A Proposed Water Quality Index for Tampa Bay and Evaluation of 40 Year Water Quality Trends: 1974-2015

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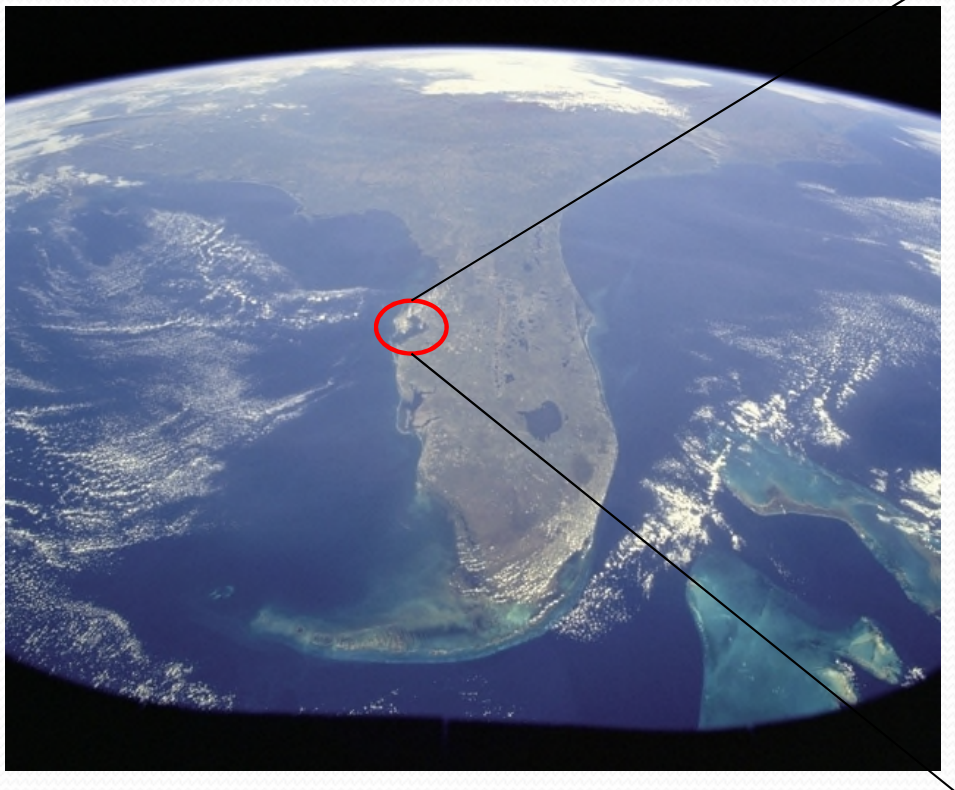
Tampa Bay



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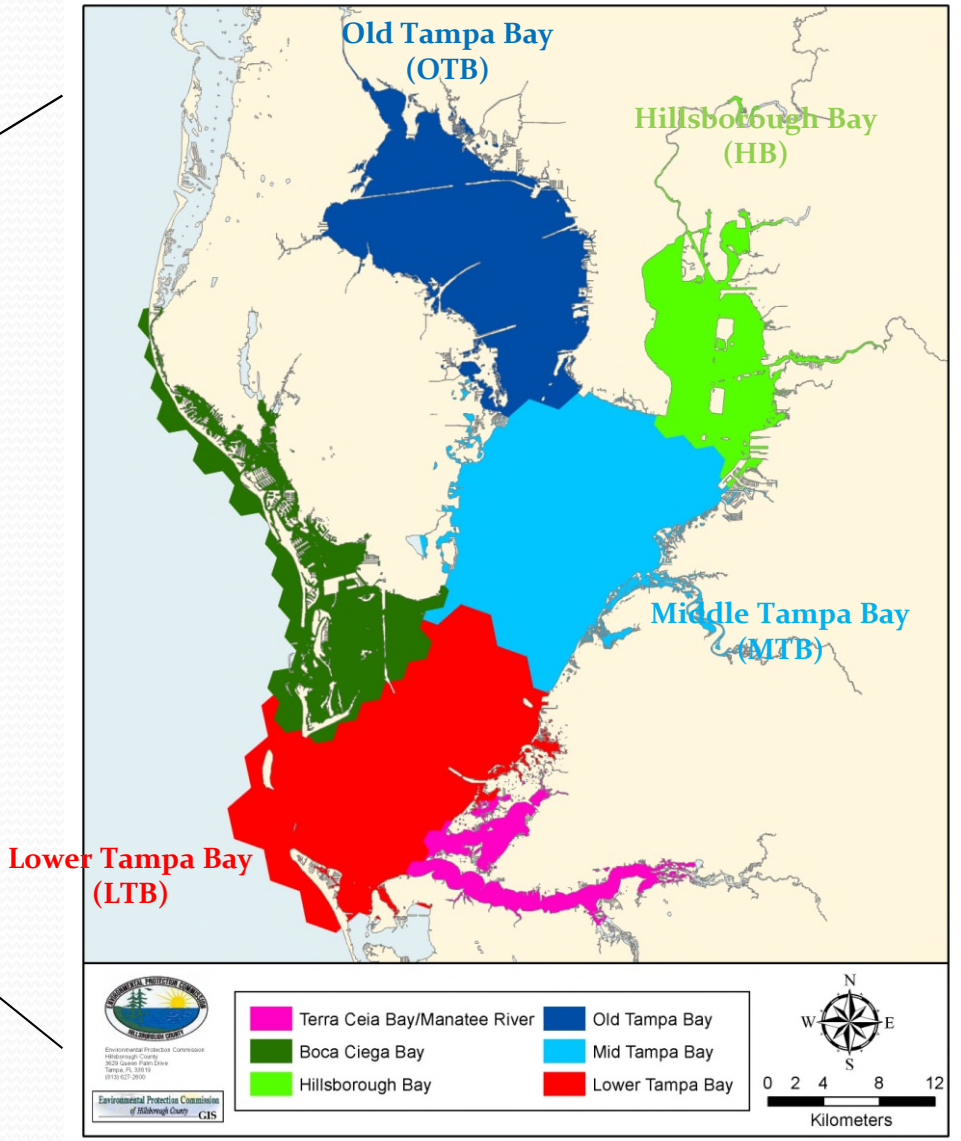
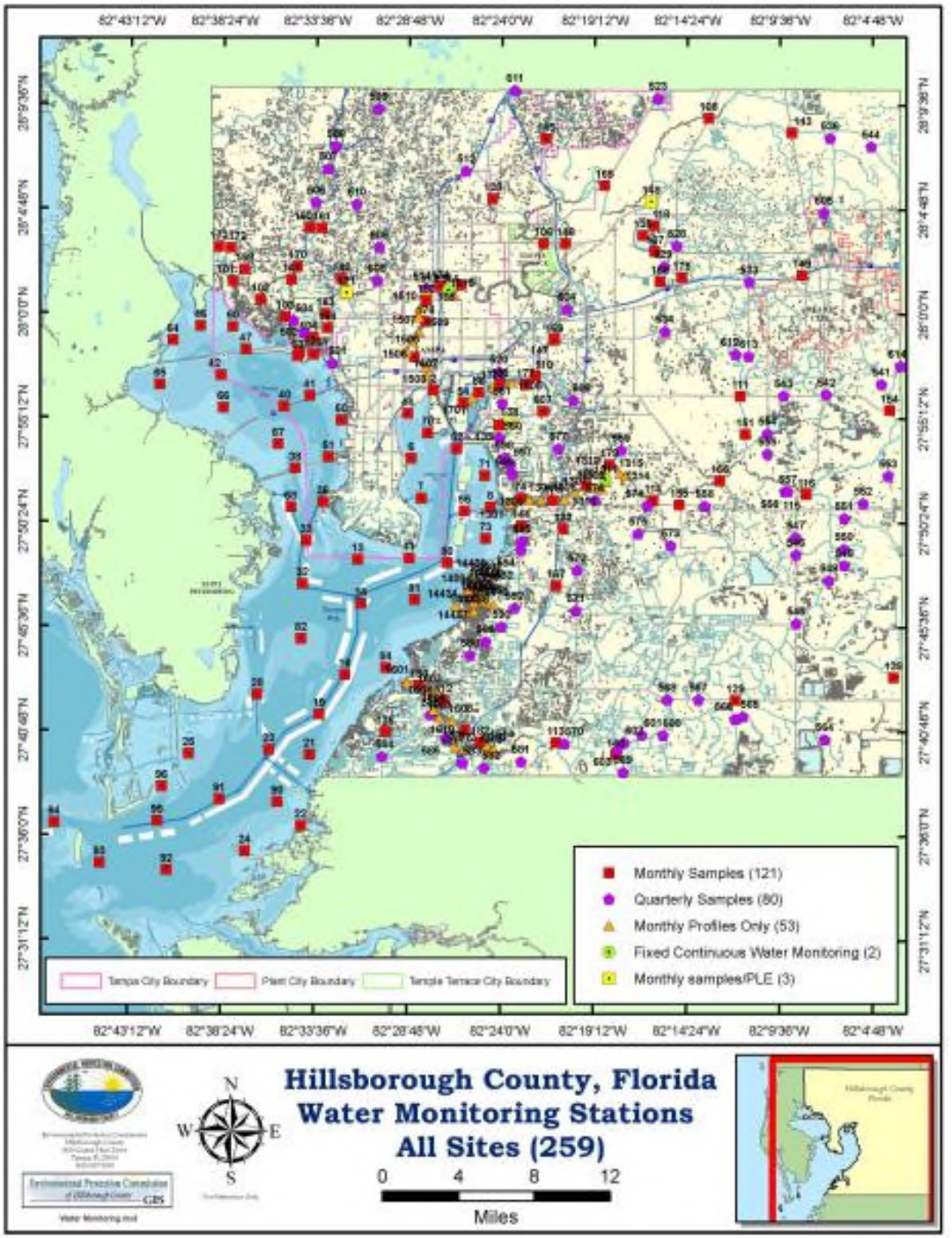


Surface area = 1,030 km²
Watershed = 5,700 km²
Population = 4.5 million

EPC Water Monitoring Network

- 259 Total Stations
  - 121 Monthly Stations
  - 80 Quarterly Stations
  - 53 Monthly Profile Stations
  - 2 Fixed Continuous Recorders
  - 3 Monthly PLE Stations
- >2500 Sampling Events / Year
- >120 Total Analytes



Surface Water Quality

2001-2010

Hillsborough County, Florida

Surface Water Quality

2001-2010

Hillsborough County, Florida

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Water Quality Metrics

- TBEP "Stop Light"
  - Chl a
  - Effective Light Penetration
- EPC 1984-1985 Water Quality Report (Boler 1987)
  - Water Quality Index formulated from 7 parameters:
    - %D.O. saturation; BOD; Chl a; TKN, TP; Total coliform; effective light penetration

2000	Green	Green	Yellow	Yellow
2001	Yellow	Green	Yellow	Yellow
2002	Yellow	Green	Green	Green
2003	Red	Yellow	Green	Yellow
2004	Red	Green	Green	Yellow
2005	Green	Green	Yellow	Yellow
2006	Green	Green	Green	Green
2007	Green	Green	Green	Green
2008	Yellow	Green	Green	Yellow
2009	Yellow	Yellow	Green	Green
2010	Green	Green	Green	Green
2011	Red	Green	Yellow	Green
2012	Green	Green	Green	Green
2013	Green	Green	Green	Green

Continuing water quality monitoring support provided by the EPCHC.

Consulting support provided by Janicki Environmental, Inc.

Janicki Environmental, Inc.

Chesapeake Bay: Bay Health Index

- Williams et al. 2009
- Composite Index
  - Biotic Index
    - Benthic Index
    - Plankton
    - SAV
  - Water Quality Index
    - Chl a
    - Secchi
    - Dissolved Oxygen
- Bay Report Card

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Development and evaluation of a spatially-explicit index of Chesapeake Bay health

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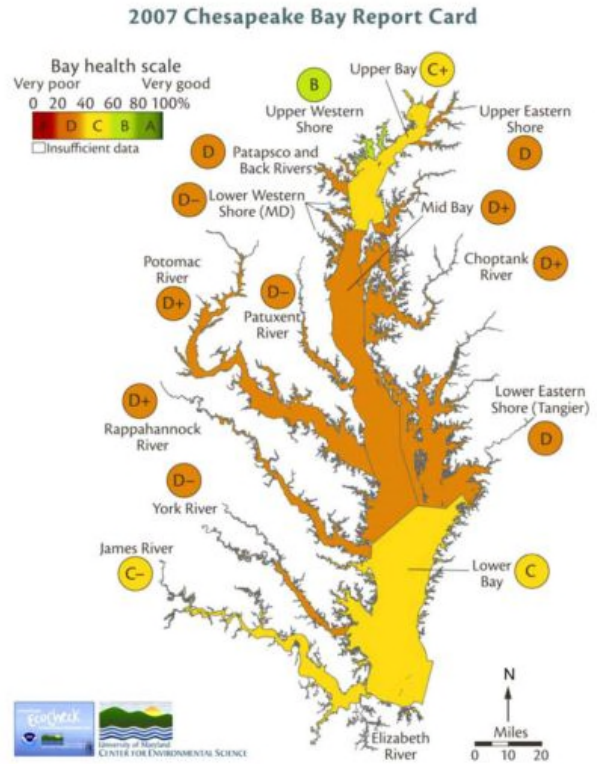


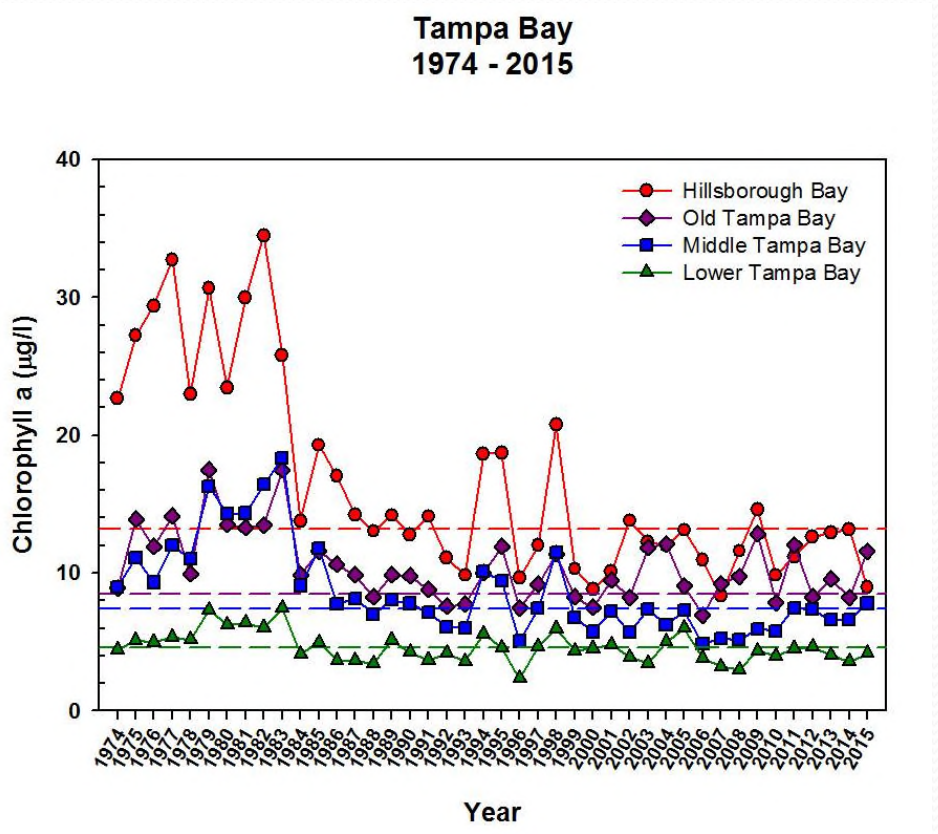
Fig. 7. Map of grades for each reporting region determined from BHI values (BHI values can be found in Table 4). This map was used in the 2007 Bay Health Report Card (www.eco-check.org). For the purposes of the report card, "Upper" and "Lower" represent Northern and Southern reaches of the bay, respectively; "MD" designates the state of Maryland for the Lower Western Shore reporting region, and "Tangier" designates Tangier Sound that is a part of the Lower Eastern Shore reporting region.

Proposed Tampa Bay WQI

- Based on 7 parameters: Chl a; TN; TP; Bottom D.O.; Fecal Coliform; Secchi depth; Turbidity
- Parameter targets
  - State criteria (Water Class specific)
  - TBEP targets (Bay segment specific)
  - Calculated targets (historical mean; regression analysis)
- Pass/Fail:
  - Meets target = 1
  - Does not meet target = 0

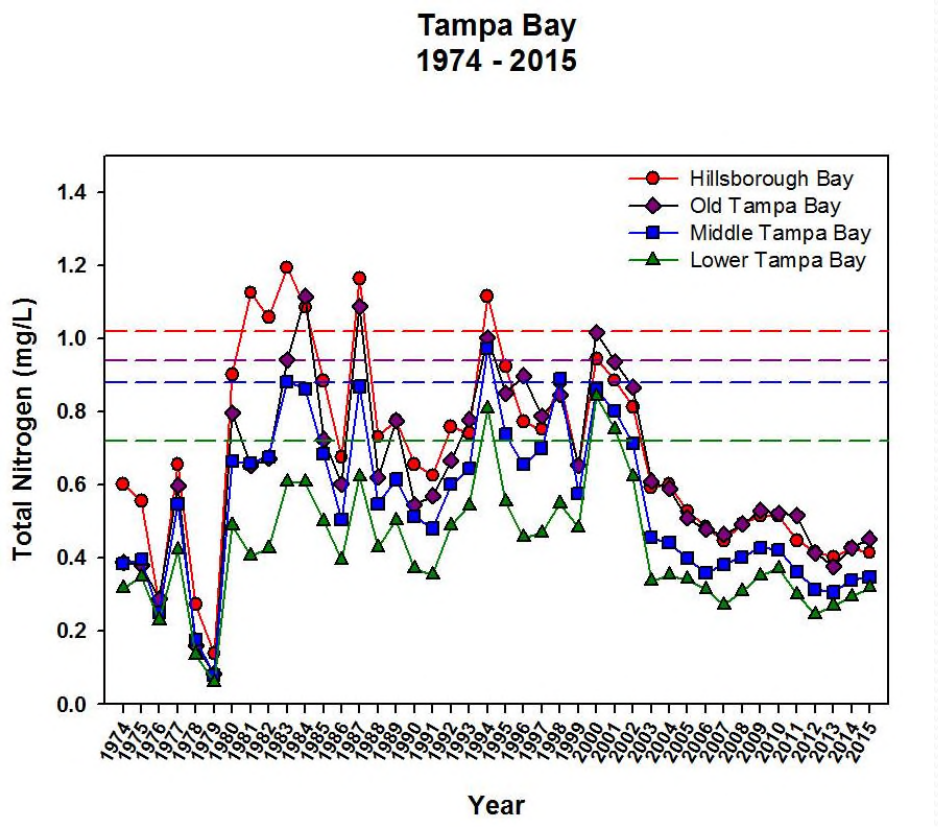
Chlorophyll a

- Tampa Bay
  - TBEP Segment Targets (Janicki et al. 2000)
    - HB = 13.2 µg/L
    - OTB = 8.5 µg/L
    - MTB = 7.4 µg/L
    - LTB = 4.6 µg/L
- Tributaries
  - Estuarine = Bay Targets
  - Freshwater = TSI (Paulic et al. 1996)
    - 20 µg/L
- > =Fail (0); < = Pass (1)



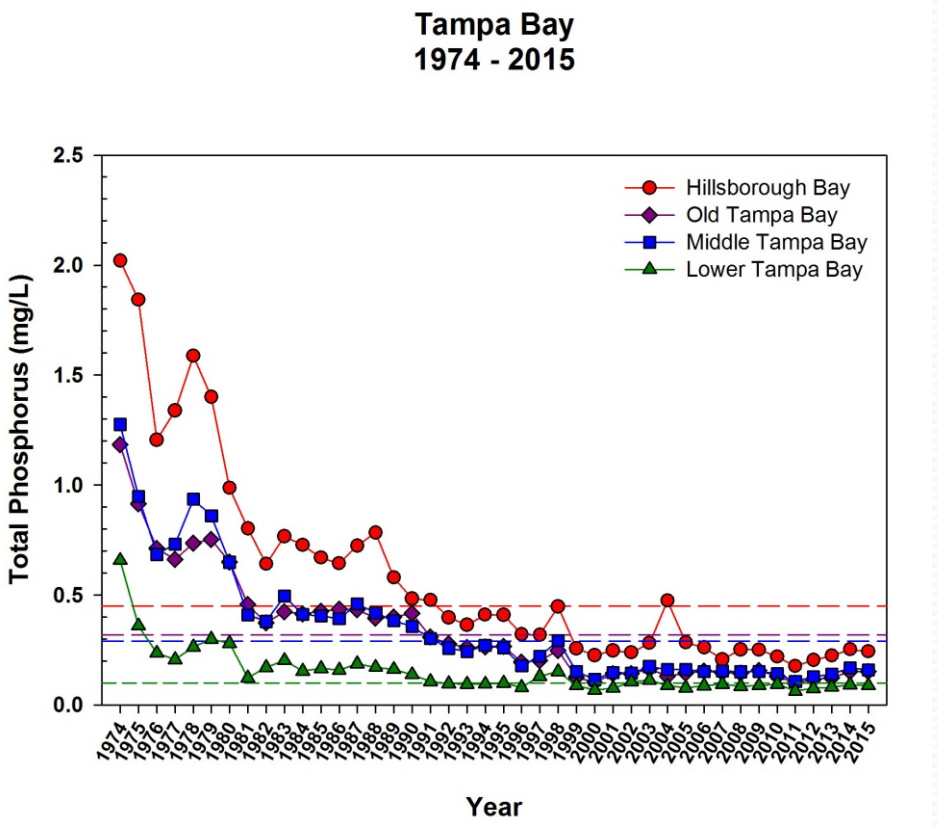
Total Nitrogen

- TBEP Proposed targets (Janicki Environmental 2010)
  - HB = 1.02 mg/L
  - OTB = 0.94 mg/L
  - MTB = 0.88 mg/L
  - LTB = 0.72 mg/L
- Freshwater = State NNC for West Central Florida (FDEP 2013)
  - 1.65 mg/L
- > =Fail (0); < = Pass (1)

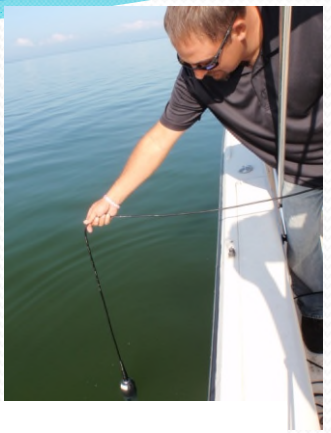


Total Phosphorus

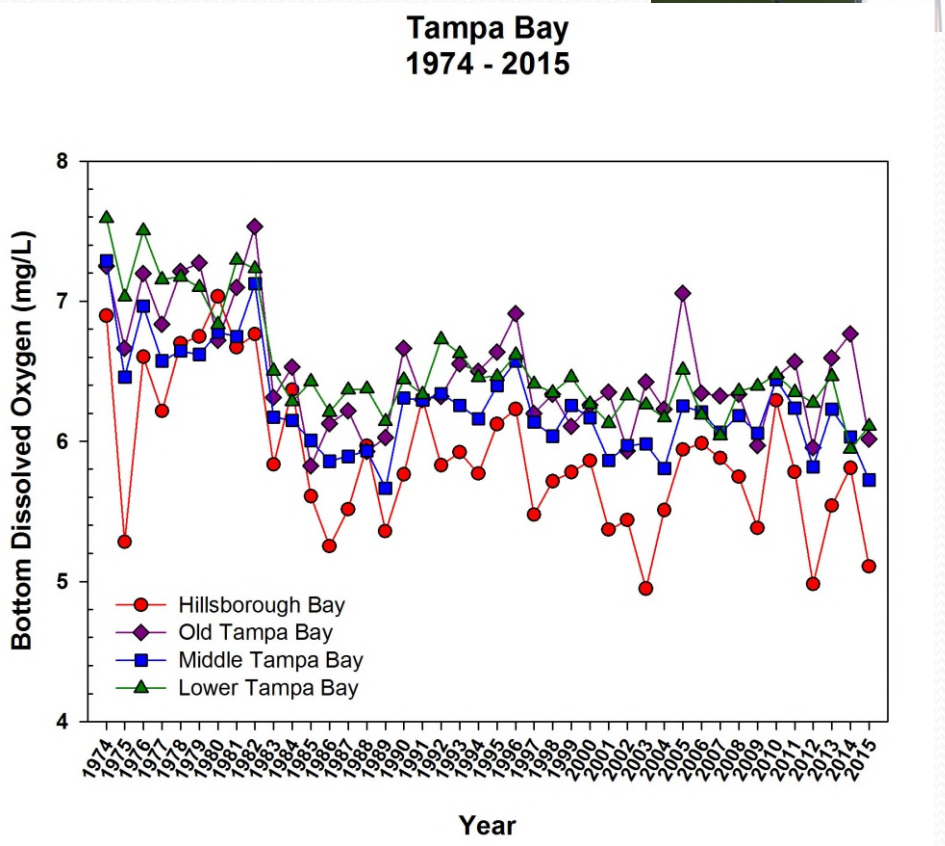
- TBEP Proposed targets (Janicki Environmental 2010)
  - HB = 0.45 mg/L
  - OTB = 0.32 mg/L
  - MTB = 0.29 mg/L
  - LTB = 0.10 mg/L
- Freshwater = State NNC for West Central Florida (FDEP 2013)
  - 0.49 mg/L
- > =Fail (0); < = Pass (1)



Bottom Dissolved Oxygen

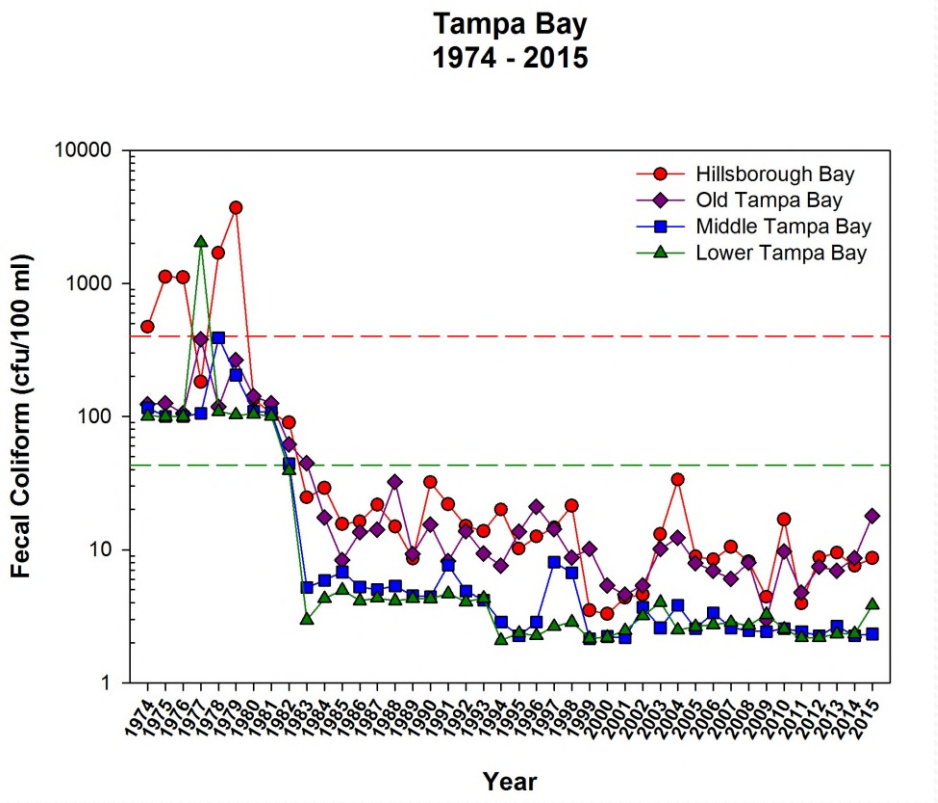


- State Criteria
  - Tampa Bay
    - 4 mg/L
  - Tributaries
    - Estuarine = 4 mg/L
    - Freshwater = 5 mg/L
- > =Pass (1); < = Fail (0)



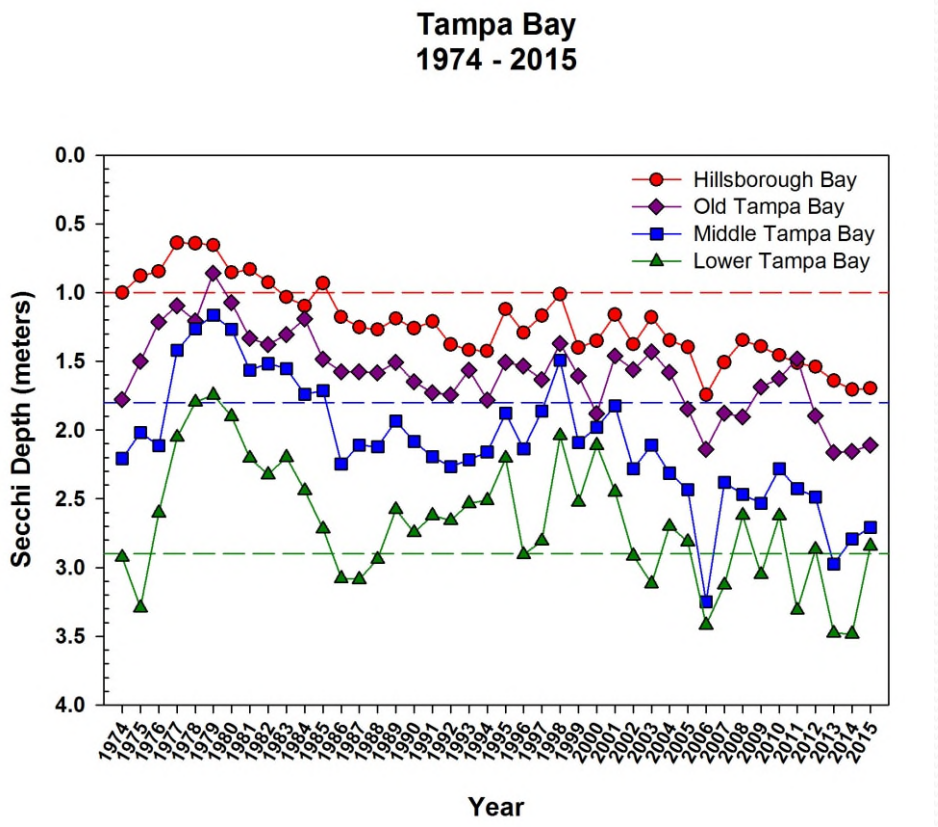
Fecal Coliform

- State Criteria
  - Class III: 400 cfu/100 ml
  - Class II: 43 cfu/100 ml
- > =Fail (0); < = Pass (1)



Effective Light Penetration (Secchi depth)

- TBEP Bay Targets (Janicki et al. 2000)
  - HB = 1.0 meter
  - OTB = 1.8 meters
  - MTB = 1.8 meters
  - LTB = 2.9 meters
- Freshwater
  - Historical avg. 1974-2012
  - 0.77 meters
- > =Pass (1); < = Fail (0)
- Secchi > bottom = 1

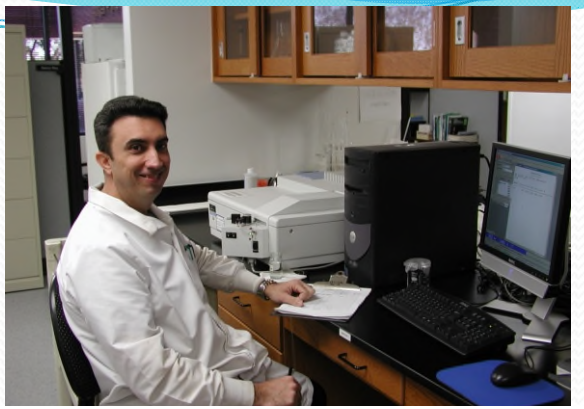


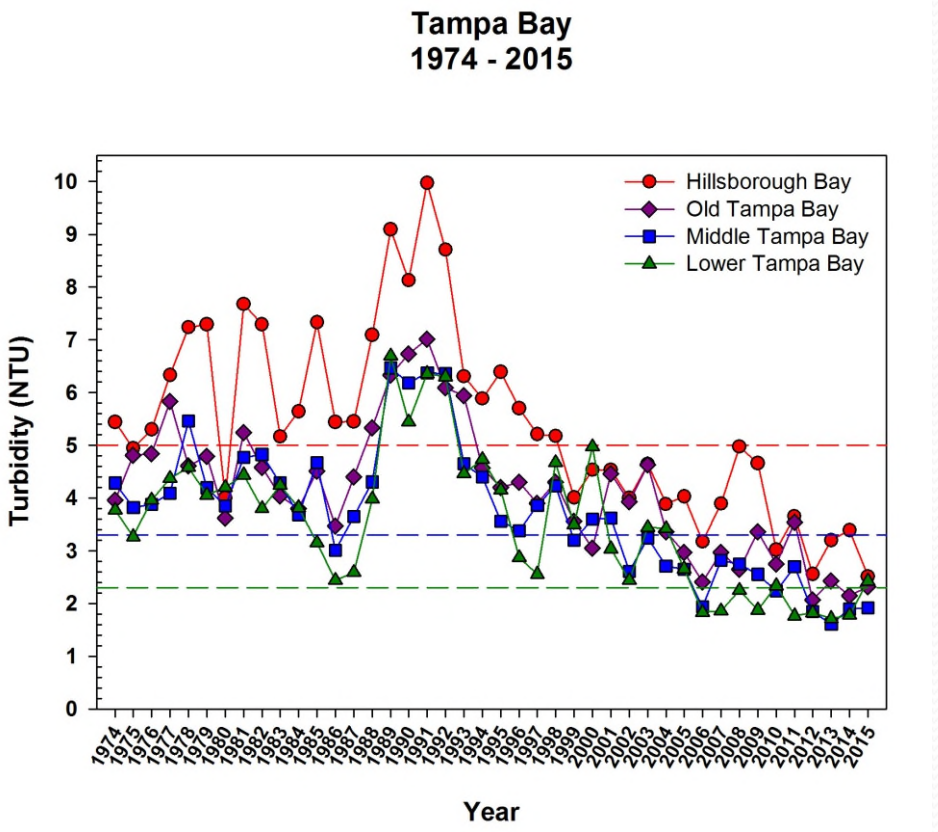
Turbidity

- Calculated from Secchi depth targets
- Power function:

NTU = 5.0941(secchi)$^{-0.736}$

- Turbidity Targets:
  - HB = 5.0 NTU
  - OTB & MTB = 3.3 NTU
  - LTB = 2.3 NTU
  - Freshwater = 6.2 NTU
- > =Fail (0); < = Pass (1)

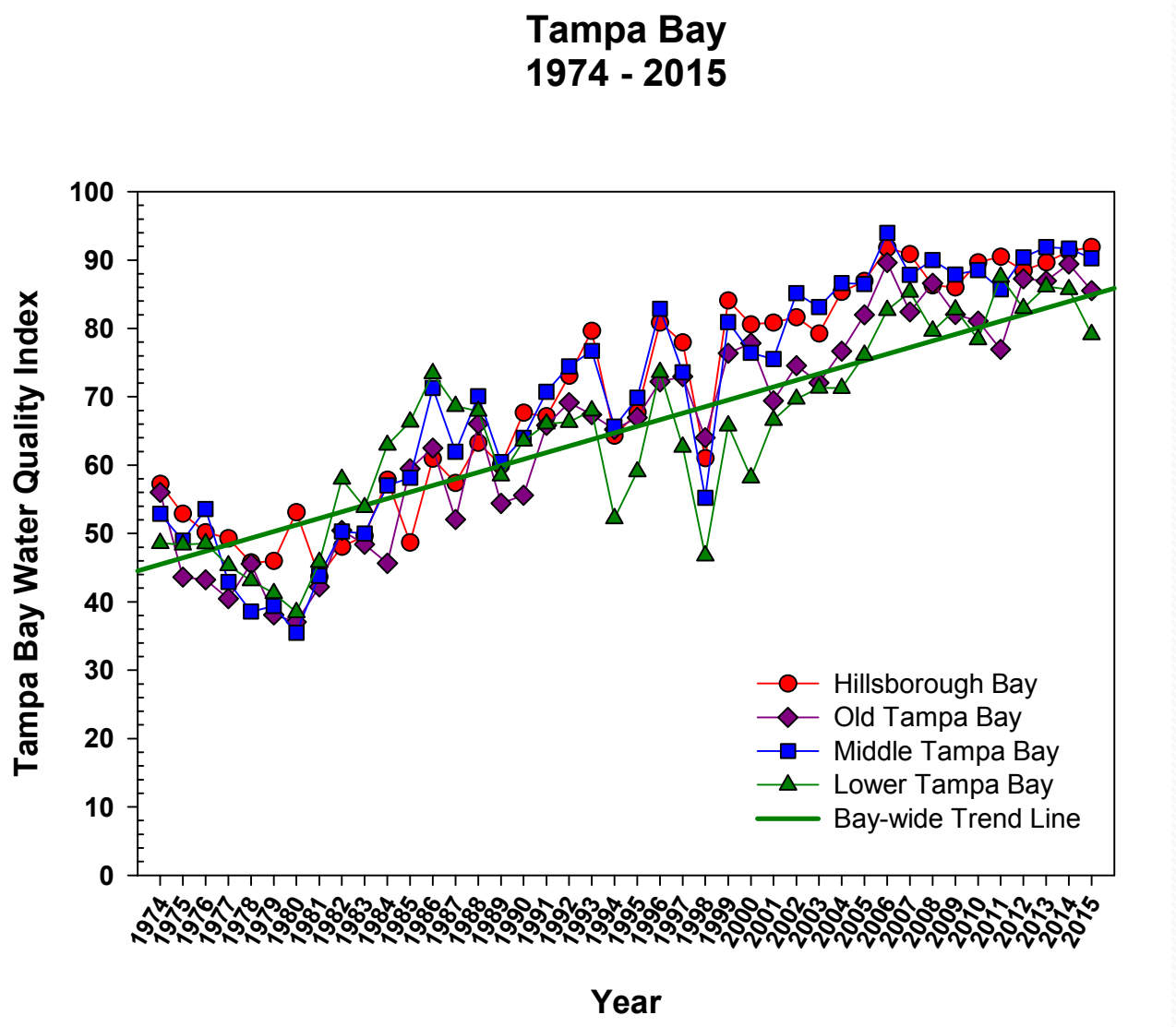


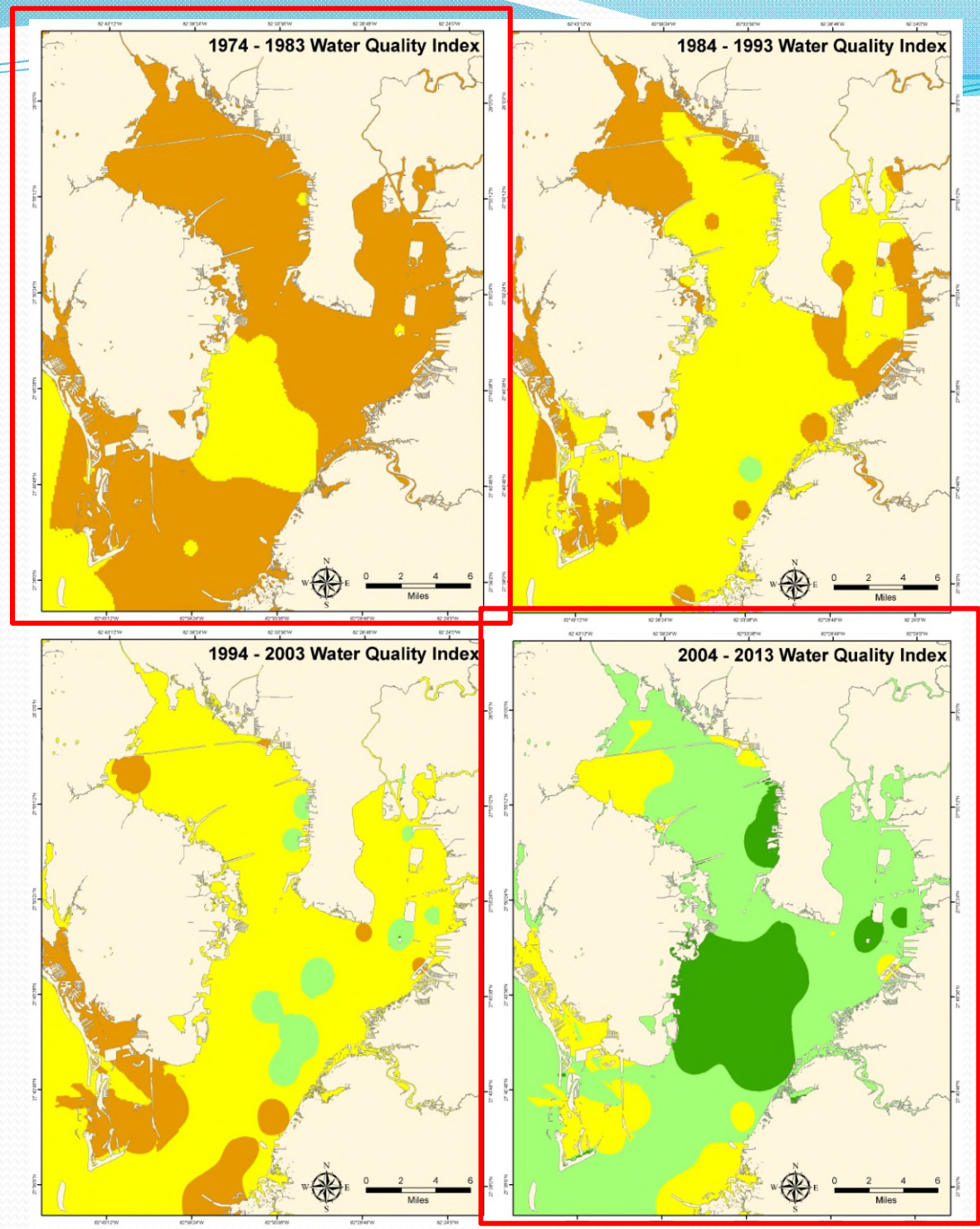


WQI Calculation

- WQI = (mean of the 7 parameters) x 100
  - Sample WQIs averaged by location and/or time period
- Final Scale 0 – 100
- WQI Report Card:
  - **A: WQI = 90 – 100**
  - **B: WQI = 80 – 90**
  - **C: WQI = 60 – 80**
  - **D: WQI = 30 – 60**
  - **F: WQI <30**

WQI Trends (Bay sites)




1974 - 1983 Water Quality Index
1984 - 1993 Water Quality Index
1994 - 2003 Water Quality Index
2004 - 2013 Water Quality Index
N
W
E
S
0 2 4 6
Miles

Bay Segment Report Card

Year	HB	OTB	MTB	LTB	Bay Wide	Grade
1974	54.06	45.76	48.33	46.29	48.34	D
1975	52.86	43.60	48.95	48.36	47.76	D
1976	50.16	43.22	53.57	48.54	48.26	D
1977	48.99	40.48	42.91	45.31	43.92	D
1978	45.71	45.55	38.46	43.10	43.36	D
1979	45.95	38.07	39.38	41.23	40.66	D
1980	53.10	37.04	35.43	38.46	40.18	D
1981	43.63	42.18	43.82	45.78	43.65	D
1982	48.05	50.45	50.27	57.95	51.58	D
1983	48.68	48.41	50.00	53.82	50.04	D
1984	57.86	45.62	57.14	62.93	54.64	D
1985	48.67	59.44	58.13	66.34	58.49	D
1986	60.93	62.48	71.26	73.41	66.67	C
1987	57.38	52.05	62.00	68.61	59.15	D
1988	63.23	66.01	70.07	67.89	66.85	C
1989	60.00	54.39	60.42	58.45	57.85	D
1990	67.64	55.56	63.97	63.54	61.74	C
1991	67.14	65.81	70.72	66.03	67.31	C
1992	73.06	69.16	74.43	66.28	70.57	C
1993	79.62	67.36	76.70	67.95	72.18	C
1994	64.88	64.41	64.83	59.83	63.84	C
1995	66.29	66.18	68.48	59.20	65.64	C
1996	78.55	70.51	78.57	75.47	74.86	C
1997	77.82	71.23	73.49	72.03	73.52	C
1998	60.37	64.06	54.91	52.06	59.48	D
1999	83.42	77.83	82.44	65.87	78.08	C
2000	80.60	77.85	76.43	58.61	73.99	C
2001	80.83	69.40	75.50	66.59	72.54	C
2002	81.47	74.43	85.12	69.68	77.36	C
2003	79.24	72.04	83.23	70.18	75.73	C
2004	85.32	76.64	86.61	71.23	79.36	C
2005	86.90	81.86	86.51	76.09	82.57	B
2006	91.79	89.62	93.95	82.64	89.42	B
2007	90.83	82.40	87.85	85.33	85.95	B
2008	86.31	86.57	89.98	79.62	85.71	B
2009	85.97	82.01	87.88	82.74	84.29	B
2010	89.56	81.08	88.49	78.37	83.79	B
2011	90.48	76.92	86.02	87.53	84.05	B
2012	88.45	87.24	90.38	82.94	87.20	B
2013	89.64	86.97	91.87	86.11	88.42	B
2014	91.27	89.42	91.67	85.71	89.44	B
2015	91.90	85.52	90.24	79.10	86.37	B

Summary

- Water Quality Index
  - Still in “beta test phase”
    - We welcome feedback for improvement
  - Simple calculations
  - Easily interpretable measure of water quality trends
  - Specific to Tampa Bay water quality targets
  - Easily adaptable to other regions or other parameters

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- Laboratory Staff: Samantha White, Dawn Jaspard, Kevin McCarthy, Diana Mesa , Noel Mesa, Shanin Shapiro, Amanda Weronik, Lukasz Talalaj, Alesia Voss
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Thank you

Questions?

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