WATER QUALITY MONITORING
Demonstration of Remediation Methods

Florida Keys Canals

10-28-2016

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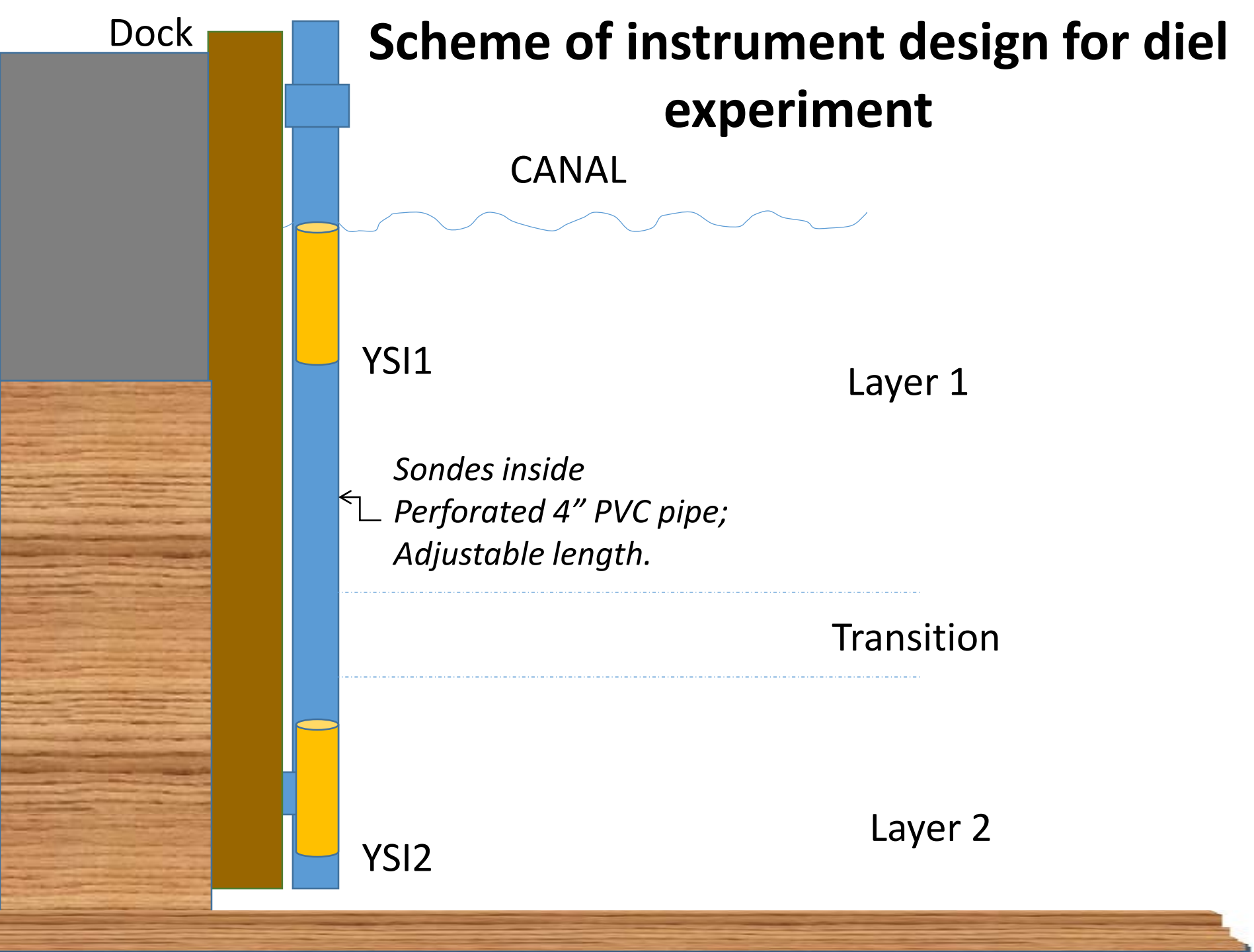
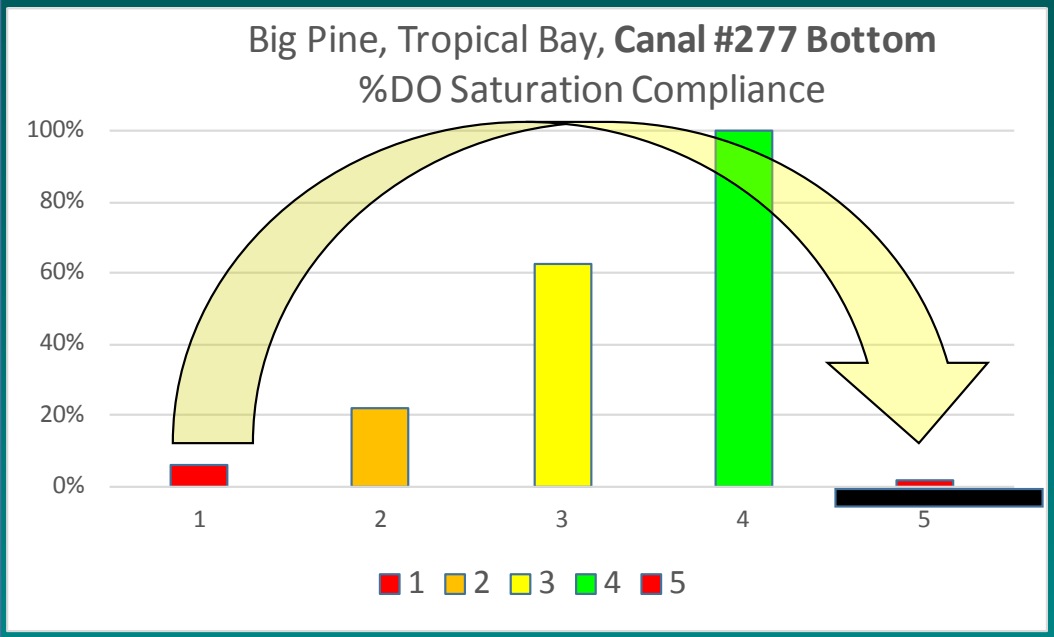
Scheme of instrument design for diel experiment



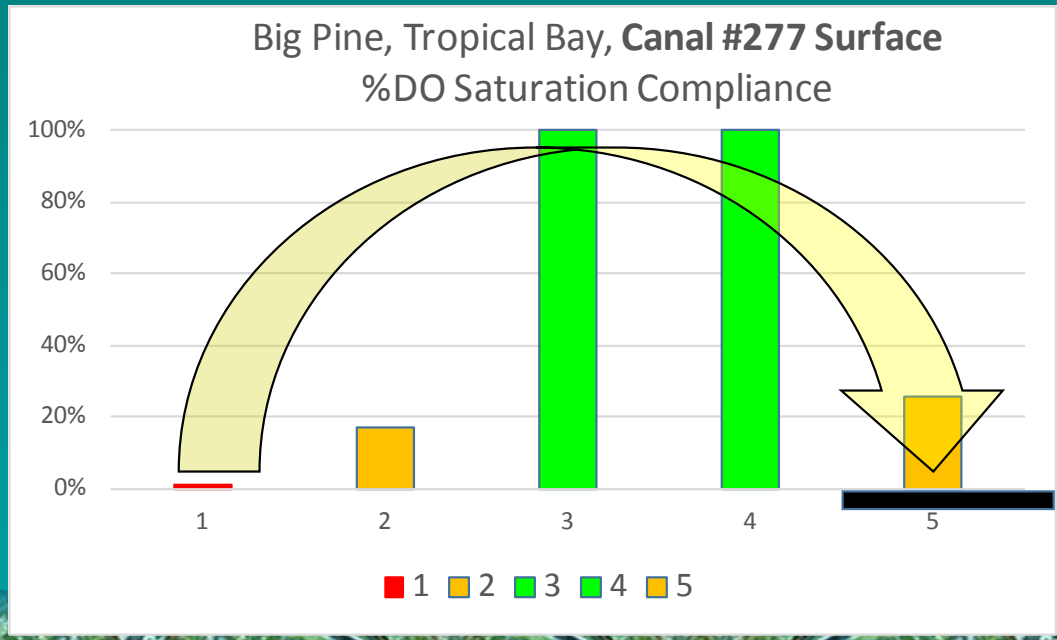
#277 Culvert Installation



	277A-Bottom	277A-Surface
6/6/2014	6%	1%
9/23/2014	22%	17%
8/14/2015	63%	100%
2/7/2016	100%	100%
6/30/2016	1%	26%

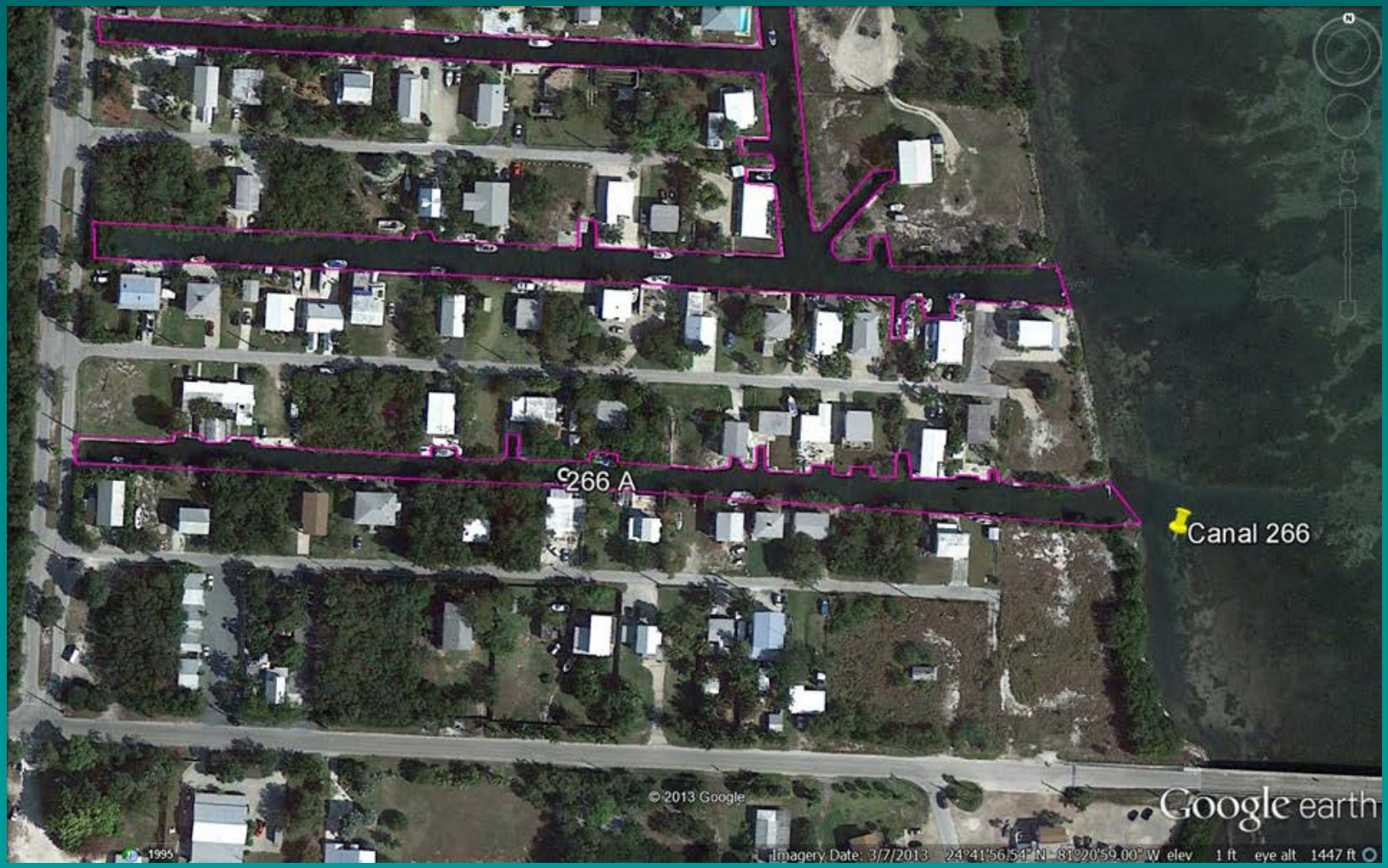
4/20/16

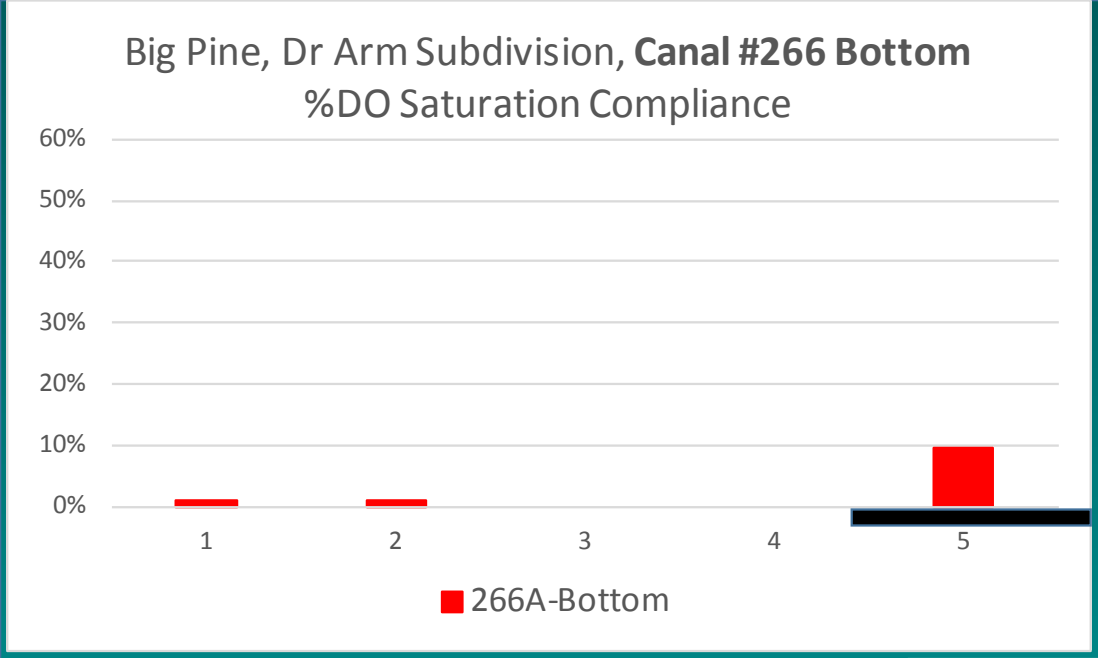
#277 Culvert Installation



<10%	10%>X<50%	50%<X<90%	>90%

#266 Organic Removal & Weed Barrier

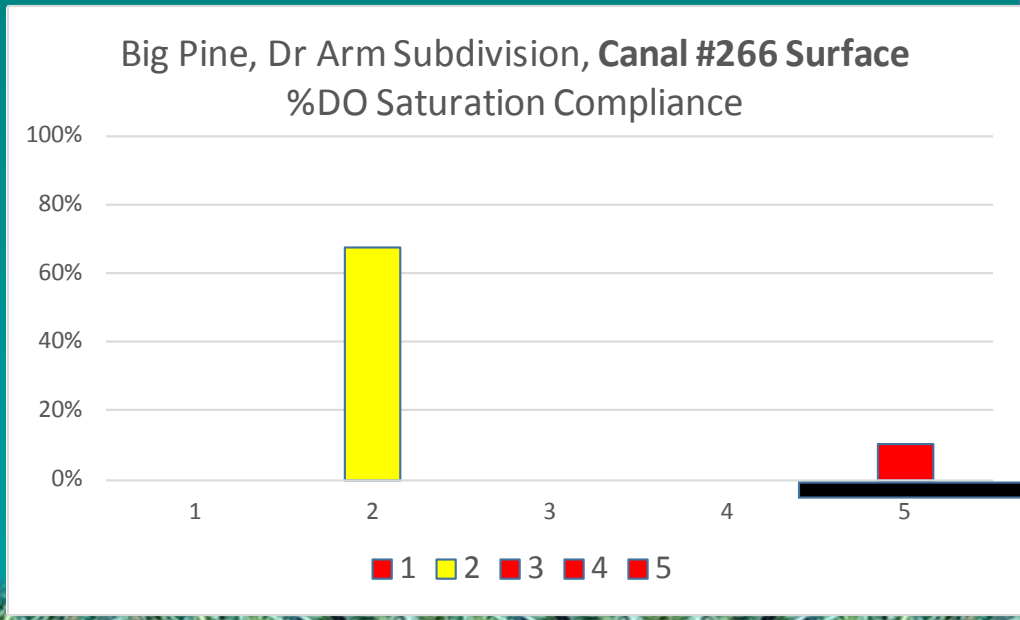




	266A-Bottom	266A-Surface
6/9/2014	1%	0%
9/24/2014	1%	68%
8/15/2015		
2/10/2016		
6/21/2016	10%	10%

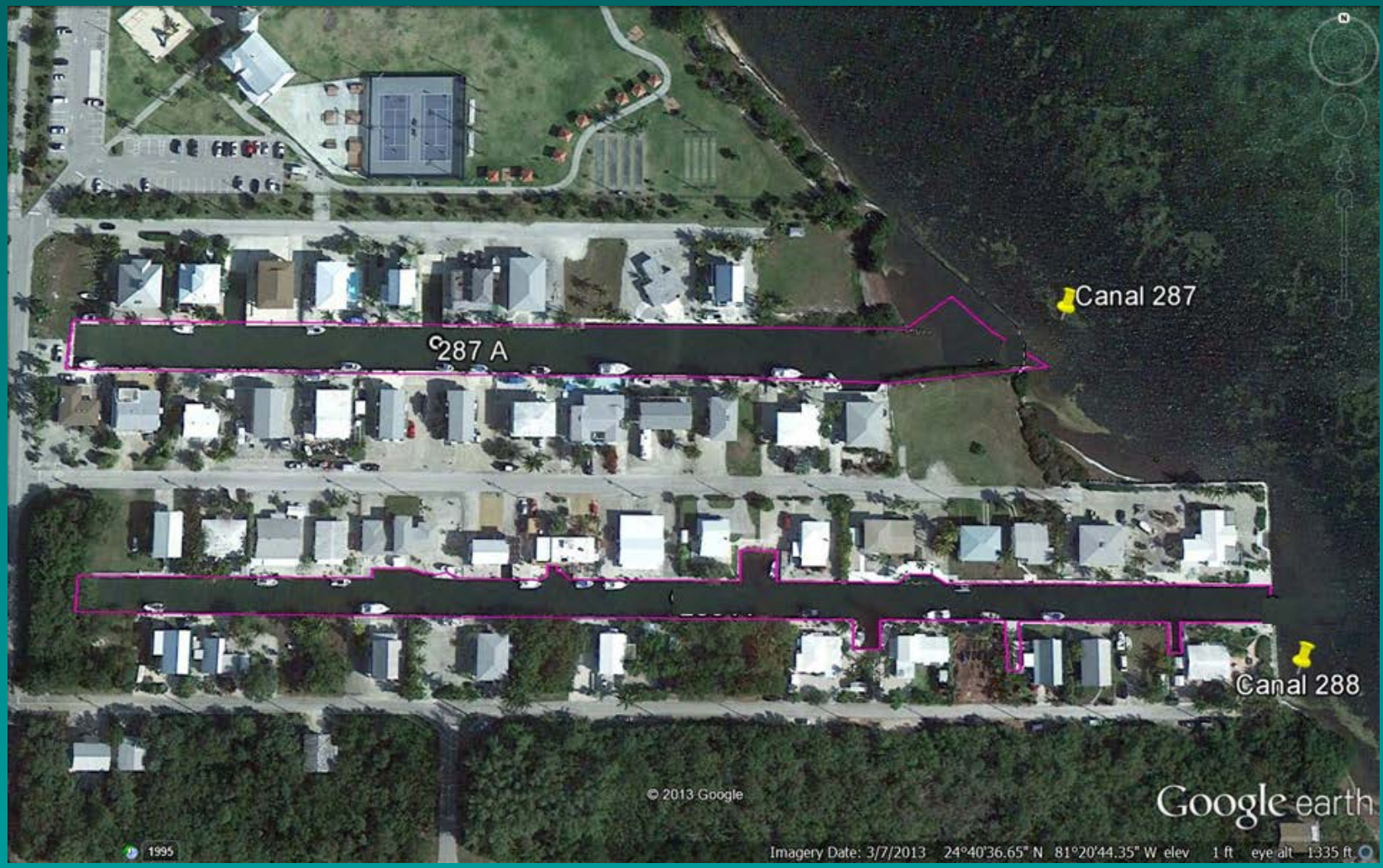
5/20/16

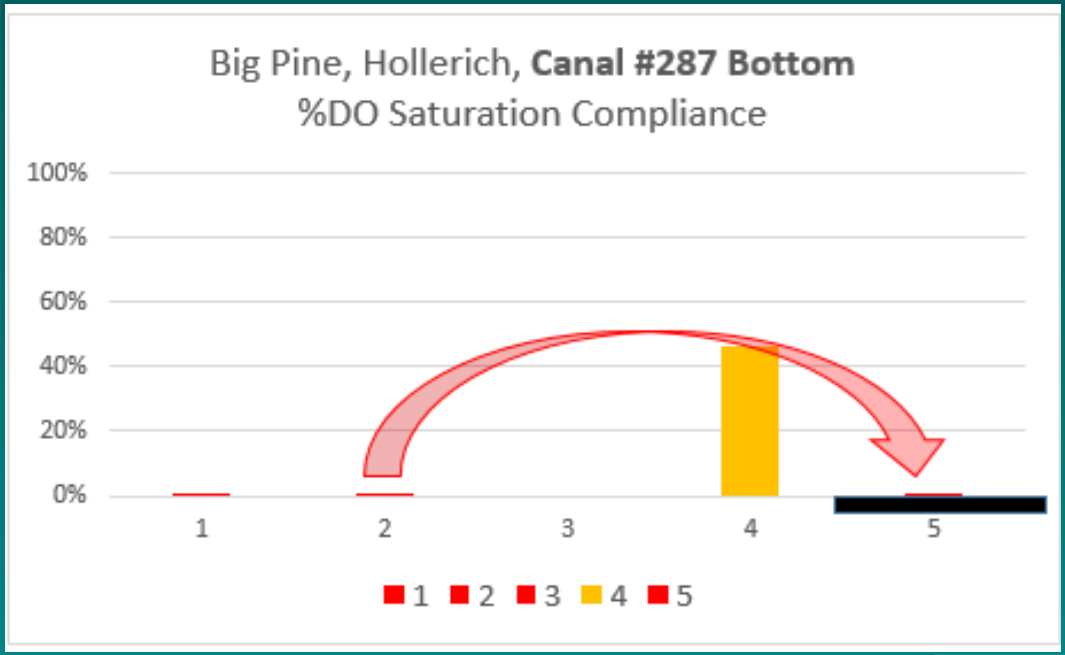
#266 Organic Removal & Weed Barrier



<10%	10%>X<50%	50%<X<90%	>90%

#287 Weed Barrier

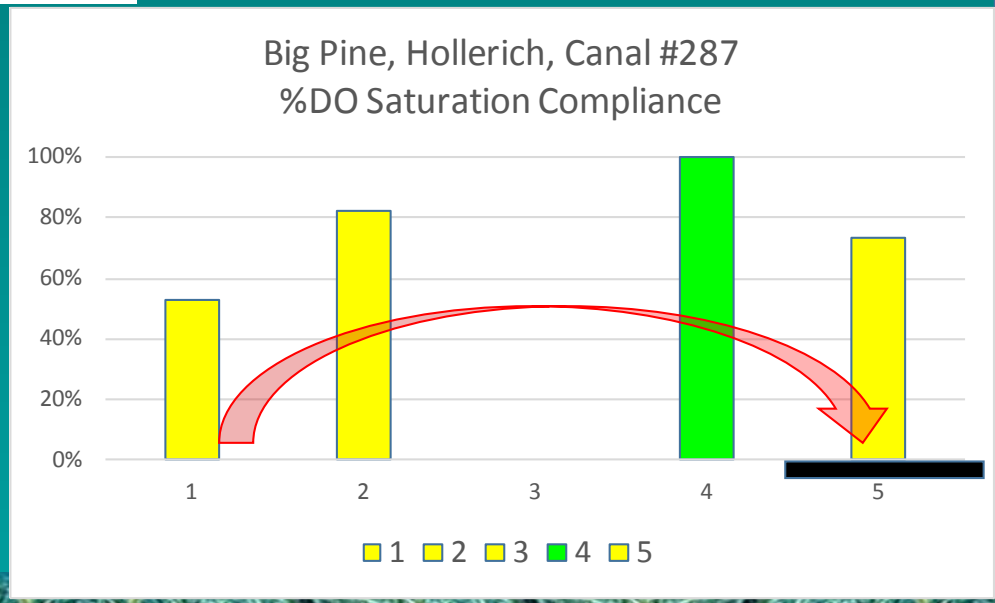




	287A-Bottom	287A-Surface
6/7/2014	1%	53%
9/23/2014	1%	82%
8/15/2015		
2/10/2016	46%	100%
6/21/2016	1%	73%

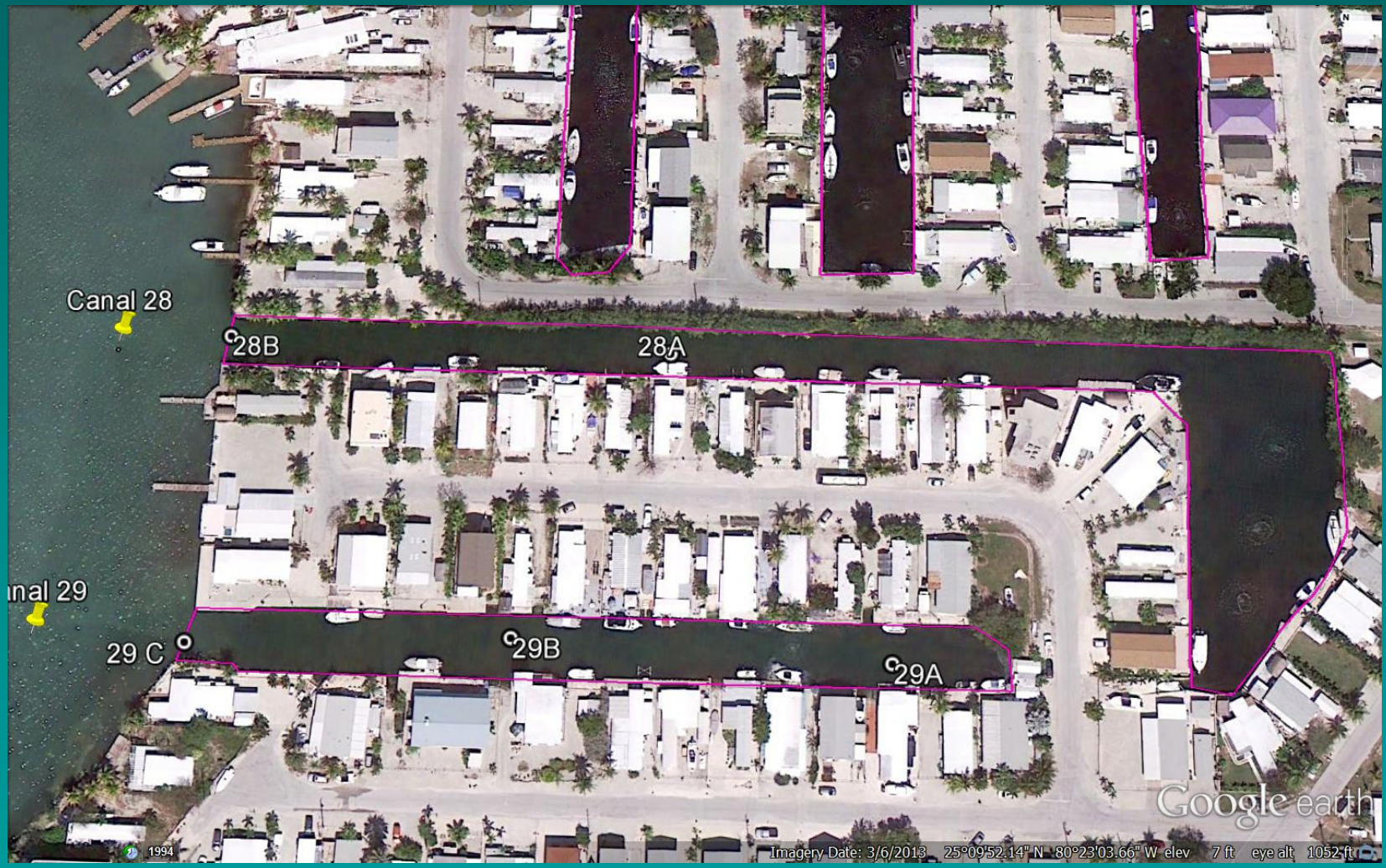
6/6/16

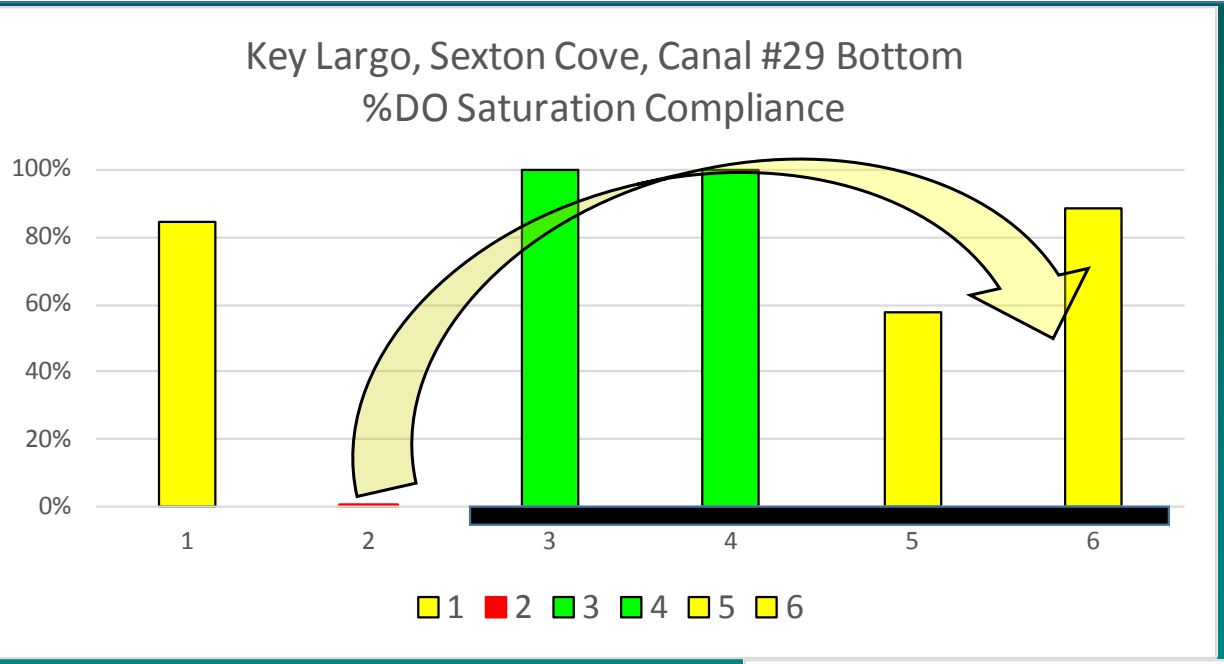
#287 Weed Barrier



<10%	10%>X<50%	50%<X<90%	>90%

#29 Backfilling

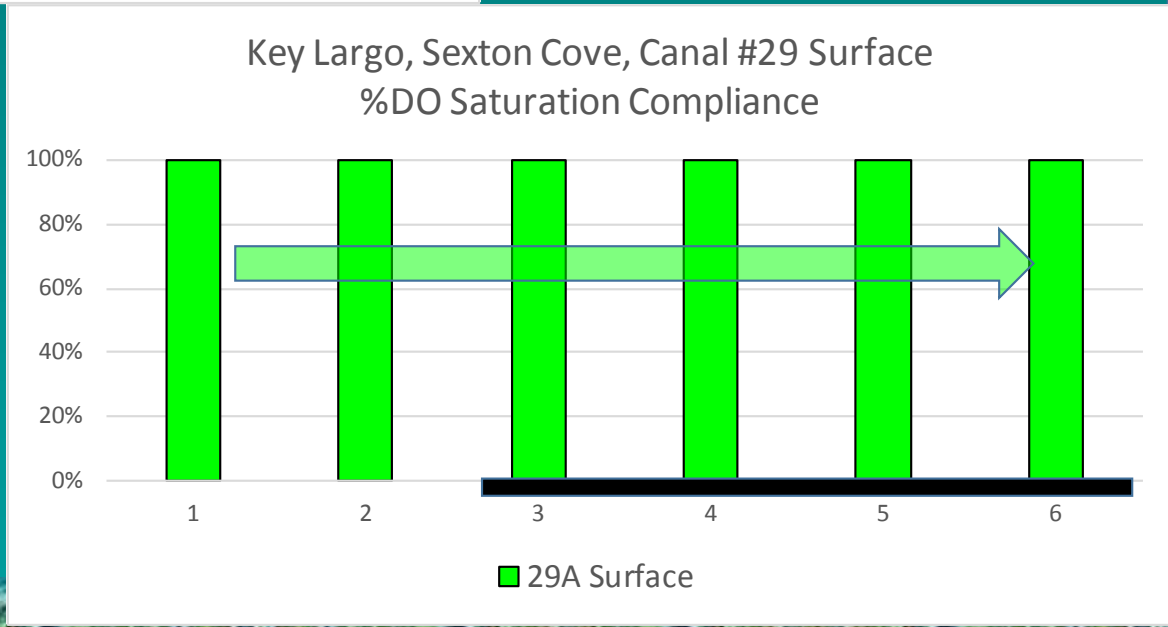




	29A Bottom	29A Surface
3/28/2014	84%	100%
9/12/2014	0%	100%
2/2/2016	100%	100%
4/28/2016	100%	100%
7/28/2016	58%	100%
8/1/2016	88%	100%

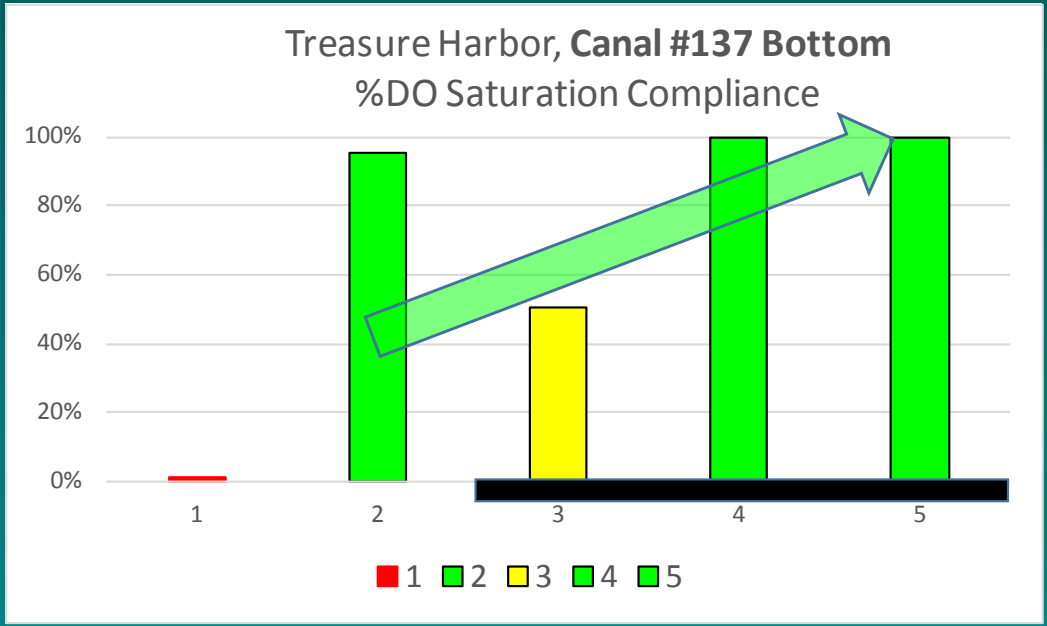
7/13/15

#29 Backfilling



<10%	10%>X<50%	50%<X<90%	>90%

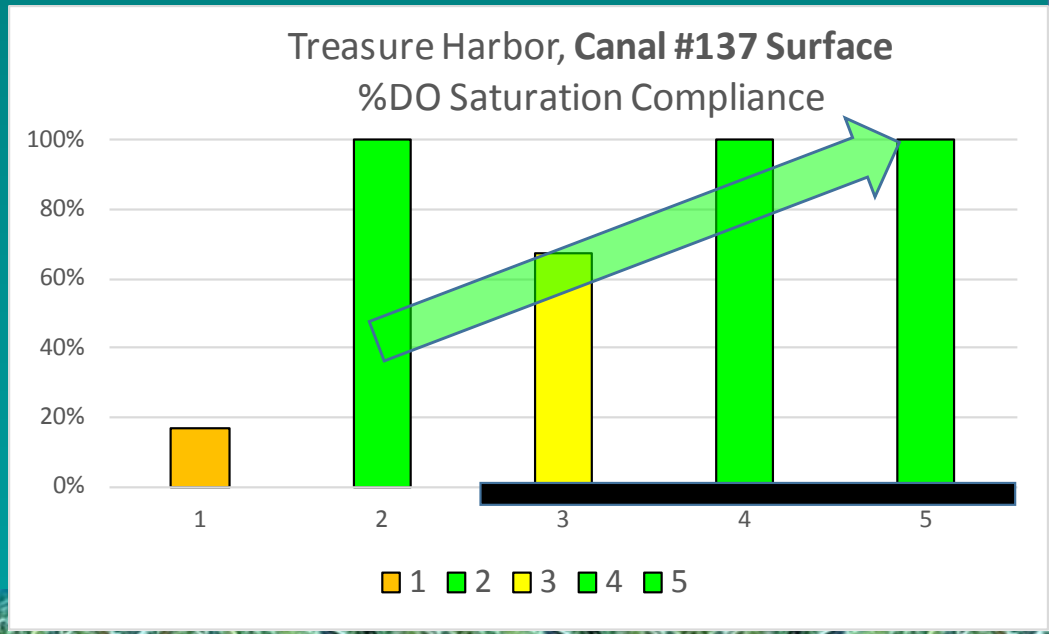
#137 Aereator & Weed Barrier



	137A-Surface	137A-Bottom
4/2/2014	17%	1%
9/16/2014	100%	95%
7/30/2015	68%	50%
1/27/2016	100%	100%
7/19/2016	100%	100%

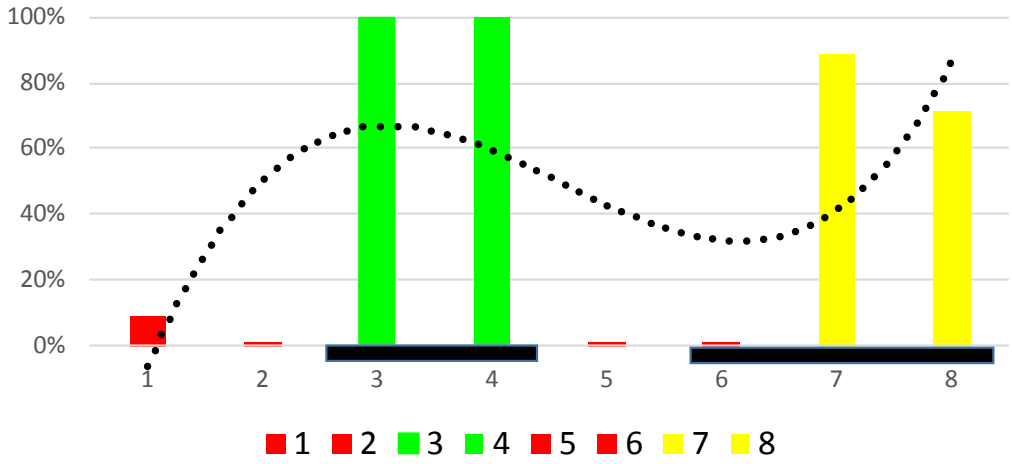
11/4/14

#137 Aereator & Weed Barrier



<10%	10%>X<50%	50%<X<90%	>90%

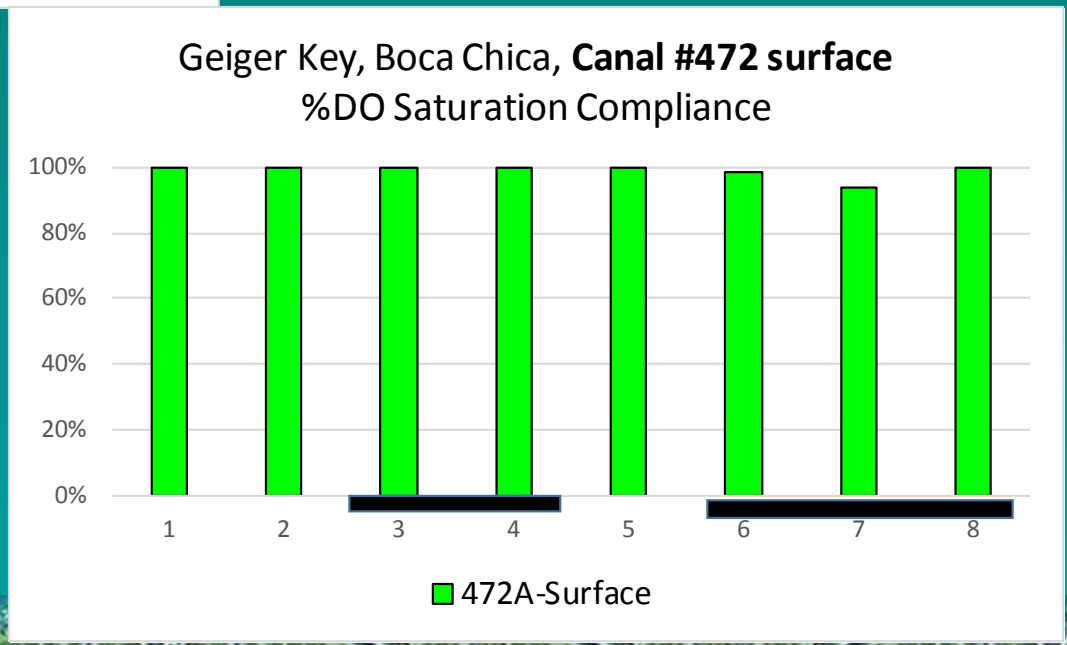
#472 Culvert Installation



	472A-Bottom	472A-Surface
5/23/2014	9%	100%
9/25/2014	1%	100%
5/4/2015	100%	100%
5/7/2015	100%	100%
8/3/2015	1%	100%
5/16/2016	1%	99%
8/21/2016	89%	94%
8/21/2016	71%	100%

4/22/15; 7/2/15; 5/5/16

#472 Culvert Installation



<10%	10%>X<50%	50%<X<90%	>90%

Preliminary Conclusions

- Data seems to indicate that signs of water quality improvement, in terms of Dissolved Oxygen, takes several months to at least one year after remediation.
- Reaction to culver installation seems to be relatively fast, as is response to combined aeration and weed-gate combination.

Are canals contributing to nutrient enrichment of Florida Keys National Marine Sanctuary waters?

Are canals contributing to nutrient enrichment of Florida Keys National Marine Sanctuary waters?

The Regional Scope

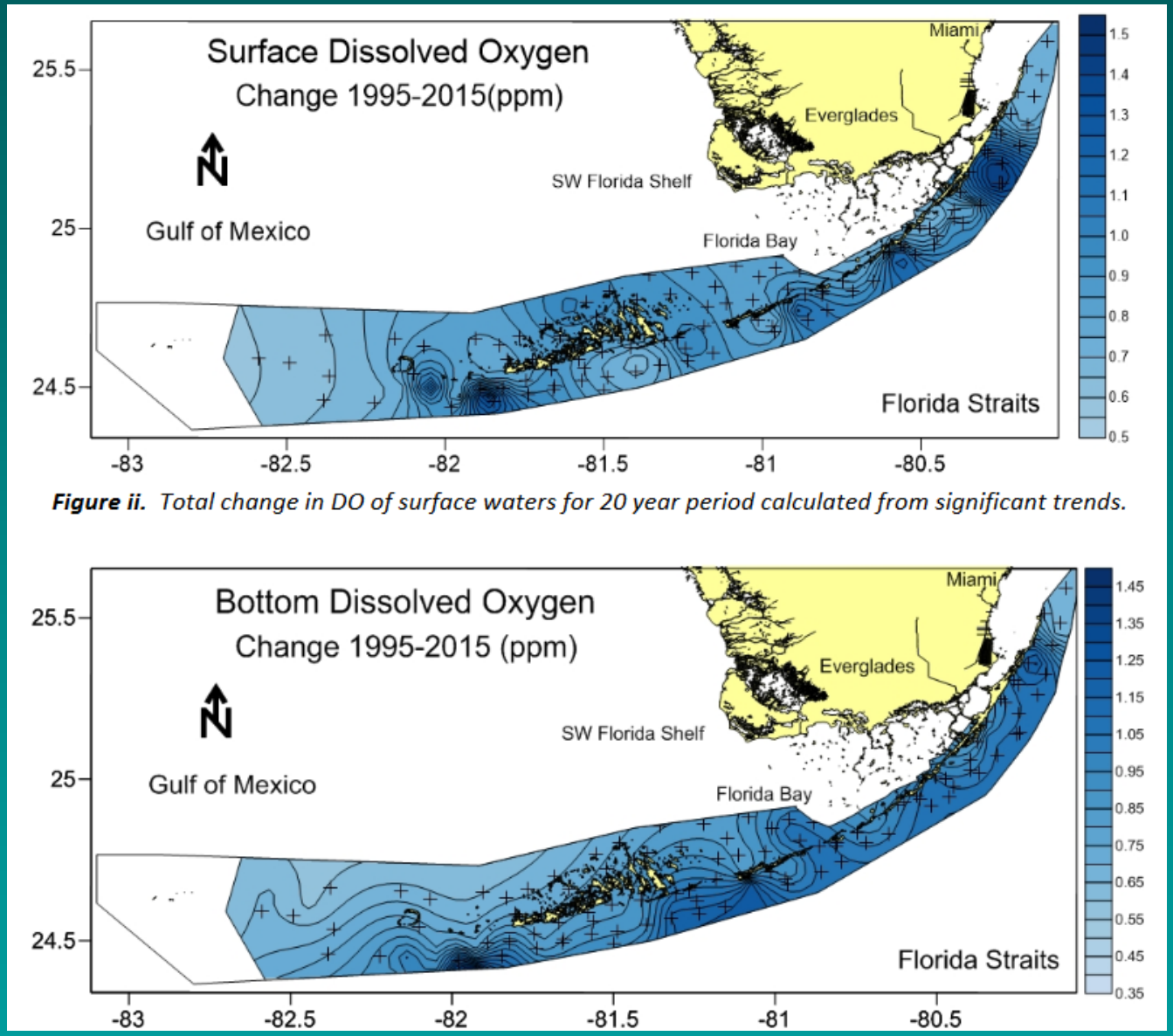
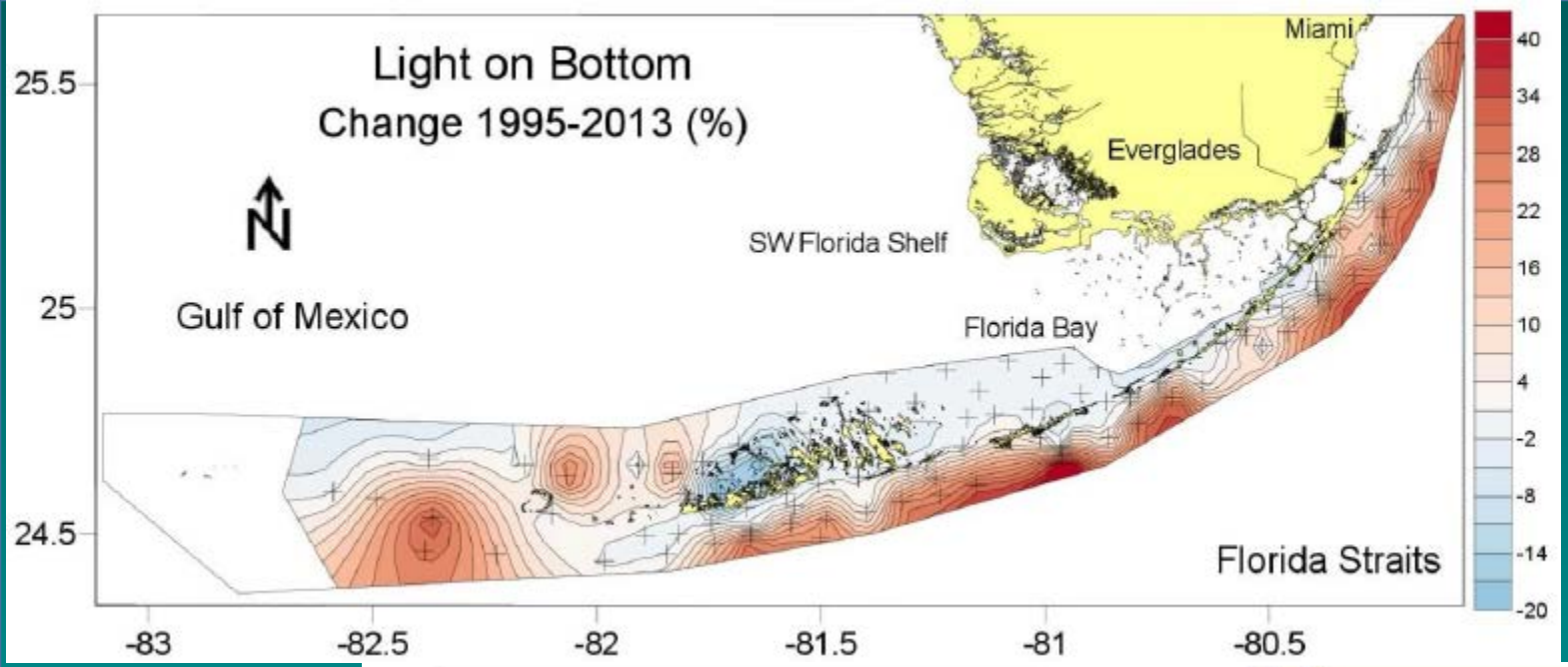
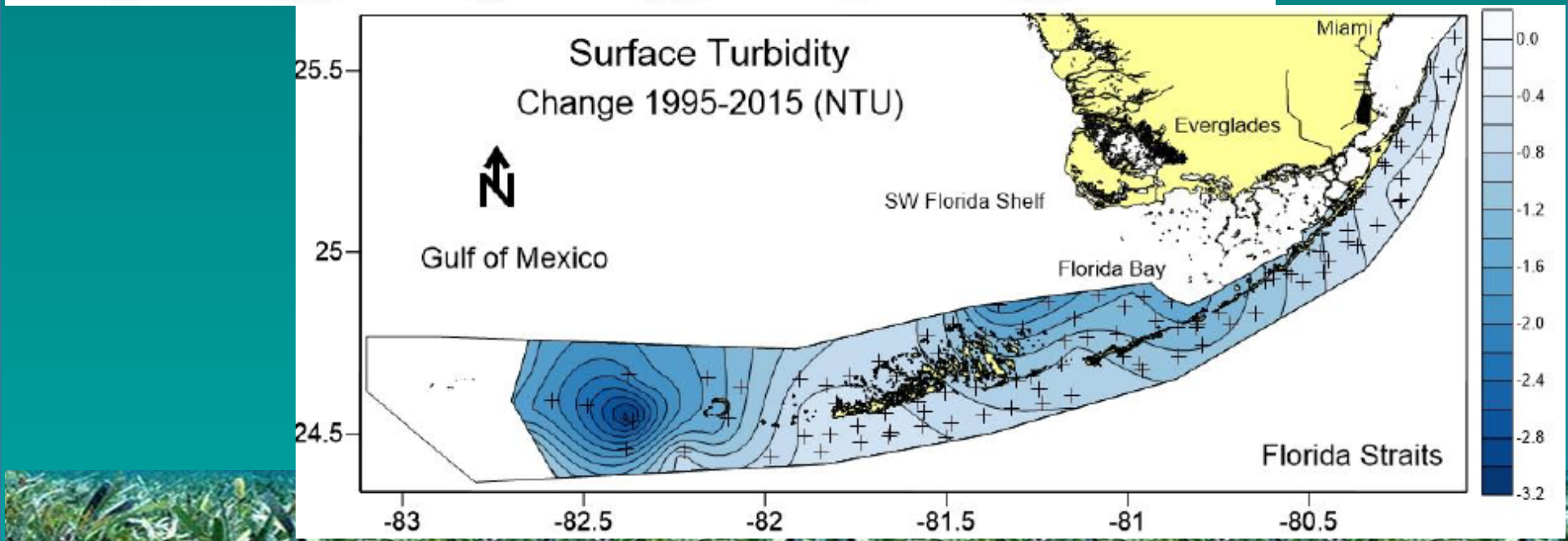
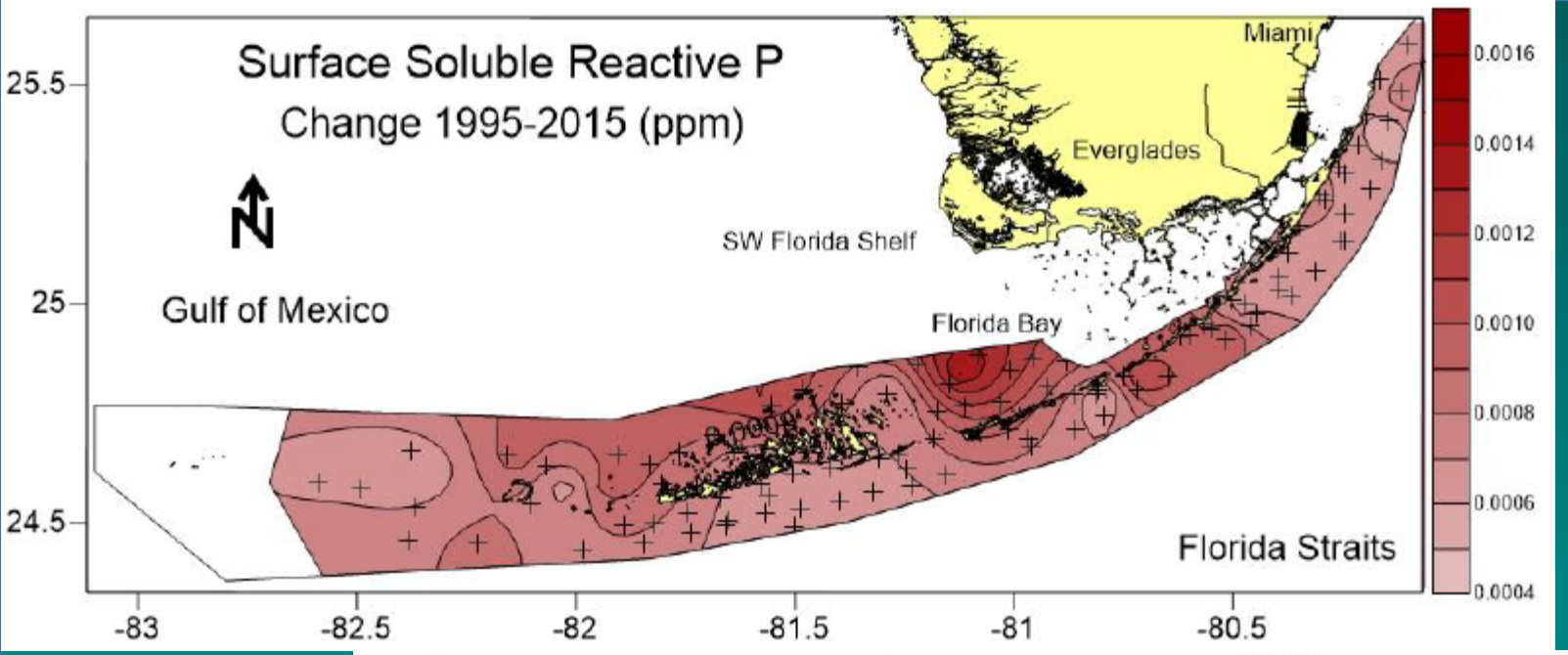
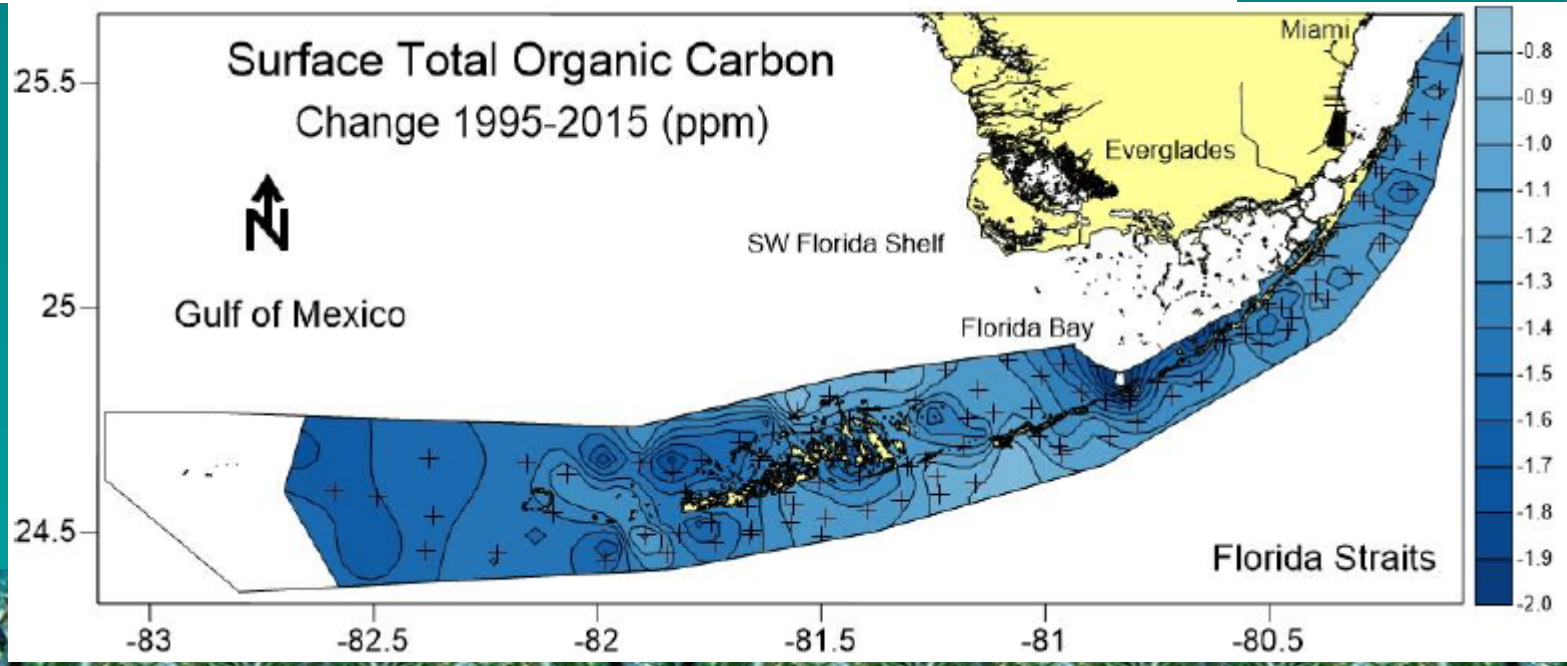


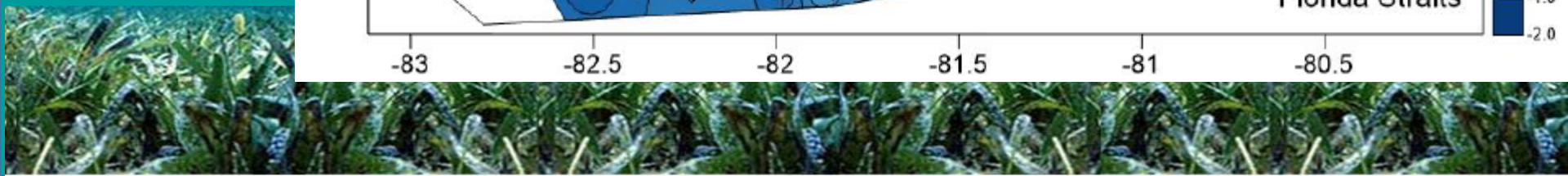
Figure ii. *Total change in DO of surface waters for 20 year period calculated from significant trends.*


Light on Bottom
Change 1995-2013 (%)
Miami
Everglades
SW Florida Shelf
Gulf of Mexico
Florida Bay
Florida Straits
25.5
25
24.5
-83
-82.5
-82
-81.5
-81
-80.5
40
34
28
22
16
10
4
-2
-8
-14
-20


Surface Turbidity
Change 1995-2015 (NTU)
Miami
Everglades
SW Florida Shelf
Gulf of Mexico
Florida Bay
Florida Straits
25.5
25
24.5
-83
-82.5
-82
-81.5
-81
-80.5
0.0
-0.4
-0.8
-1.2
-1.6
-2.0
-2.4
-2.8
-3.2

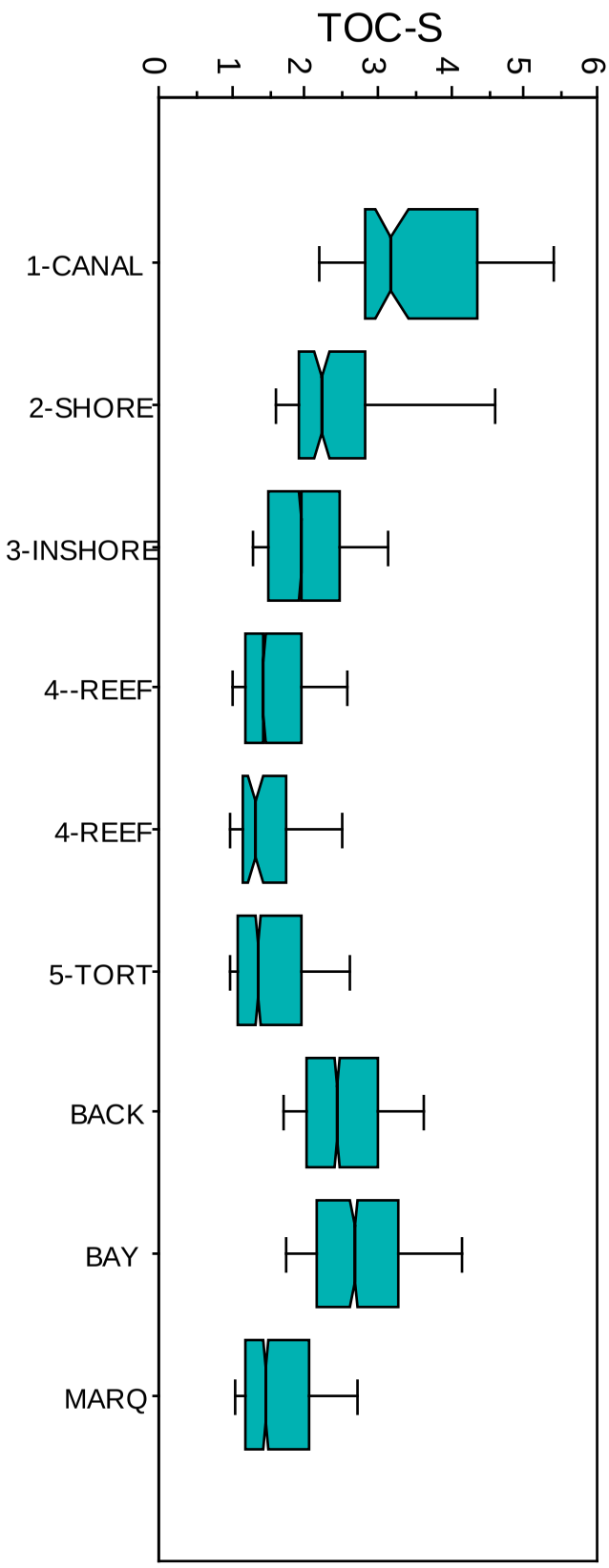

Surface Soluble Reactive P
Change 1995-2015 (ppm)
Miami
Everglades
SW Florida Shelf
Gulf of Mexico
Florida Bay
Florida Straits
25.5
25
24.5
-83
-82.5
-82
-81.5
-81
-80.5
0.0016
0.0014
0.0012
0.0010
0.0008
0.0006
0.0004

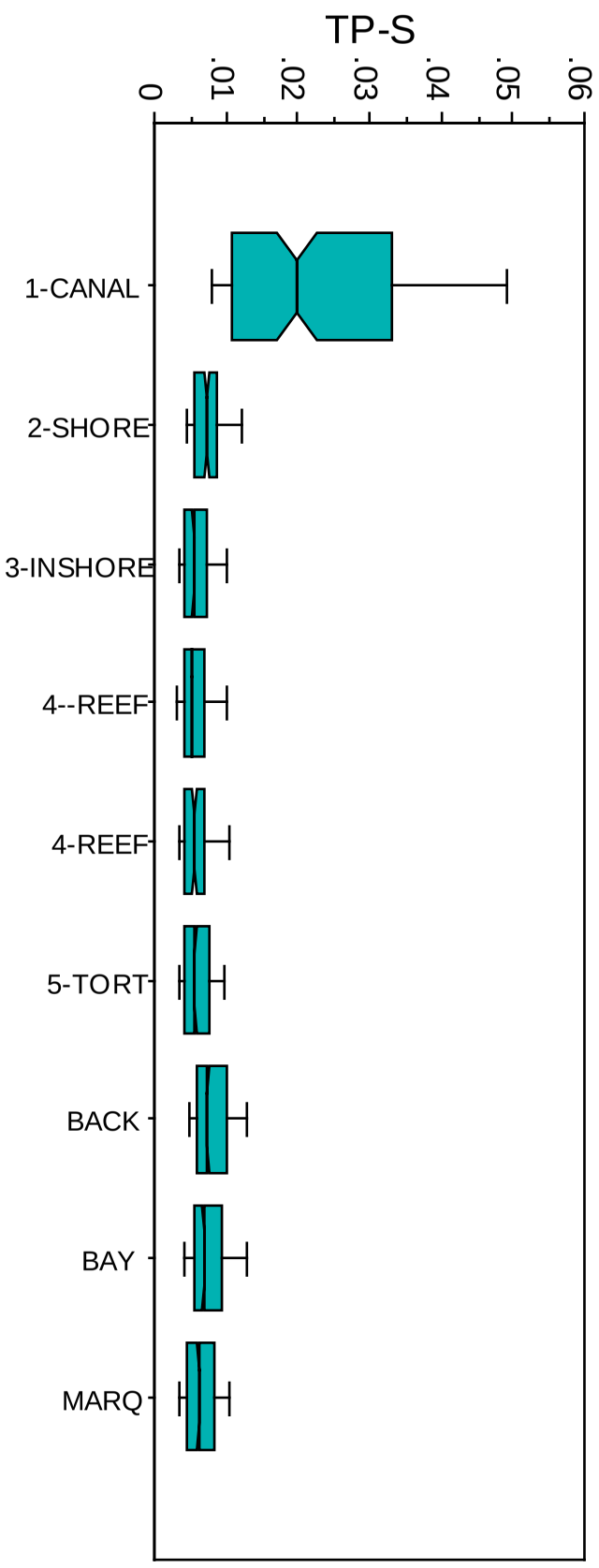

Surface Total Organic Carbon
Change 1995-2015 (ppm)
Miami
Everglades
SW Florida Shelf
Gulf of Mexico
Florida Bay
Florida Straits
25.5
25
24.5
-83
-82.5
-82
-81.5
-81
-80.5
-0.8
-0.9
-1.0
-1.1
-1.2
-1.3
-1.4
-1.5
-1.6
-1.7
-1.8
-1.9
-2.0

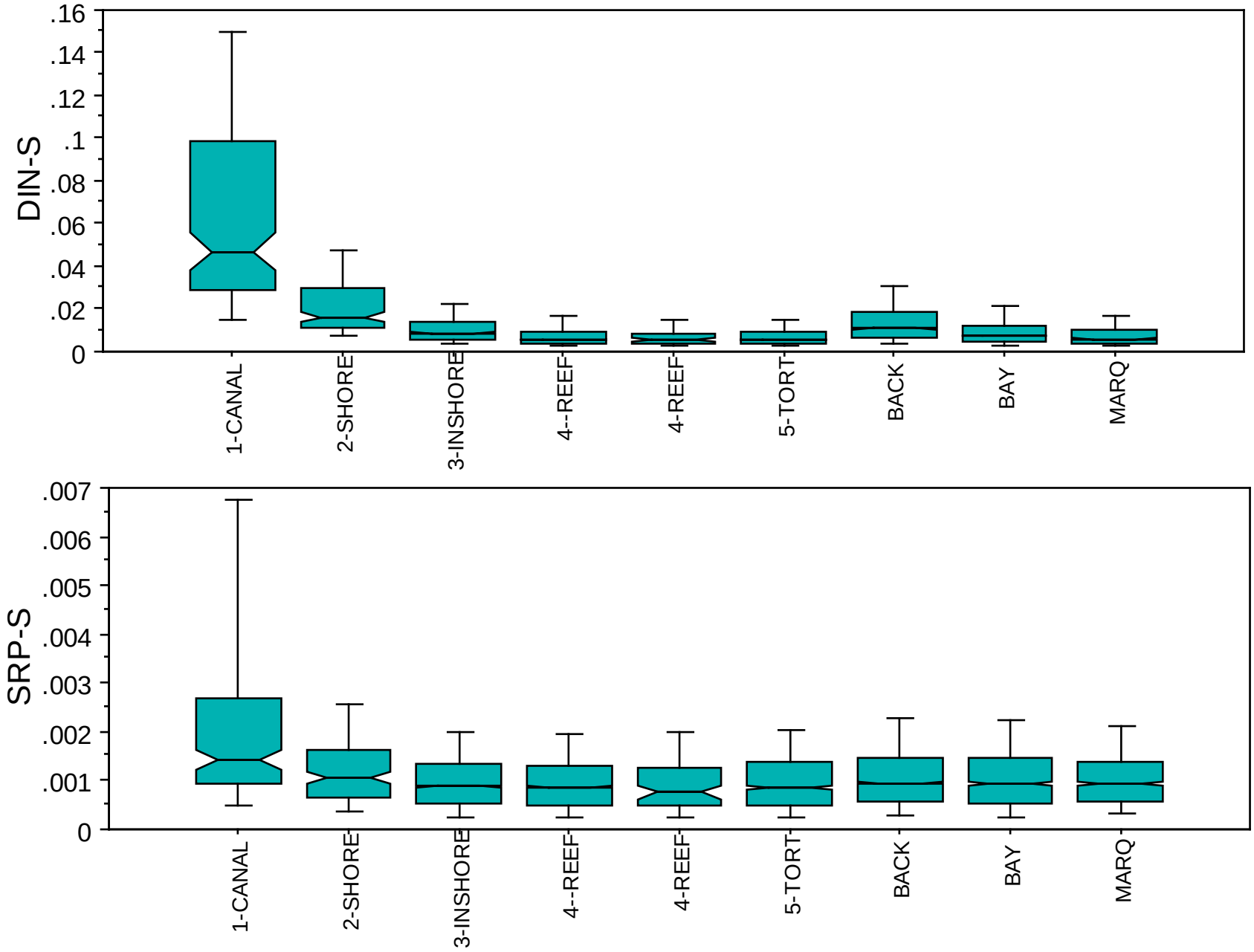


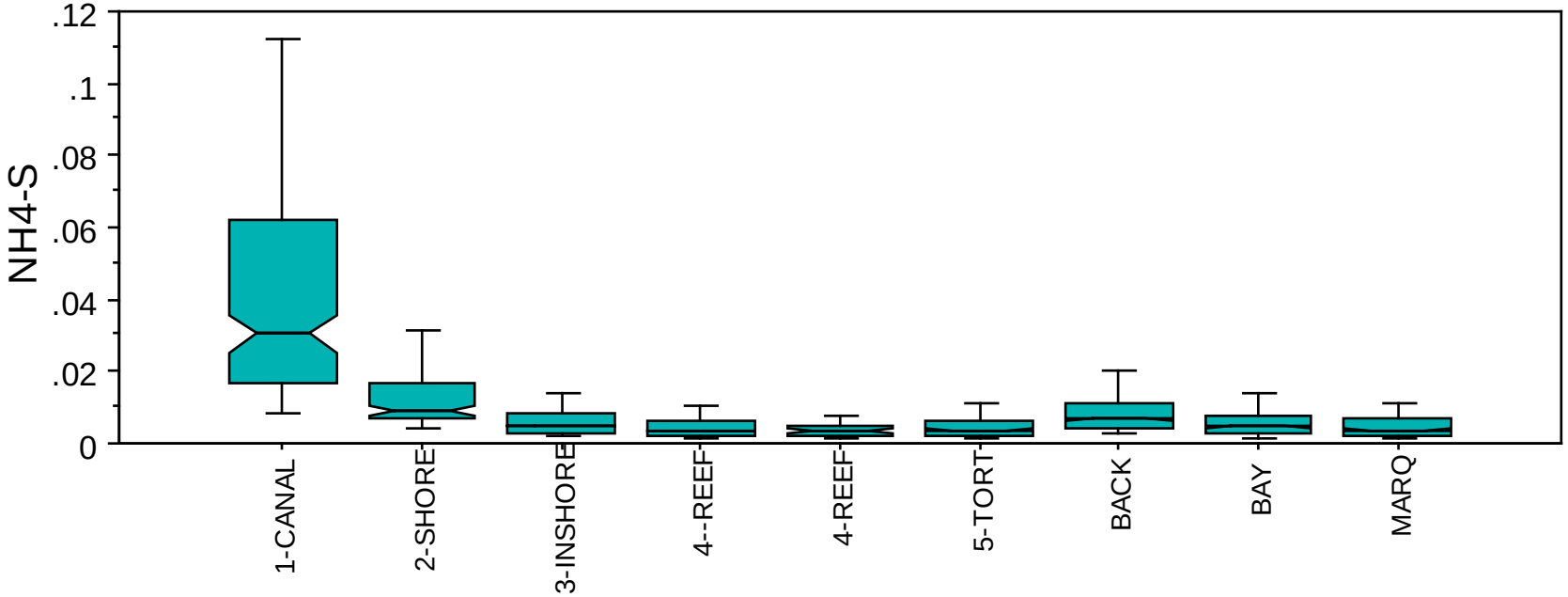
EPA WQPP Water Quality Targets

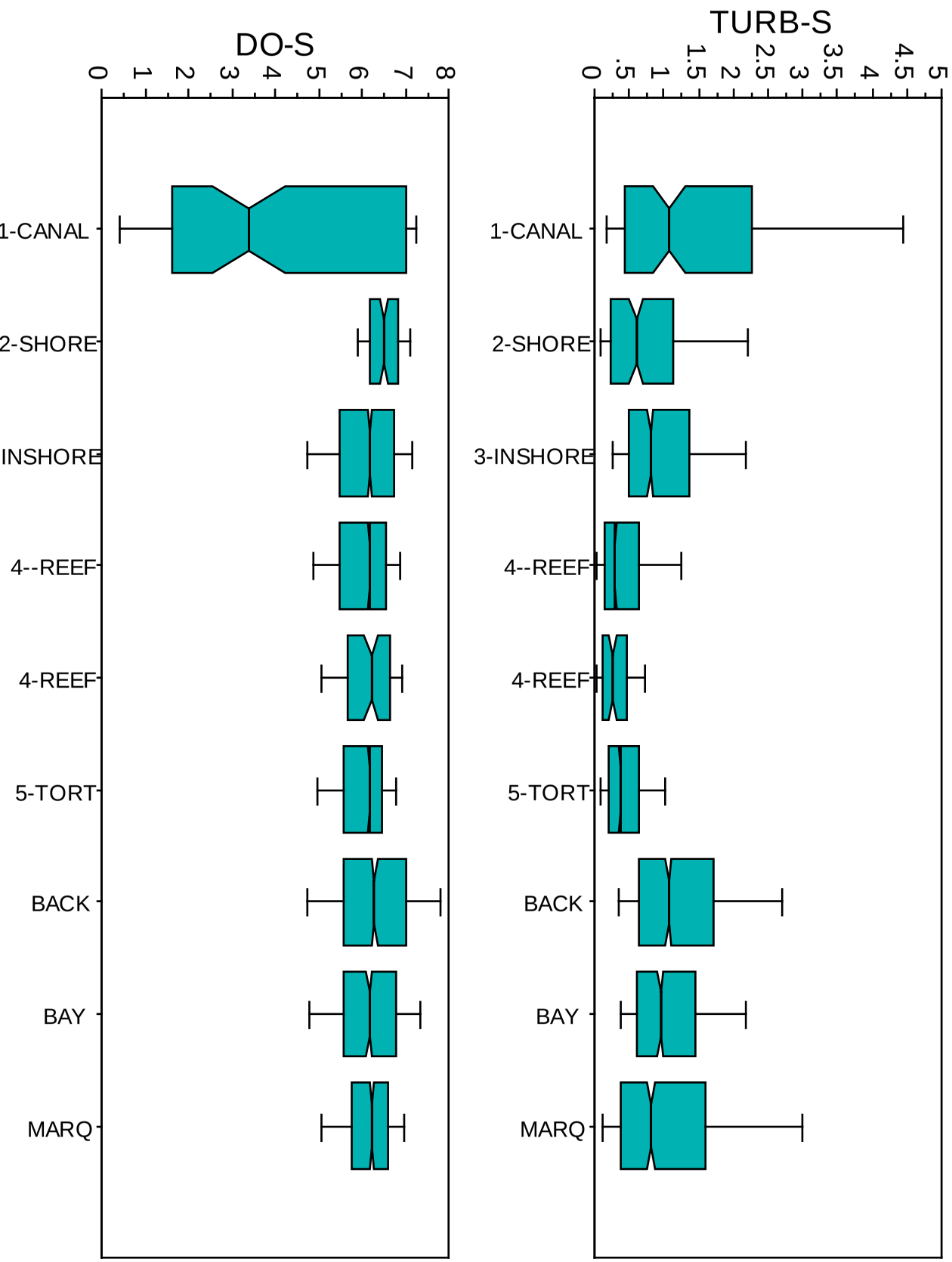
Year	REEF Stations		All Stations (excluding SHORE sites)	
	CHLA ≤ 0.35 µg l^{-1}	K_d ≤ 0.20 m^{-1}	DIN ≤ 0.75 µM (0.010 ppm)	TP ≤ 0.25 µM (0.0077 ppm)
1995-05	1778 of 2367 (75.1%)	1042 of 1597 (65.2%)	7826 of 10254 (76.3%)	7810 of 10267 (76.1%)
2006	196 of 225 (87.1%)	199 of 225 (88.4%)	432 of 990 (43.6%)	316 of 995 (31.8%)
2007	198 of 226 (87.6%)	202 of 222 (91.0%)	549 of 993 (55.3%)	635 of 972 (65.3%)
2008	177 of 228 (77.6%)	181 of 218 (83.0%)	836 of 1,000 (83.6%)	697 of 1,004 (69.4%)
2009	208 of 228 (91.2%)	189 of 219 (86.3%)	858 of 1,003 (85.5%)	869 of 1,004 (86.6%)
2010	170 of 227 (74.9%)	176 of 206 (85.4%)	843 of 1000 (84.3%)	738 of 1,003 (73.6%)
2011	146 of 215 (67.9%)	156 of 213 (73.2%)	813 of 1012 (80.3 %)	911 of 1013 (89.9 %)
2012	142 of 168 (84.5%)	135 of 168 (80.4%)	489 of 683 (71.6 %)	634 of 684 (92.7 %)
2013	148 of 172 (86.0%)	150 of 172 (87.2%)	496 of 688 (72.1 %)	603 of 688 (87.6 %)
2014	141 of 172 (82.0%)	133 of 172 (77.3%)	426 of 690 (61.7%)	540 of 690 (78.3%)
2015	122 of 172 (70.9%)	135 of 172 (78.5%)	487 of 688 (70.8%)	613 of 688 (89.1%)


TOC-S
0
1
2
3
4
5
6
1-CANAL
2-SHORE
3-INSHORE
4--REEF
4-REEF
5-TORT
BACK
BAY
MARQ


TP-S
0
.01
.02
.03
.04
.05
.06
1-CANAL
2-SHORE
3-INSHORE
4--REEF
4-REEF
5-TORT
BACK
BAY
MARQ


DIN-S
.16
.14
.12
.1
.08
.06
.04
.02
0
1-CANAL
2-SHORE
3-INSHORE
4--REEF
4-REEF
5-TORT
BACK
BAY
MARQ
SRP-S
.007
.006
.005
.004
.003
.002
.001
0
1-CANAL
2-SHORE
3-INSHORE
4--REEF
4-REEF
5-TORT
BACK
BAY
MARQ


NH4-S
.12
.1
.08
.06
.04
.02
0
1-CANAL
2-SHORE
3-INSHORE
4--REEF
4-REEF
5-TORT
BACK
BAY
MARQ


DO-S
0
1
2
3
4
5
6
7
8
1-CANAL
2-SHORE
3-INSHORE
4--REEF
4-REEF
5-TORT
BACK
BAY
MARQ
TURB-S
0
.5
1
1.5
2
2.5
3
3.5
4
4.5
5
1-CANAL
2-SHORE
3-INSHORE
4--REEF
4-REEF
5-TORT
BACK
BAY
MARQ

Summary

- There is a significant nutrient gradient from Canals to the coral reefs
- This gradient may be indicative of Key (Canal) derived nutrients diluting into offshore waters
- Tidal flushing of canal waters may contribute to the Halo (SHORE) zone around the Keys, and from there pollutants may migrate to offshore sites