TMDL Revision Update
August 25, 2015

Segmentation
Seagrass Metrics and Targets
External Loads
Internal Loads and Mass Balance
Seagrass to Loading Response
Discussion
Load Reduction/Allocations
Compliance Measures
SEGMENTATION
Comparison of IRL Basins and DEP Estuarine Nutrient Regions

(ug/L)

Chlorophyll-a Corrected
Comparison of IRL Basins and DEP Estuarine Nutrient Regions

Total Nitrogen

(mg/L)
Comparison of IRL Basins and DEP Estuarine Nutrient Regions

(ppt)

Salinity

DEP-NIRL  IRLN  DEP-CIRL  IRLC  DEP-BRL  BRL  DEP-NFH

[Box plots showing salinity levels for different regions]
PROPOSED SEGMENTATION

DEP Estuarine Nutrient Region
With inclusion of Newfound Harbor
and Sykes Creek Estuary in Banana River
and exclusion of Sebastian River
TASK 2 UPDATE

DEVELOP TOTAL LOADS, INTERSEGMENT TRANSPORT, AND MASS BALANCE

Applied Technology & Management

August 2015
FINAL TOTAL EXTERNAL LOADS
BY BASIN
Central Indian River Lagoon TP Load

Runoff  Baseflow  Atmospheric  Point Sources

Load (lbs)


0  50000  100000  150000  200000  250000  300000  350000
INTERSEGMENT TRANSPORT
MASS BALANCE
## BASIN GEOMETRY

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<th>Basin/Segment</th>
<th>Total Area (acre)</th>
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DISCUSSION
IRL LOADINGS
FLUXES
AND
MASS BALANCES
SEAGRASS METRICS AND TARGETS
Indian River Lagoon
Annual Seagrass Coverage & Median Depth
North Indian River Lagoon

Seagrass (acres)

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Indian River Lagoon
Area Versus Median Depth
North Indian River Lagoon

Regression Equation:
acres = -972.024 + 17372.53*enr_median
p < 0.0074
R^2 = 0.57
Indian River Lagoon
Annual Seagrass Coverage & Median Depth
Banana River Lagoon

Seagrass (acres)

Depth (m)


Indian River Lagoon
Area Versus Median Depth
Banana River Lagoon

Regression Equation:
acres = -6553.395 + 21459.65*enr_median

p< 0.0001
R^2=0.82
Indian River Lagoon
Annual Seagrass Coverage & Median Depth
Central Indian River Lagoon

Seagrass (acres)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0


Depth (m)
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0

Indian River Lagoon
Area Versus Median Depth
Central Indian River Lagoon

Regression Equation:
acres = -10778.94 + 15506.58*enr_median

p< 0.0001
R²=0.95
Indian River Lagoon
Annual Seagrass Coverage & Median Depth
Region - IRL North

Seagrass (acres)
30,000

Depth (m)
1.4

Indian River Lagoon
Annual Seagrass Coverage & Median Depth
Region - Banana River

Seagrass (acres)
30,000

Depth (m)
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0

Indian River Lagoon
Annual Seagrass Coverage & Median Depth
Region - IRL Central

Seagrass (acres)

Depth (m)

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<td>2009</td>
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## PROPOSED SEAGRASS TARGETS

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<tr>
<th>Location</th>
<th>Area</th>
<th>Median Deep Depth</th>
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<tbody>
<tr>
<td>IRL North</td>
<td>20,059 acres</td>
<td>1.31 m</td>
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<tr>
<td>IRL Central</td>
<td>8,827 acres</td>
<td>1.28 m</td>
</tr>
<tr>
<td>Banana River</td>
<td>22,793 acres</td>
<td>1.48 m</td>
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Loading Estimates

• Annual Loads
• Monthly Loads
• Cumulative Loads
Indian River Sublagoon Loads
Annual Volume-Normalized TN Loads (lbs/acre-ft)
Sublagoon=BRL
Indian River Sublagoon Loads
Monthly Volume-Normalized TN Loads (lbs/acre-ft)

Sublagoon=BRL
Indian River Sublagoon Loads
Annual Volume-Normalized TN Loads (lbs/acre-ft)
Sublagoon=IRL Central
Indian River Sublagoon Loads
Monthly Volume-Normalized TN Loads (lbs/acre-ft)
Sublagoon=IRL Central
Indian River Sublagoon Loads
Monthly Volume-Normalized TN Loads (lbs/acre-ft)
Sublagoon=IRL North
Load vs Seagrass Regressions

- Area - current annual load - CIRL NS, BR & NIRQ slightly significant
- Area - previous annual load - NS
- Area - wet/dry season loads - NS
- Area - 6, 12, 18, 24 month cumulative loads - 6 month best fit
- Area - 6 month cumulative load normalized by sublagoon volume (lbs/acre-ft)
- Area - 2, 3, 4, 5, 6 cumulative load normalized by sublagoon volume (lbs/acre-ft)
Indian River Sublagoon Loads
5-Month: Jan-May Volume-Normalized TN Loads (lbs/acre-ft)
Sublagoon=BRL
Indian River Sublagoon Loads

6-Month: Dec-May Volume-Normalized TN Loads (lbs/acre-ft)

Sublagoon=BRL
Indian River Sublagoon Loads
5-Month: Jan-May Volume-Normalized TN Loads (lbs/acre-ft)
Sublagoon=IRL Central
Indian River Sublagoon Loads
6-Month: Dec-May Volume-Normalized TN Loads (lbs/acre-ft)

Sublagoon=IRL Central
Indian River Sublagoon Loads
5-Month: Jan-May Volume-Normalized TN Loads (lbs/acre-ft)
Sublagoon=IRL North
Indian River Sublagoon Loads
6-Month: Dec-May Volume-Normalized TN Loads (lbs/acre-ft)
Sublagoon=IRL North
Indian River Lagoon
5 Months TN Load (Normalized by Sublagoon Volume) vs Seagrass Acreage
Banana River Lagoon
Indian River Lagoon
5 Months TN Load(Normalized by Sublagoon Volume) vs Seagrass Acreage
North Indian River Lagoon
Indian River Lagoon

6 Months TN Load (Normalized by Sublagoon Volume) vs Seagrass Acreage

Central Indian River Lagoon
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<tr>
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<th>4 month cumulative</th>
<th>5 month cumulative</th>
<th>6 month cumulative</th>
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<tr>
<td></td>
<td>p &gt; F</td>
<td>r^2</td>
<td>p &gt; F</td>
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<tr>
<td>Banana River</td>
<td>0.0303</td>
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<td>0.0181</td>
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<tr>
<td>North IRL</td>
<td>0.0202</td>
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<td>Central IRL</td>
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<td>TP Load vs Seagrass Area</td>
<td>4 month cumulative</td>
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Further Analysis/Relationships

• More robust regressions can be developed by incorporating all three sublagoons into the same regression
Normalize by Seagrass Coverage

Indian River Lagoon

7 Months TN Load (Normalized by Sublagoon Volume) vs Seagrass Acreage (Normalized by 2007 Acreage)

\[ R^2 = 0.75 \]
Seagrass Target = 22,793 acres

TN Loading Target = 0.48 lbs/acre-ft/7-months
Indian River Lagoon North
Relationship Between TN Loading and Seagrass Area

Seagrass Target = 20.059 acres

TN Loading Target = 0.69 lbs/acre-ft/7-months
Indian River Lagoon Central
Relationship Between TN Loading and Seagrass Area

Seagrass Target = 8,827 acres

TN Loading Target = 3.09 lbs/acre-ft/7-months
7-Month: Dec-May Volume-Normalized TN Loads (lbs/acre-ft)
Sublagoon=BRL

Critical Load
7-Month: Dec-May Volume-Normalized TN Loads (lbs/acre-ft)
Sublagoon=IRL Central

Critical Load
TN Cumulative Load (lbs/acre-ft)
7 month - 12 month
Sublagoon=BRL

P < 0.0008
r^2 = 0.59
p < 0.0001

$r^2 = 0.69$
TN Cumulative Load (lbs/acre-ft)
7 month - 12 month
Sublagoon=IRL North

\[ p < 0.0008 \]
\[ r^2 = 0.59 \]