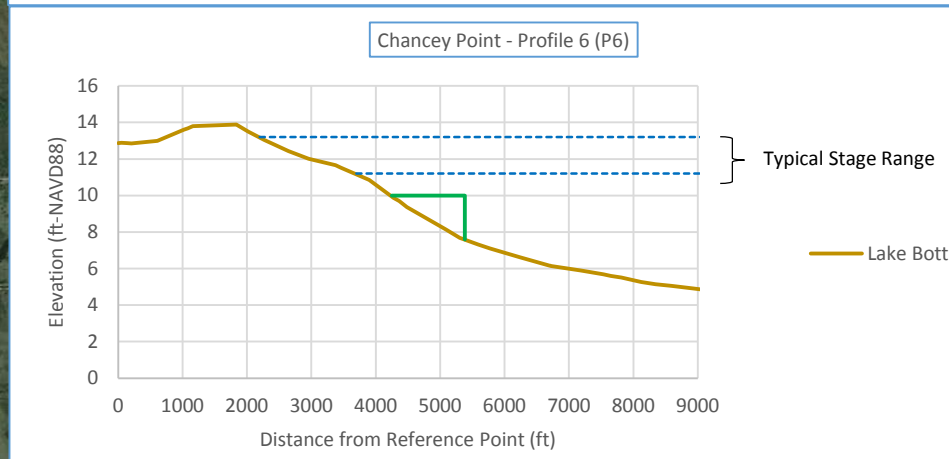

Create Habitat at 10 ft-NAVD88

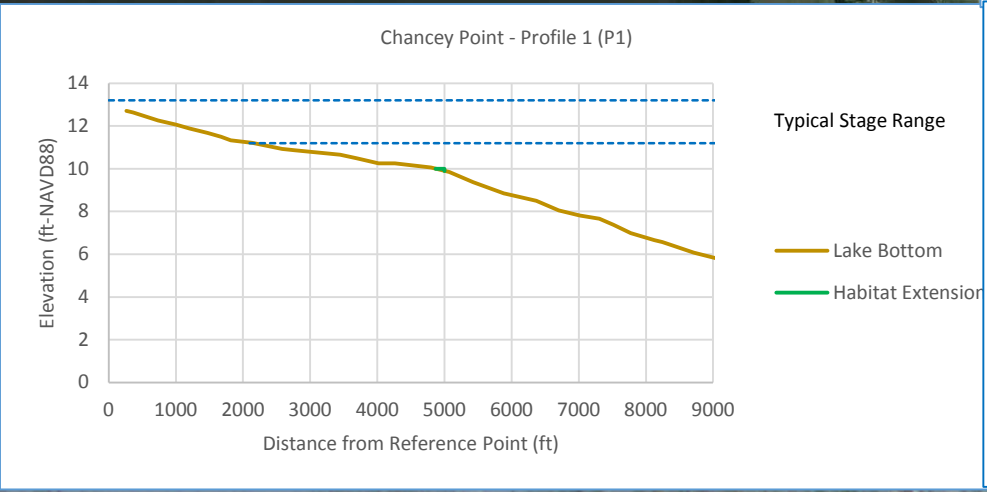
Surface Area: 500 acres
Volume of Fill: 690,000 cubic yards

Lakeside Length (for possible stabilization structures): 3.5 miles


P1
P2
P3
P4
P5
P6
P7
P8
P9
P10


Chancey Point - Profile 3 (P3)
Elevation (ft-NAVD88)
0
2
4
6
8
10
12
14
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Distance from Reference Point (ft)
Typical Stage Range
Lake Bottom
Habitat Extens


Chancey Point - Profile 6 (P6)
Elevation (ft-NAVD88)
0
2
4
6
8
10
12
14
16
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Distance from Reference Point (ft)
Typical Stage Range
Lake Bott


Chancey Point - Profile 1 (P1)
Elevation (ft-NAVD88)
0
2
4
6
8
10
12
14
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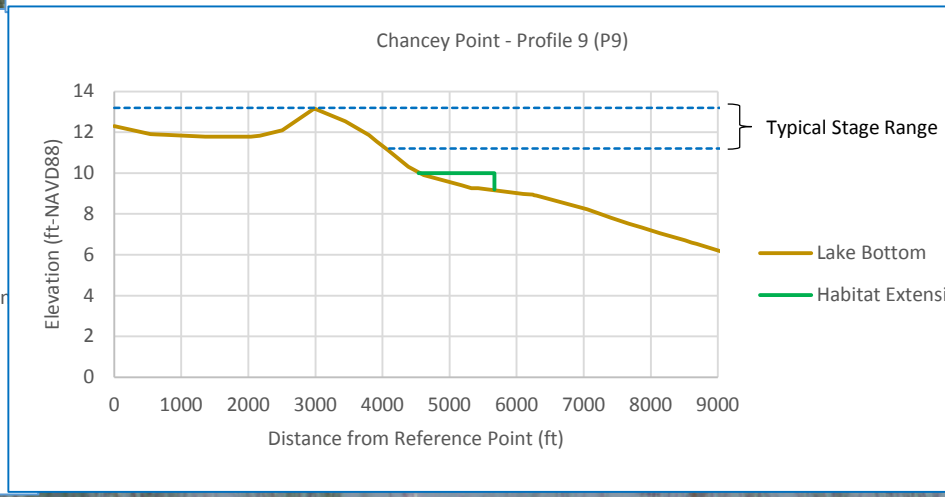
3000
4000
5000
6000
7000
8000
9000
Distance from Reference Point (ft)
Typical Stage Range
Lake Bottom
Habitat Extension


Chancey Point - Profile 9 (P9)
Elevation (ft-NAVD88)
0
2
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9000
Distance from Reference Point (ft)
Typical Stage Range
Lake Bottom
Habitat Extensi

# Northern Estuaries Performance Measures

## Caloosahatchee Estuary

PM 3.1 Low Flow Target - no months during October to July when the mean monthly inflow from the Caloosahatchee watershed, as measured at S-79, falls below a low-flow limit of 450 cfs

PM 3.2 High Flow Target - no months with mean monthly flows greater than 2,800 cfs as measured at the S-79

**Scoring**

- Number of months flow < 450 cfs from Lake Okeechobee releases (Oct-July)
- Number of months flow > 2800 cfs from Lake Okeechobee releases (Jan - Dec)

# Northern Estuaries Performance Measures

## St. Lucie Estuary

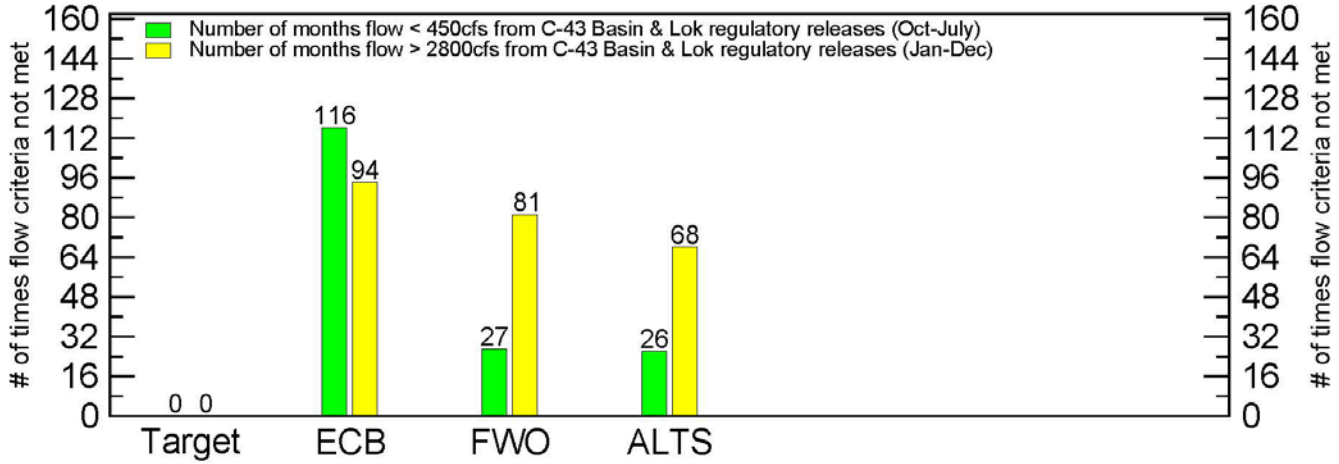
PM 4.1 Low Flow Target – 31 months where mean flow is less than 350 cubic feet per second (cfs).

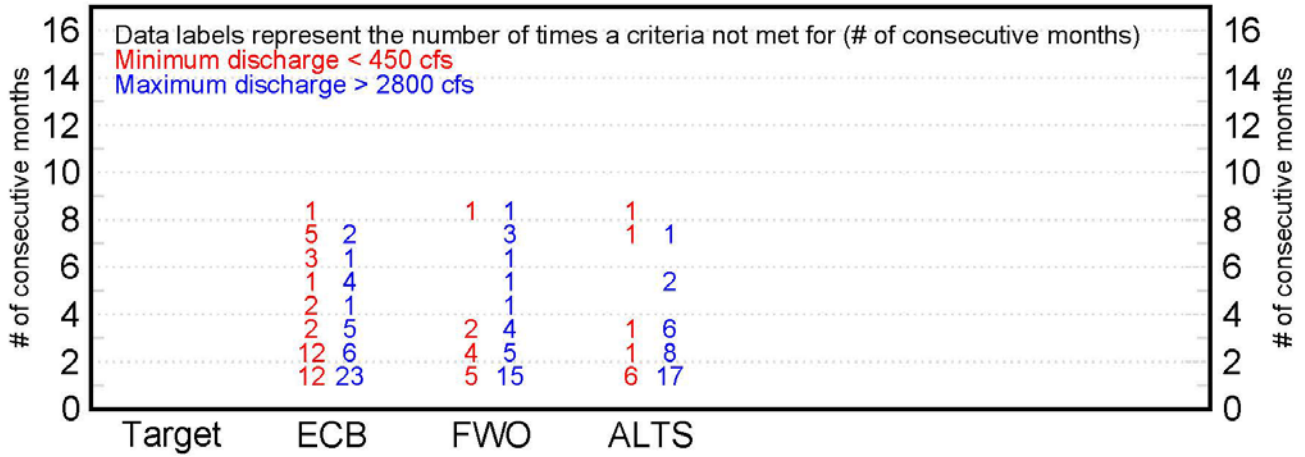
PM 4.2 High Flow Target - 0 Lake Okeechobee regulatory discharge events (14 day moving averages > 2000 cfs)

**Scoring**

- Number of months where mean flow is less than 350 cfs
- Number of Lake Okeechobee regulatory discharge events (14 day moving averages > 2000 cfs)

# Number of times Salinity Envelope Criteria NOT Met for the Calooshatchee Estuary (mean monthly flows 1965 - 2005)




RECOVER Performance Measure

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RSMBN V2.3.5
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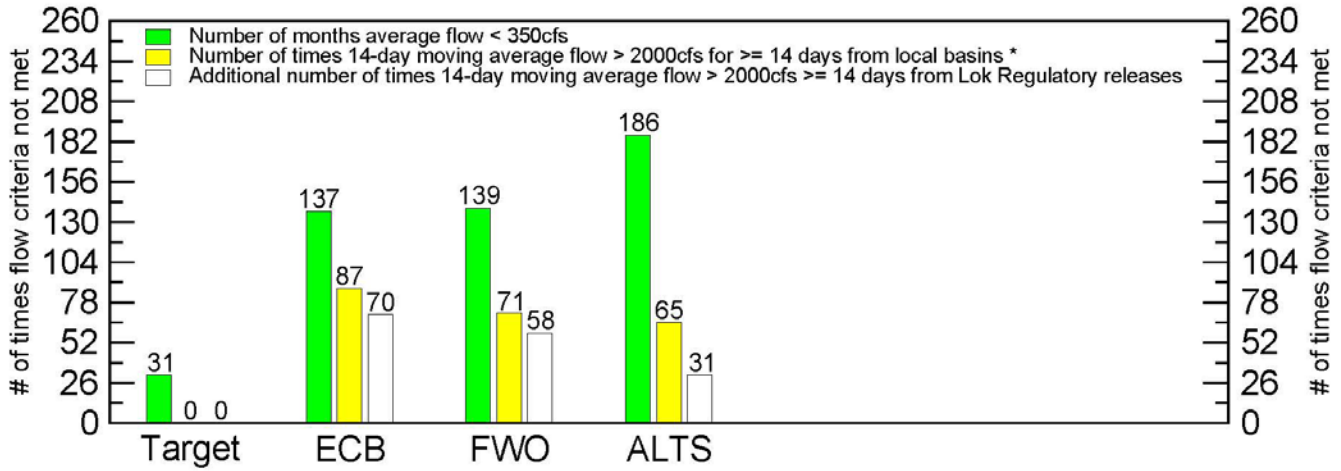
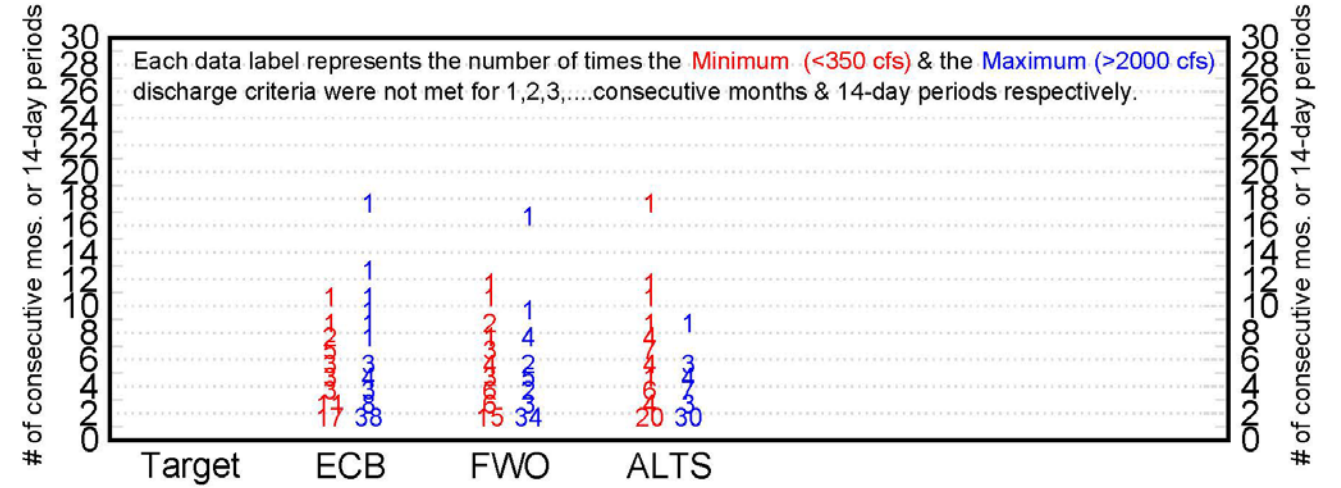
Filename: caloos_salinity_flow_bar.out.agr

# Number of times Salinity Envelope Criteria NOT Met for the St. Lucie Estuary (mean monthly flows 1965 - 2005)

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Filename: stluc_salinity_flow_bar.out.agr

RECOVER Performance Measure

# Scaling Northern Estuaries Habitat Units



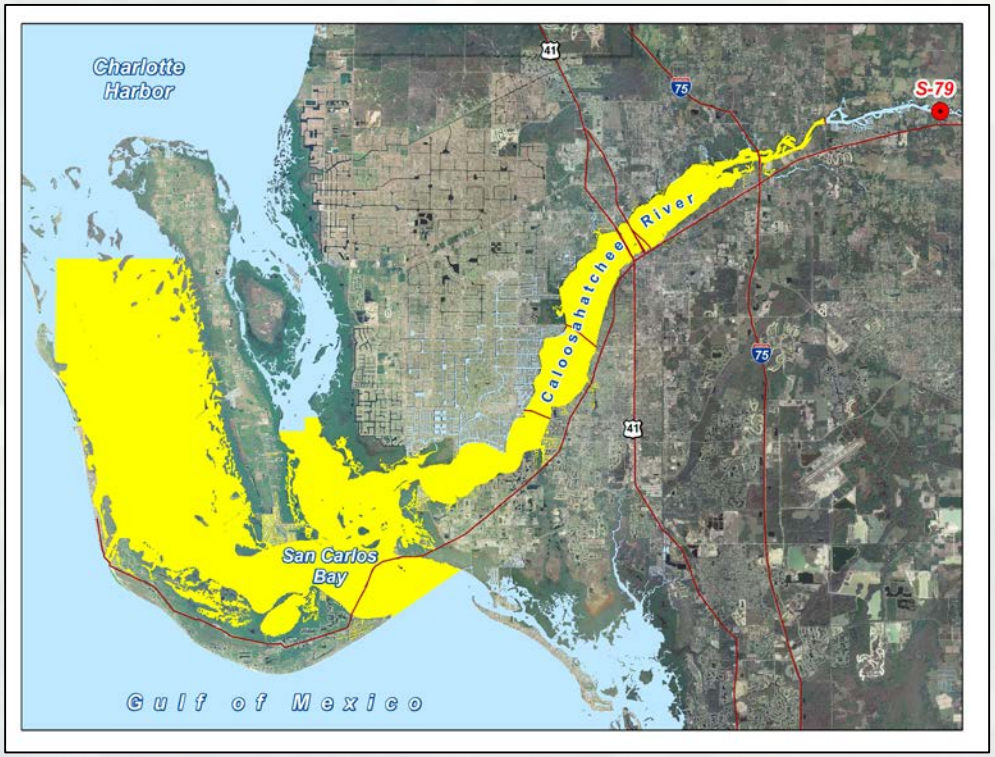
- 2007 RECOVER System Status Report (SSR)
  - Surveys performed on the state of the oyster reefs in the Northern Estuaries
  - Documented number of acres of live oyster habitat

- Used the percentage of target from the surveys presented in the 2007 SSR to set the ECB value (0 to 100 Scale)
  - Set ECB re-scaled score to 14 for the St. Lucie and 4 for the Caloosahatchee.
  - Extrapolated to determine the minimum or 0 value.
  - Alternatives can still score lower than the ECB – ECB No longer has 0 HU value.

| Estuary | Existing Oyster Acres (year recorded) | Restoration Target (acres) | % of Target |
|---|---|---|---|
| St. Lucie | 117 (2003) | 834 | 14% |
| Caloosahatchee | 18 (2004) | 500 | 4% |

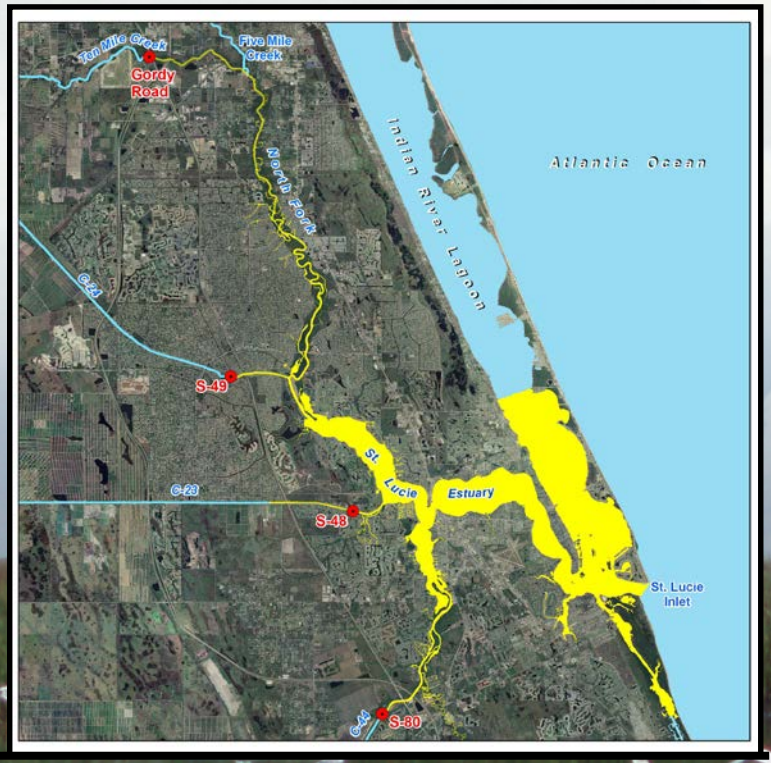
# Northern Estuaries

- Rescaled results (0 to 100 Scale) for Zones CE-1 and SE-1.
- Compare alternatives to FWO and ECB in Northern Estuaries.




| Metric | Performance Measure Metric (Zone CE-1) | ECB | FWO | ALT ? |
|---|---|---|---|---|
| 3.1 | Low Flow | 4 | 78 | |
| 3.2 | High Flow | 4 | 17 | |
| | **Habitat Suitability Index (0 to 1 Scale)** | **0.40** | **0.48** | |

| Metric | Performance Measure Metric (Zone SE-1) | ECB | FWO | ALT ? |
|---|---|---|---|---|
| 4.1 | Low Flow | 14 | 12 | |
| 4.2 | High Lake O. Discharge Events | 14 | 29 | |
| | **Habitat Suitability Index (0 to 1 Scale)** | **0.14** | **0.21** | |



# HU and HU Lift: Northern Estuaries

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| CEPP Example HU | | | | | |
|---|---|---|---|---|---|
| Planning Regions | Zones | Maximum Acreage | Alts | ECB | FWO |
| Northern Estuaries | CE-1 | 70,979 | 38,696 | 2,839 | 33,691 |
| | SE-1 | 14,994 | 4,365 | 2,099 | 3,078 |

| CEPP Example HU LIFT | | | |
|---|---|---|---|
| Planning Regions | Zones | Alts | ECB |
| Northern Estuaries | CE-1 | 5,006 | -30,768 |
| | SE-1 | 1,288 | -933 |

- Example HU Results and HU Lift for Caloosahatchee and St. Lucie Estuaries from CEPP
- ALTS perform better than FWO Project Condition and ECB.

# Questions?