OPEN SCIENCE IN TAMPA BAY: BRINGING WATER QUALITY (*AND OTHER DATA*) TO THE MASSES

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FLORIDA STORMWATER ASSOCIATION

DECEMBER 6, 2019

TBEP TAMPA BAY ESTUARY PROGRAM PARTNERSHIP FOR A HEALTHY BAY

PARTNERS!

https://twitter.com/allison_horst

Janicki Environmental
- Mike Wessel
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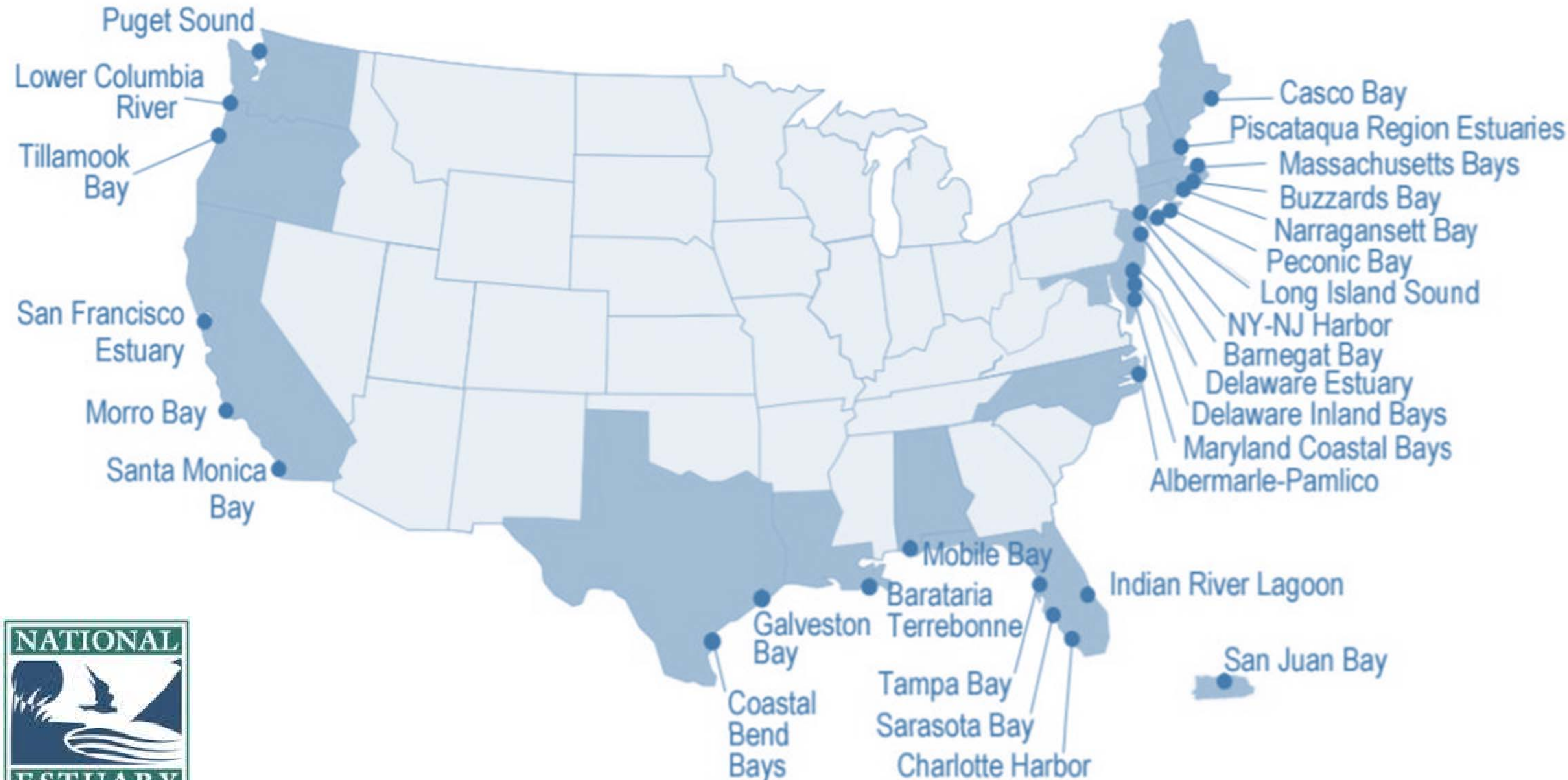
EcoQuants
- Ben Best

US EPA
- Mike McManus

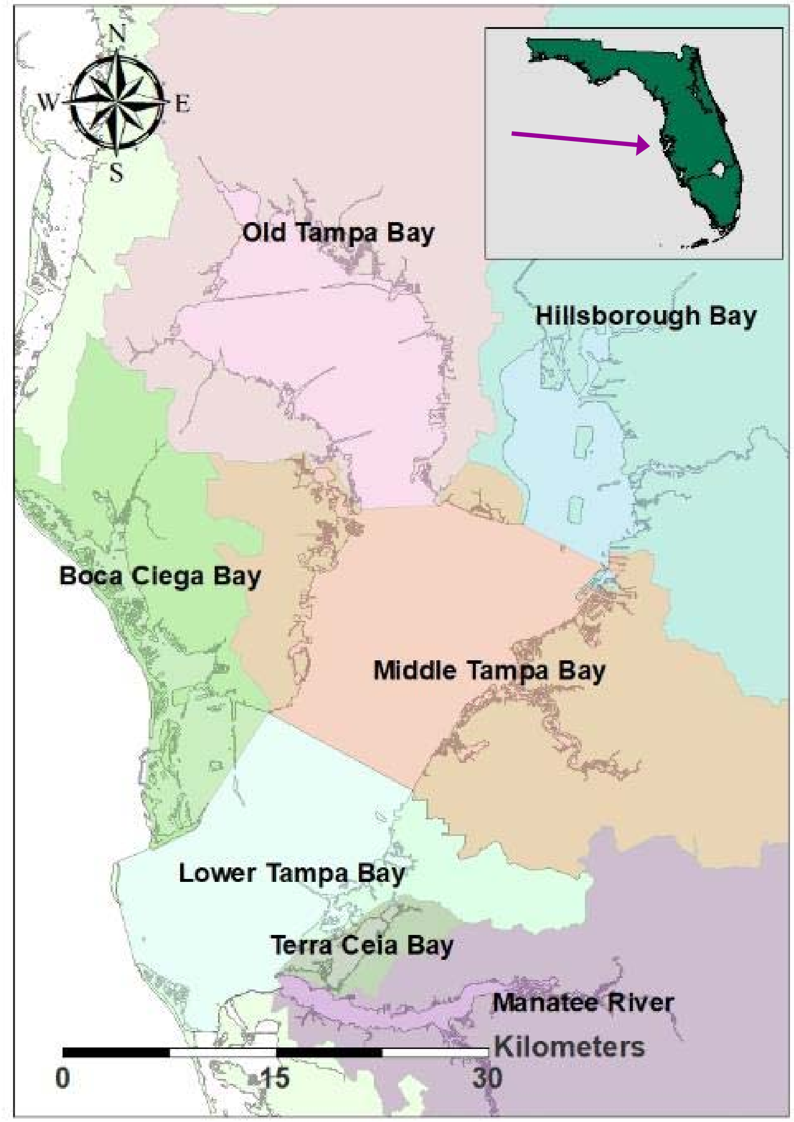
Tampa Bay Estuary Program
- Ed Sherwood
- Marcus Beck
- Maya Burke

OVERVIEW

- Tampa Bay Estuary Program
- Open Science Philosophy
- Seagrass-Water Quality Paradigm
- Water Quality Tool
- Workshop
- Future Steps



NATIONAL ESTUARY PROGRAM


N
S
W
E
Old Tampa Bay
Hillsborough Bay
Boca Ciega Bay
Middle Tampa Bay
Lower Tampa Bay
Terra Ceia Bay
Manatee River
Kilometers
0
15
30

TAMPA BAY WATERSHED

SIZE:

- **TAMPA BAY PROPER:** 400 SQUARE MILES
- **TAMPA BAY WATERSHED:** 2,200 SQUARE MILES

AVERAGE DEPTH: 11 FEET

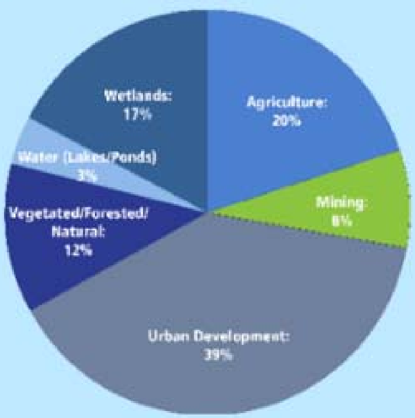
MAXIMUM DEPTH: 43 FEET (MAIN SHIPPING CHANNEL)

SALINITY RANGE: >20–35 PPT IN BAY PROPER; <1–25 PPT IN TIDAL TRIBUTARIES

POPULATION IN WATERSHED: 2.7 MILLION (2010 CENSUS)

MAJOR TRIBUTARIES: HILLSBOROUGH, ALAFIA, LITTLE MANATEE AND MANATEE RIVERS

Land Use in the Watershed



Tampa Bay Estuary Program Study Area.

A HISTORY OF TAMPA BAY

KEY MILESTONES IN THE RESTORATION OF TAMPA BAY, 1950–2016.

Courtesy Florida State Archives

1950s
Population less than ¼ of today.

1960s
Bay degradation is recognized.

Image credit JOR Johansson

1967
Environmental Protection Commission of Hillsborough County established.

1970s
Save Our Bays and other citizen groups call for legislative action to reduce pollution discharges.

1972
EPA Clean Water Act approved.

1972
Florida legislation- Wilson-Grizzle Act requires wastewater plants discharging to Tampa Bay to upgrade to Advanced Wastewater Treatment standards, or enact 100% reclaimed.

SWFWMD photo

1974
EPCHC initiates baywide water quality monitoring program.

1979
City of Tampa's Howard F. Curren WWTP achieves AWT standard, reduces nitrogen loadings by 90%. City of St Petersburg implements 100% reclaimed water from their direct discharge, with similar reductions. Other WWTPs in the region implement nutrient reductions.

1982
Statewide Stormwater Rule is enacted, requiring nutrient management from municipal stormwater systems.

1982
The first Bay Area Science Information Symposium (BASIS) is conducted by the Tampa Bay Regional Planning Council.

1985
The Tampa Bay Regional Planning Council convenes the region to develop the Future of Tampa Bay report, including specific actions to reduce pollution and recover habitats in Tampa Bay. The Agency on Bay Management is established to support the report's recommendations.

1987
The State's Water Management Districts establish Surface Water Implementation and Management (SWIM) programs to restore and protect priority water bodies within each District. Tampa Bay is identified as the Southwest Florida Water Management District's priority water body.

1991
Tampa Bay is recognized by EPA as an "estuary of national significance," and the Tampa Bay National Estuary Program is approved. TBNEP's primary mission is to develop a Comprehensive Conservation and Management Plan.

1996
TBNEP's CCMP is approved by local partners, the Governor, and the EPA Administrator. Numeric goals for habitat restoration and water quality improvement are adopted.

1996
The public/private Tampa Bay Nitrogen Management Consortium (TBNMC) is formed to assist in meeting nitrogen management targets needed to meet seagrass goals.

1998
The TBNMC develops an Action Plan (Partnership for Progress) to meet nutrient management targets.

1998
An Interlocal Agreement between the TBNEP partners forms a new Independent Special District of the State of Florida, the Tampa Bay Estuary Program. TBEP partners commit to implementing projects to assist in meeting numeric goals, and to support a funding schedule.

2006
First year that all bay segments achieve TBEP water quality targets.

2009
TBNMC develops voluntary nutrient loading limits for all sources, to continue to meet water quality targets. Federal and state regulatory agencies adopt limits to meet regulatory requirements.

2014
Tampa Bay surpasses seagrass recovery goal of 38,000 acres.

2016
Surveys show continued seagrass increases, to 41,655 acres.


WATER AND SEDIMENT QUALITY
BAY HABITATS
FISH AND WILDLIFE
PUBLIC EDUCATION AND INVOLVEMENT
INVASIVE SPECIES
PUBLIC ACCESS
LOCAL IMPLEMENTATION
CLIMATE CHANGE
SPILL PREVENTION AND RESPONSE
DREDGING AND DREDGE MATERIAL MANAGEMENT

Why Open Science?

Scientist: My 500 page report will answer all your questions!

Manager: This 500 page report does not answer any of my questions!

Courtesy of the Integration and Application Network, University of Maryland Center for Environmental Science (ian.umces.edu/symbols/).

OPEN SCIENCE OVERVIEW

- Open data
- Open process
- Open products

Open Knowledge International,
http://opendefinition.org/,
https://creativecommons.org

MY AHA MOMENT!

Share data and analytical tools

EXISTING BARRIERS

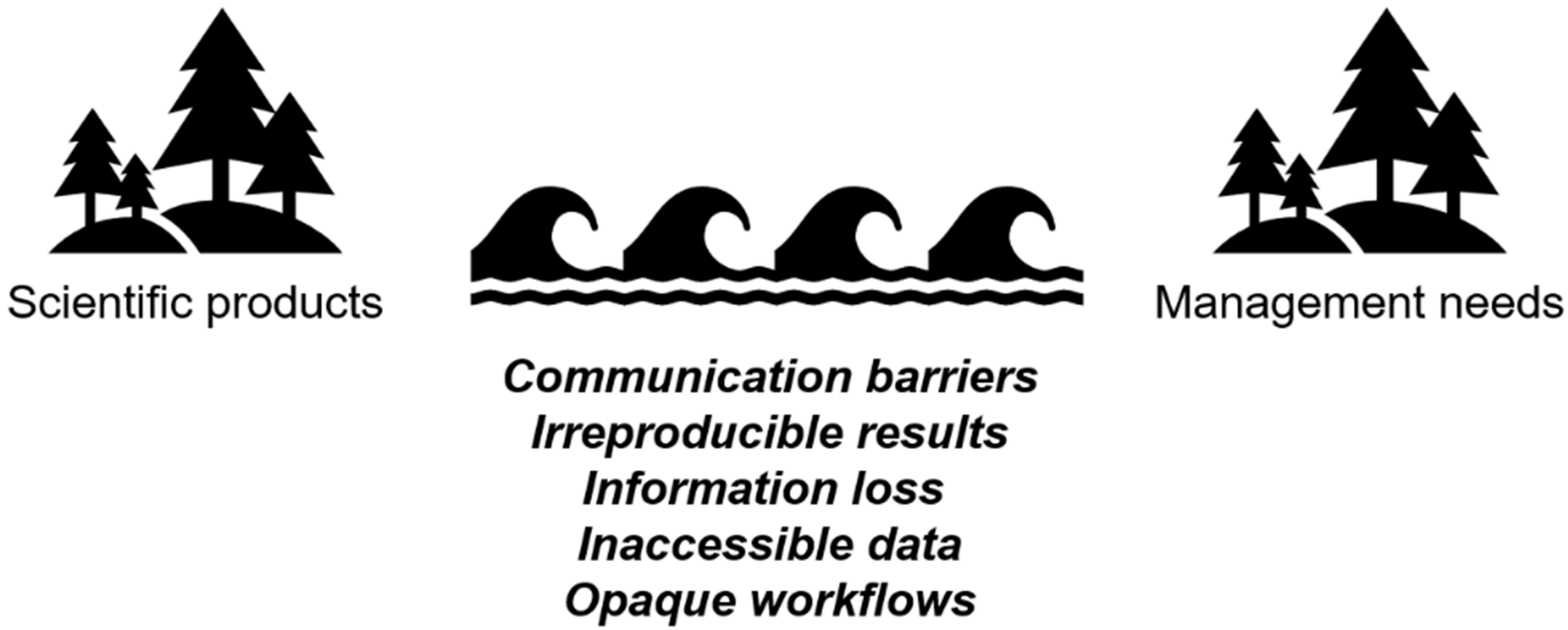


Image courtesy M. Beck, TBEP

BRIDGING THE DIFFERENCES

Open Science can bridge the research-management divide!

Image courtesy M. Beck, TBEP

TBEP and its partners can:

- ***Automated reporting*** of CCMP indicators
- Made available through TBEP website – keeping entire workflow ***transparent*** and ***accessible***
- Lower barriers to inclusion to make ***better science*** in ***less time***

The open science cake

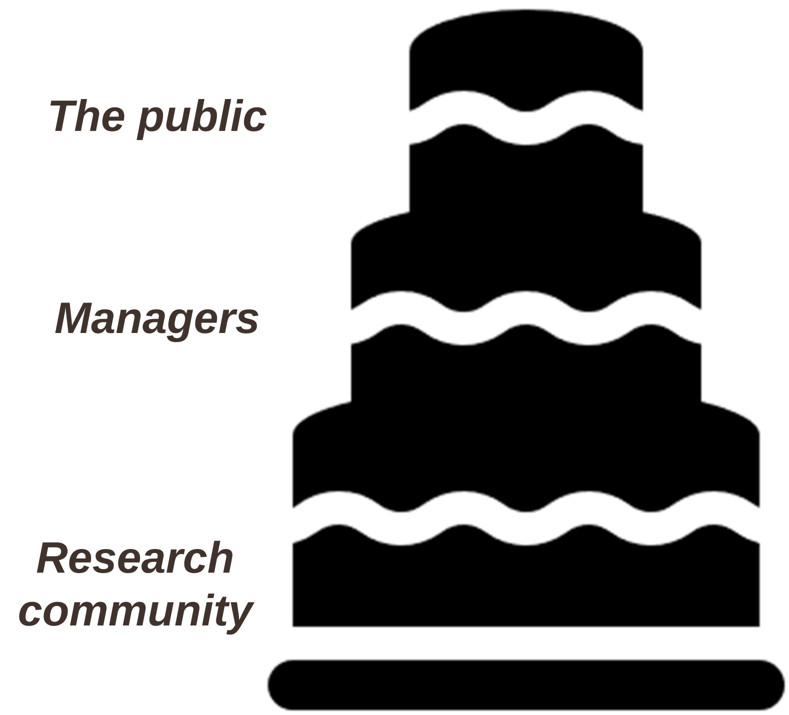
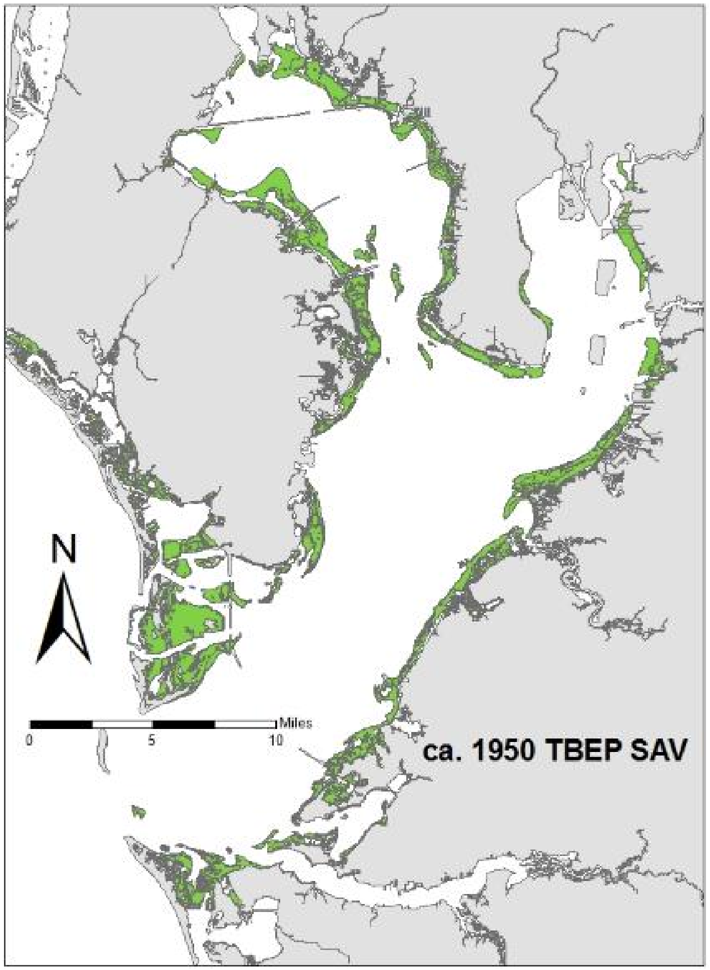


Image courtesy M. Beck, TBEP

KEY INDICATOR - SEAGRASS

- Habitat and economic value
- Straightforward indicator for public, managers, and researchers
- Science-based numeric goals & targets
- Long-term monitoring
- Adaptive management – Ongoing assessment & adjustment

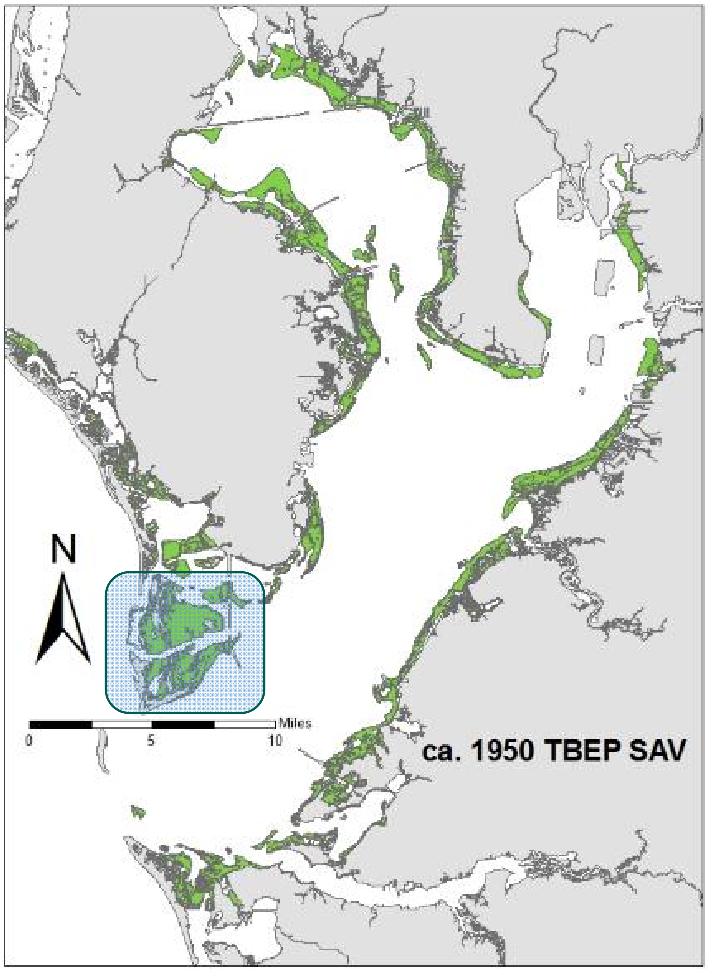
Setting Seagrass Restoration Goals – ca. 1950



Approximately 40,400 acres, however…

TBEP
TAMPA BAY ESTUARY PROGRAM
PARTNERSHIP FOR A HEALTHY BAY

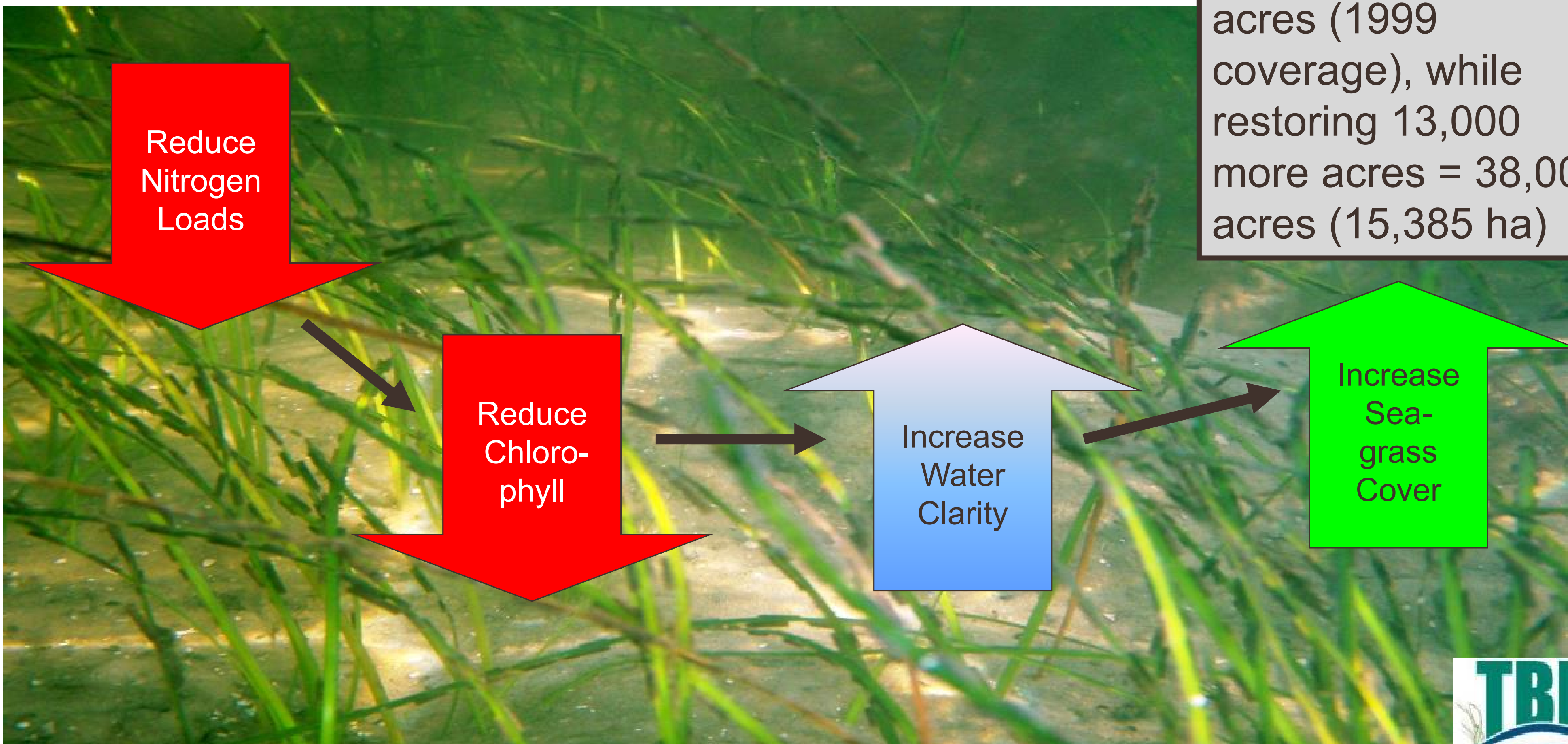
Setting Seagrass Goals – Dredge and Fill



Adjusted From 40,400 to 38,000 acres

NITROGEN MANAGEMENT PARADIGM

Seagrass Goal: Preserve 25,000 acres (1999 coverage), while restoring 13,000 more acres = 38,000 acres (15,385 ha)



What can TBEP do with open science?

Tampa Bay Estuary Program
Technical Report #04-00

Estuary Program

DEVELOPING AND ESTABLISHING A PROCESS TO TRACK THE STATUS OF CHLOROPHYLL-a CONCENTRATIONS AND LIGHT ATTENUATION TO SUPPORT SEAGRASS GOALS IN TAMPA BAY

FINAL REPORTS

December 1999 and October 2000

Tampa Bay National Estuary Program
Technical Publication #06-96

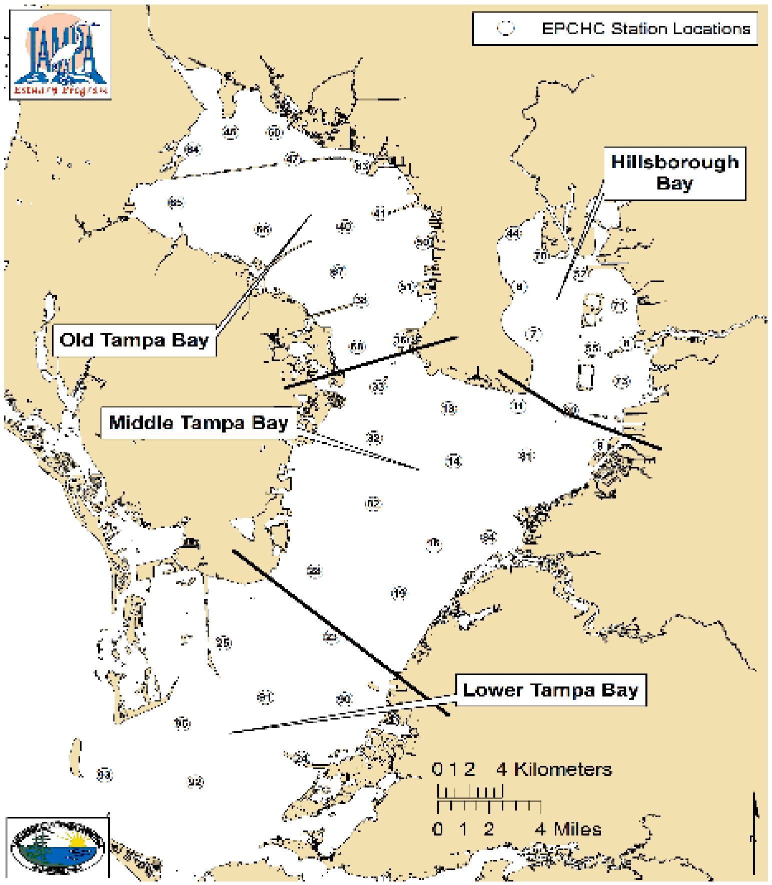
National Estuary Program

ESTIMATING CRITICAL EXTERNAL NITROGEN LOADS FOR THE TAMPA BAY ESTUARY: AN EMPIRICALLY BASED APPROACH TO SETTING MANAGEMENT TARGETS

FINAL REPORT

NOVEMBER 1996

WATER QUALITY ASSESSMENT



- Rely on long-term ambient water quality stations sampled by EPCHC
- 45 fixed stations have been monitored since 1974
- Annual averages developed from chlorophyll-a & secchi disk depth measurements

Tampa Bay Nitrogen Management Consortium

- Formed in 1998, now includes 40+ public/private partners
- Members include TBEP government and regulatory agency participants, local phosphate companies, agricultural interests and electric utilities
- Mid-1990s, collectively accepted responsibility for meeting nitrogen load reduction goals
- Consortium members may choose to implement any combination of projects to maintain loads to Tampa Bay at 1992-1994 levels

Public Partners:
- Hillsborough County
- Manatee County
- Pinellas County
- Pasco County
- Polk County
- Sarasota County
- City of Tampa
- City of St. Petersburg
- City of Clearwater
- City of Palmetto
- City of Bradenton
- City of Largo
- City of Lakeland
- City of Oldsmar
- City of Gulfport
- City of Mulberry
- City of Plant City
- City of Safety Harbor
- SWFWMD
- US EPA
- FDEP
- FDACS
- FDOH
- FDOT
- MacDill AFB
- TBRPC
- Tampa Bay Water
- Tampa Port Authority
- EPC of Hillsborough County
- AEDC of Hills. County

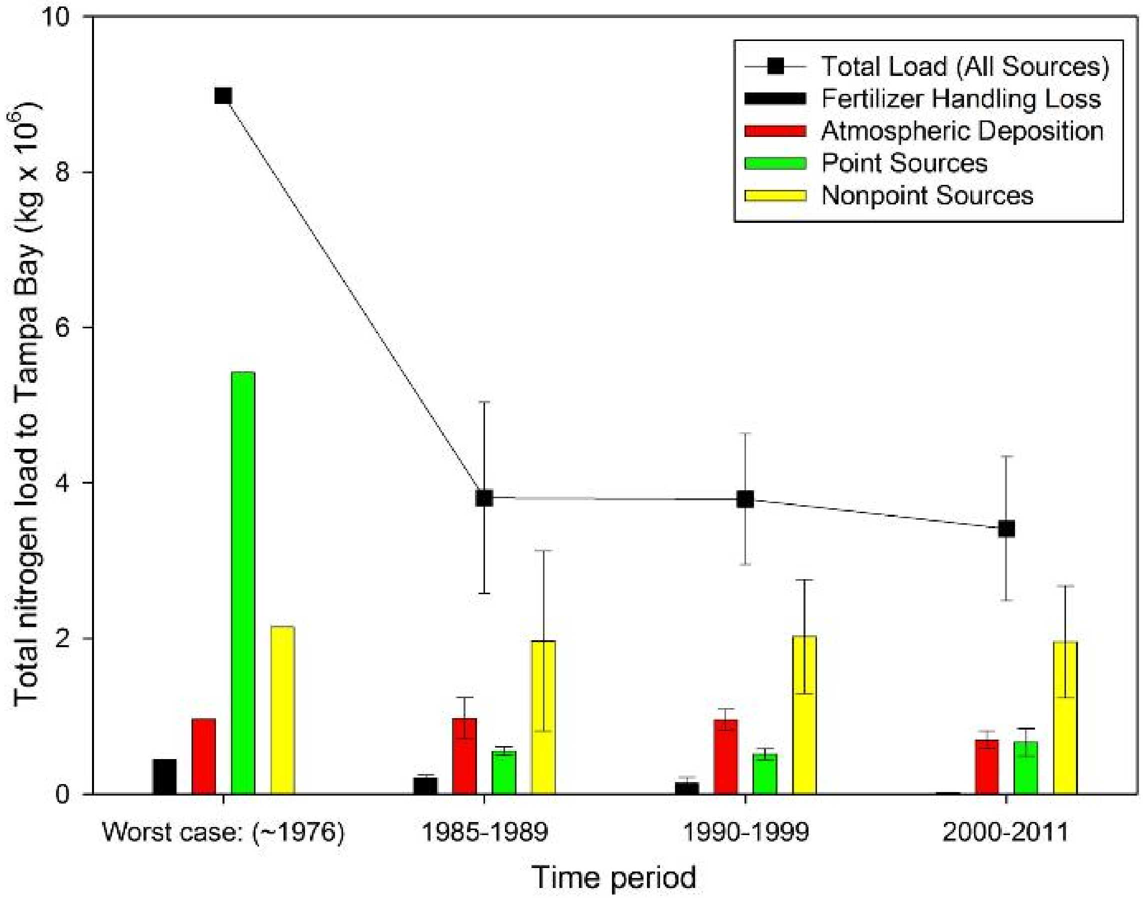
Private Partners:
- Eastern Terminals
- Mosaic
- CSX Transportation
- Florida Power & Light
- CF Industries
- Tampa Electric Co.
- Kinder Morgan Bulk T., Inc.
- Progress Energy
- Tropicana Products, Inc.
- Kerry I&F
- Trademark Nitrogen
- Yara N.A.
- Alafiia Preserve, LLC
- Eagle Ridge, LLC
- LDC Donaldson Knoll Investments, LLC

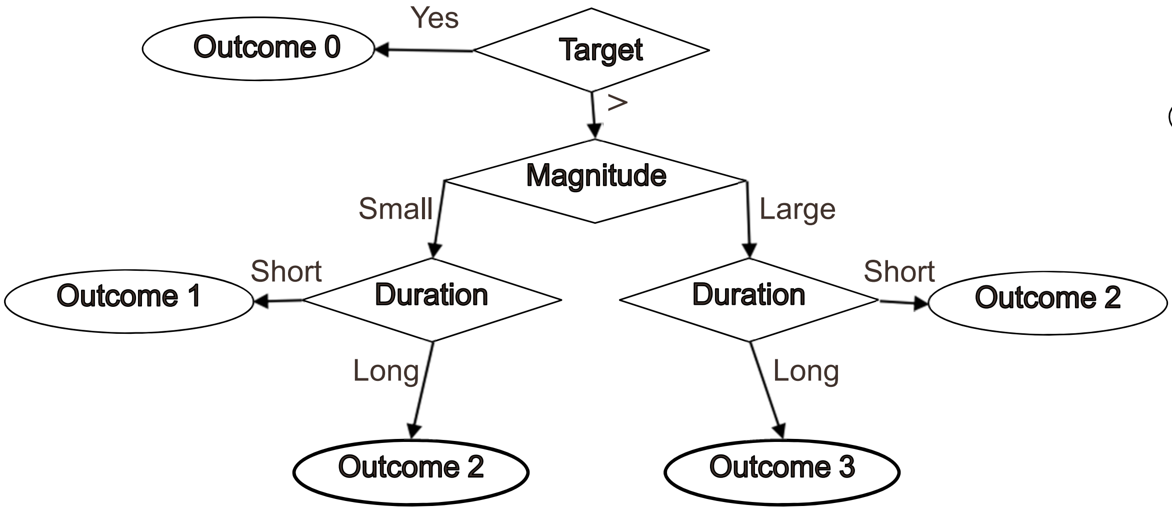
Site Specific Thresholds for Chlorophyll-a

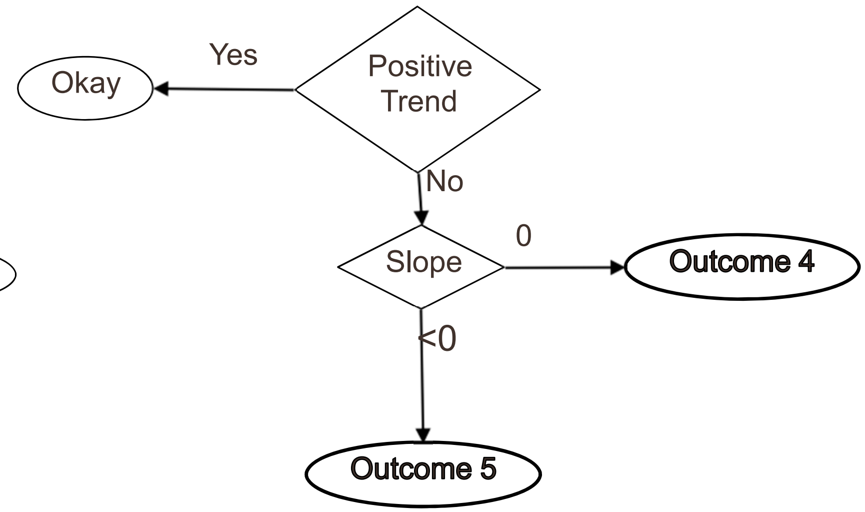
- Hillsborough Bay: 15.0 ug/L
- Old Tampa Bay: 9.3 ug/L
- Middle Tampa Bay: 8.5 ug/L
- Lower Tampa Bay: 5.1 ug/L

Nitrogen Management Goal:
“Hold the line” on nitrogen loading at 1992-1994 average level. To compensate for expected increase in load with population growth, reduce or preclude an additional 17 tons per year.

Reducing TN Loads to Tampa Bay







CHLOROPHYLL CONCENTRATION DECISION TREE

SEAGRASS ACREAGE DECISION TREE

MANAGEMENT ACTION CATEGORIES

Decision matrix identifying appropriate categories of management actions in response to various outcomes of the monitoring and assessment of chlorophyll-*a* and light attenuation data.

CHLOROPHYLL ॐ	LIGHT ATTENUATION			
	Outcome 0	Outcome 1	Outcome 2	Outcome 3
Outcome 0	*GREEN*	*YELLOW*	*YELLOW*	*YELLOW*
Outcome 1	*YELLOW*	*YELLOW*	*YELLOW*	*RED*
Outcome 2	*YELLOW*	*YELLOW*	*RED*	*RED*
Outcome 3	*YELLOW*	*RED*	*RED*	*RED*

"Stay the course"; partners continue with planned projects to implement the CCMP. Data summary and reporting via the Baywide Environmental Monitoring Report and annual assessment and progress reports.

TAC and Management Board on caution alert; review monitoring data and loading estimates; attempt to identify causes of target exceedences; TAC report to Management Board on findings and recommended responses if needed.

TAC, Management and Policy Boards on alert; review and report by TAC to Management Board on recommended types of responses. Management and Policy Boards take appropriate actions to get the program back on track.

Water Quality Has Improved

Bay Segment	Chlorophyll-a (ug/L)	
	2016 Average	**FDEP RA Thresholds**
Old Tampa Bay	9.0	9.3
Hillsborough Bay	11.4	15.0
Middle Tampa Bay	5.7	8.5
Lower Tampa Bay	3.0	5.1

AWT & Reuse Standards Implemented

Stormwater Regulations Enacted

85/86

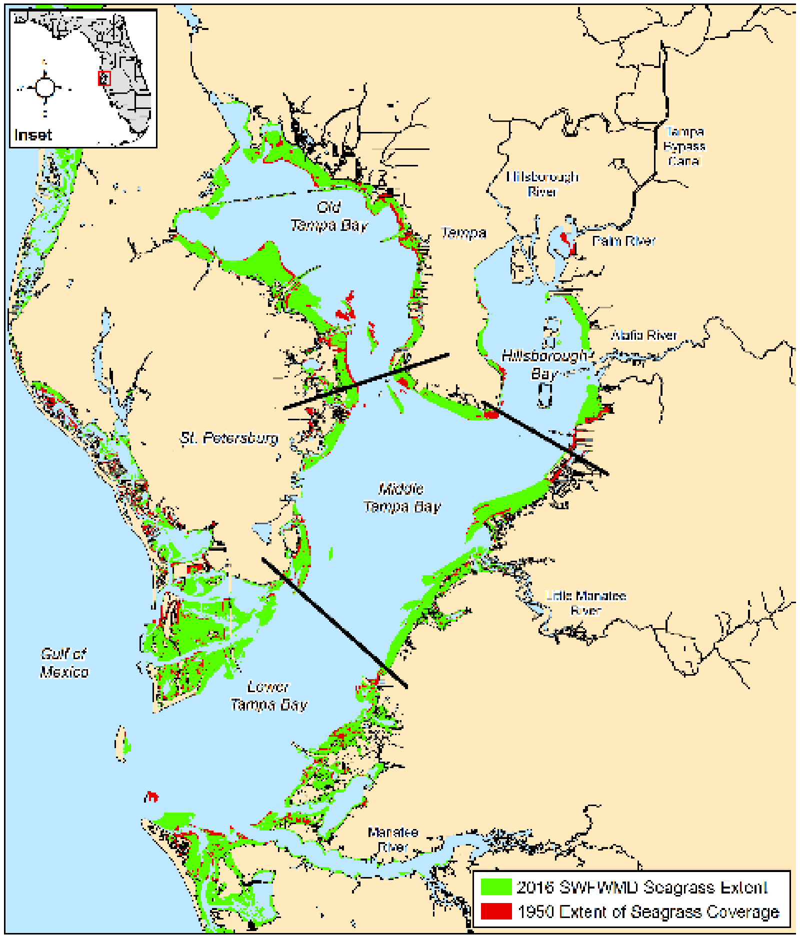
2006: First-time All Segments Meet TBEP Water Quality Targets

TBEP Partner & NMC Actions Implemented

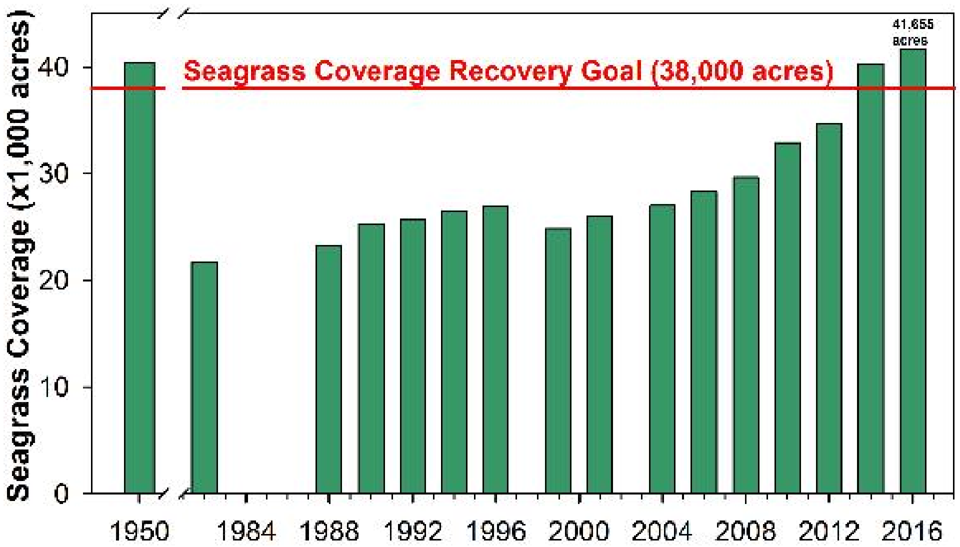
1992

Year	Old Tampa Bay	Hillsborough Bay	Middle Tampa Bay	Lower Tampa Bay
1975	Red	Red	Red	Green
1976	Red	Red	Red	Yellow
1977	Red	Red	Red	Red
1978	Red	Red	Red	Yellow
1979	Red	Red	Red	Red
1980	Red	Red	Red	Red
1981	Red	Red	Red	Red
1982	Red	Red	Red	Red
1983	Red	Yellow	Red	Red
1984	Red	Green	Red	Yellow
1985	Red	Red	Red	Yellow
1986	Red	Yellow	Red	Green
1987	Red	Yellow	Red	Green
1988	Yellow	Green	Yellow	Green
1989	Red	Yellow	Red	Yellow
1990	Red	Green	Red	Yellow
1991	Green	Yellow	Yellow	Yellow
1992	Yellow	Green	Yellow	Yellow
1993	Yellow	Green	Yellow	Yellow
1994	Yellow	Yellow	Red	Red
1995	Red	Yellow	Red	Yellow
1996	Yellow	Green	Yellow	Green
1997	Yellow	Green	Red	Yellow
1998	Red	Red	Red	Red
1999	Yellow	Green	Yellow	Yellow
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
2014	Green	Green	Green	Green
2015	Yellow	Green	Yellow	Green
2016	Yellow	Green	Green	Green

Results? Seagrass Coverage Expansion!



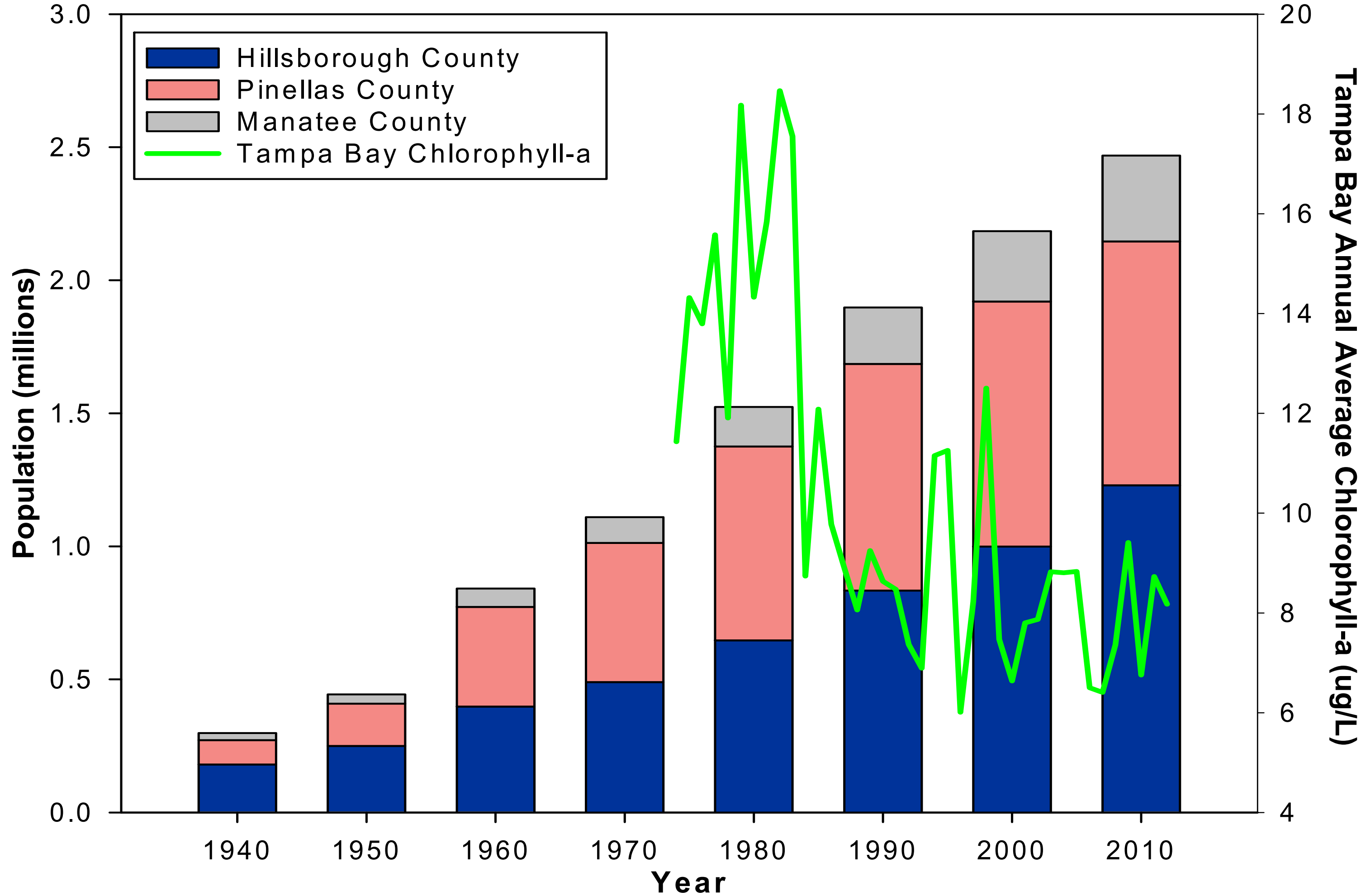
Data from SWFWMD



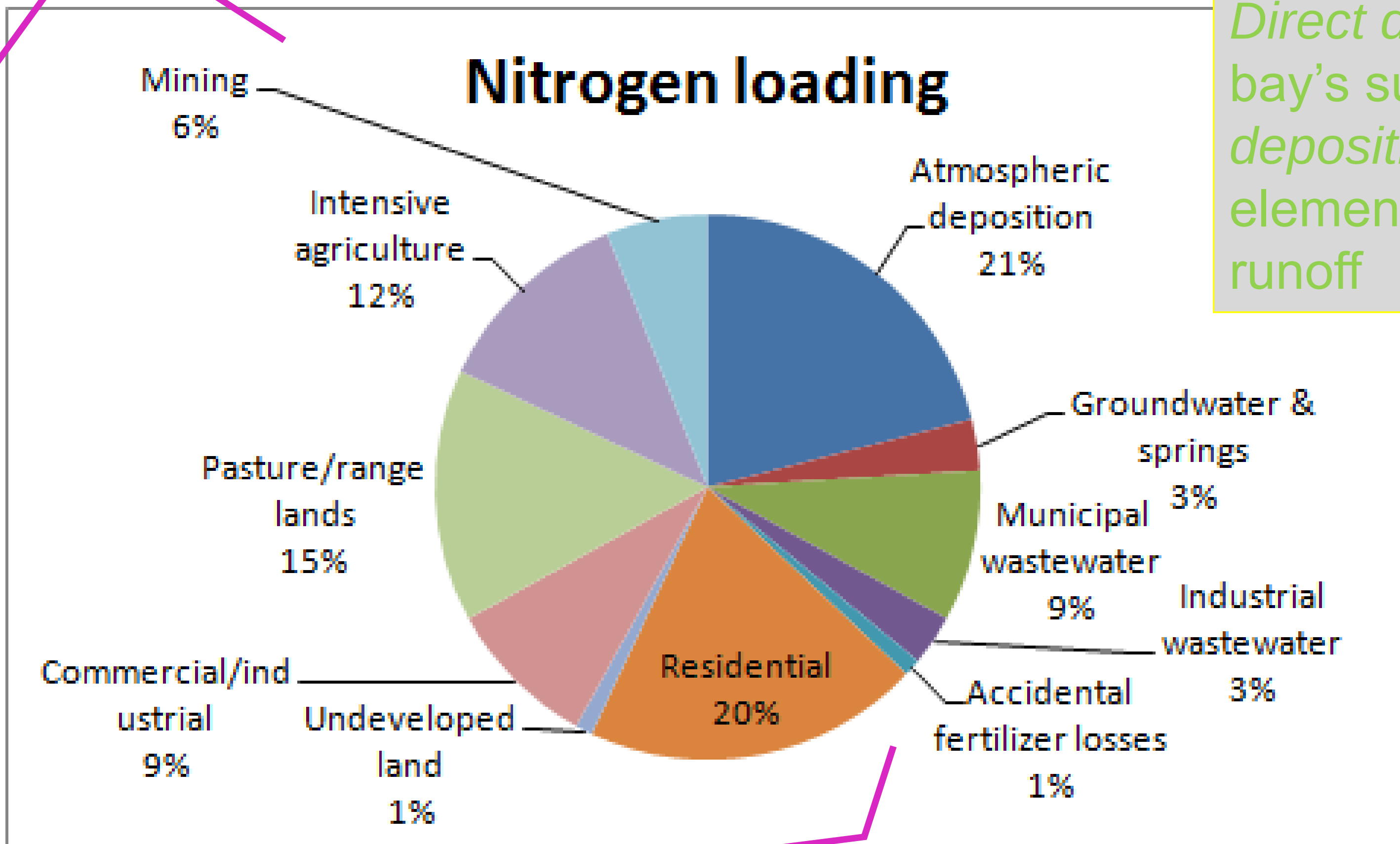
Exceeded 1950s estimate of 40,400 acres!

Sustaining Success

- Can recovery be maintained w/ increasing population?
- Expected to double (again) by 2050
- New Actions / Offsets will be Needed

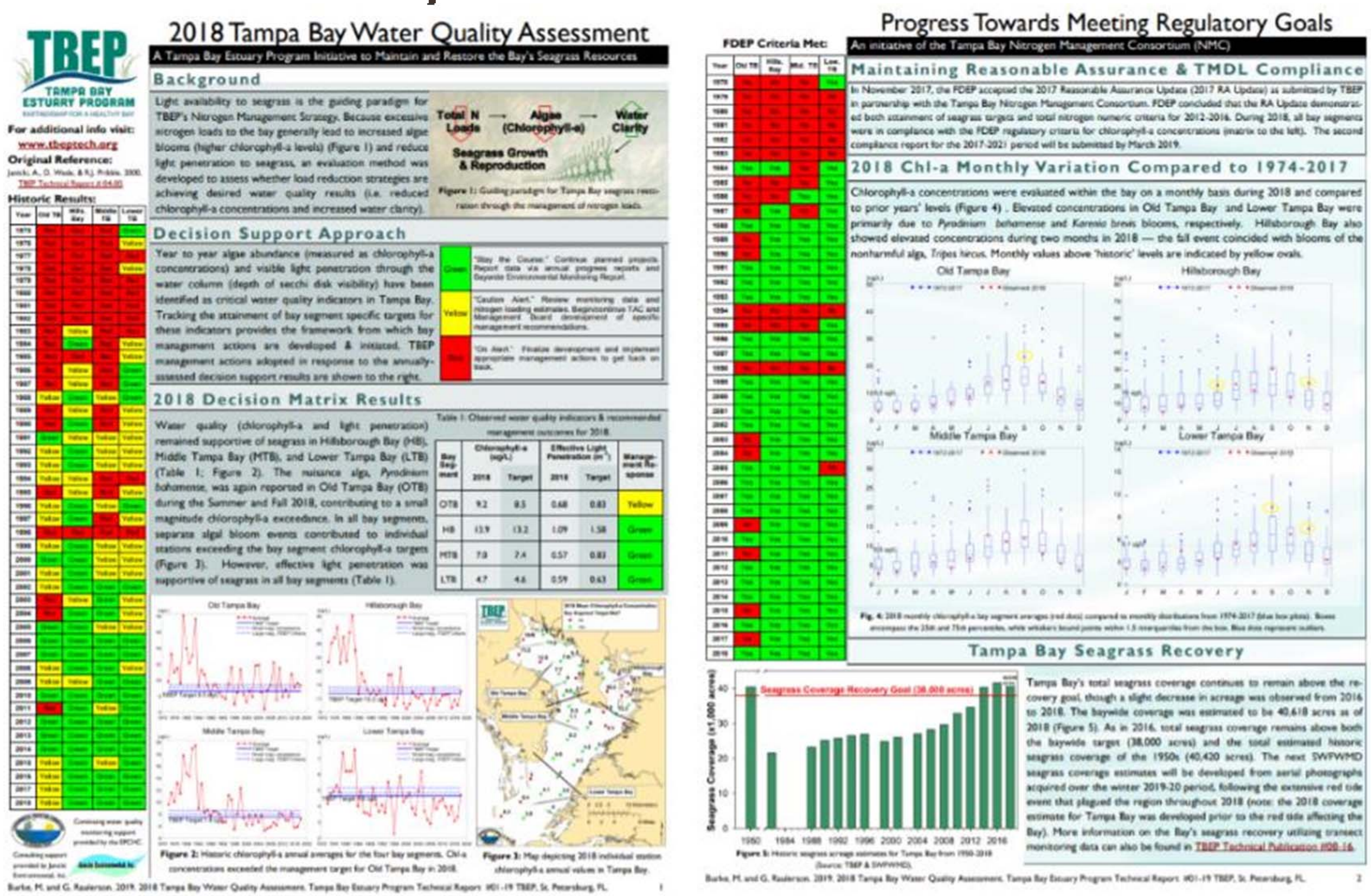


Stormwater



Atmospheric Deposition - *Direct deposition* to the bay's surface, and *indirect deposition,* which is an element of stormwater runoff

TBEP and Open Science?



2018 Tampa Bay Water Quality Assessment

A Tampa Bay Estuary Program Initiative to Maintain and Restore the Bay's Seagrass Resources

TBEP Tampa Bay Estuary Program

For additional info visit: www.tbeptech.org

Background

Decision Support Approach

2018 Decision Matrix Results

Progress Towards Meeting Regulatory Goals

An initiative of the Tampa Bay Nitrogen Management Consortium (NMC)

FDEP Criteria Met:

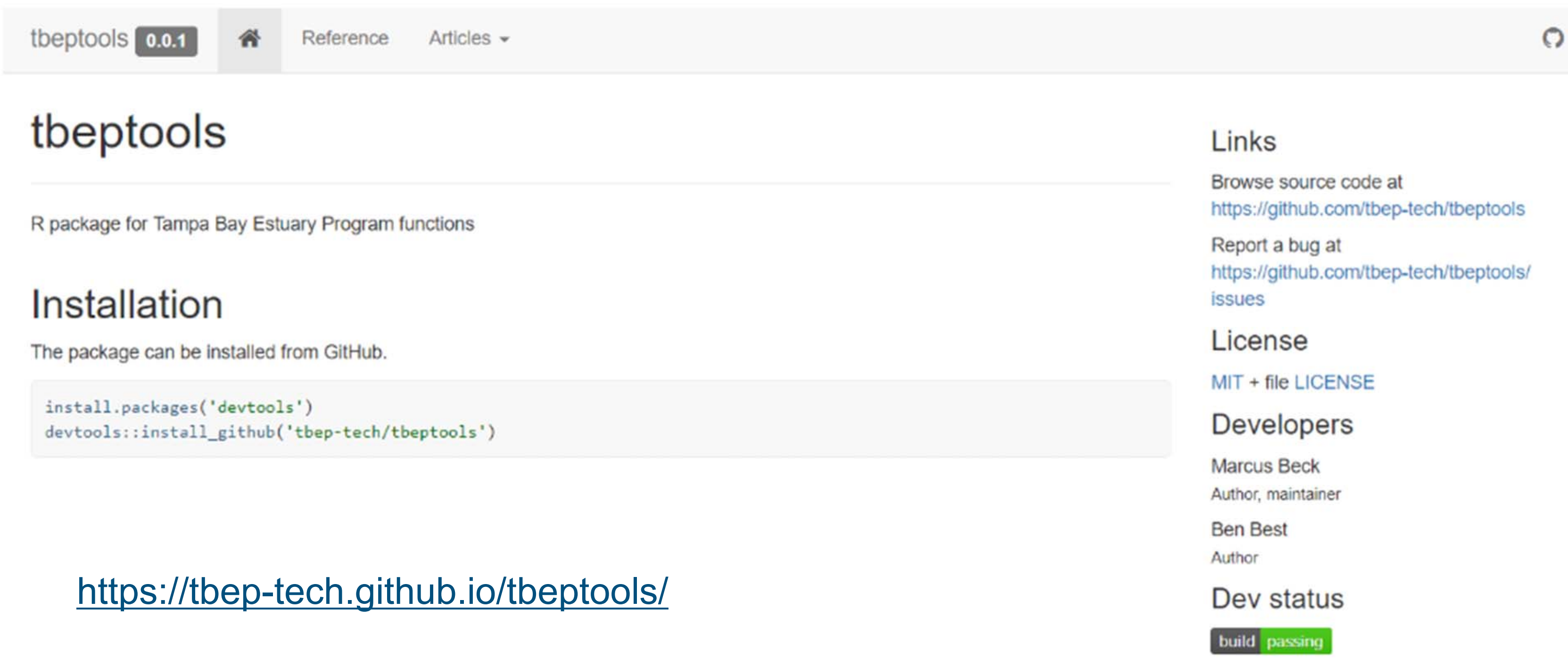
Maintaining Reasonable Assurance & TMDL Compliance

2018 Chl-a Monthly Variation Compared to 1974-2017

Tampa Bay Seagrass Recovery

What is TBEP doing with open science?

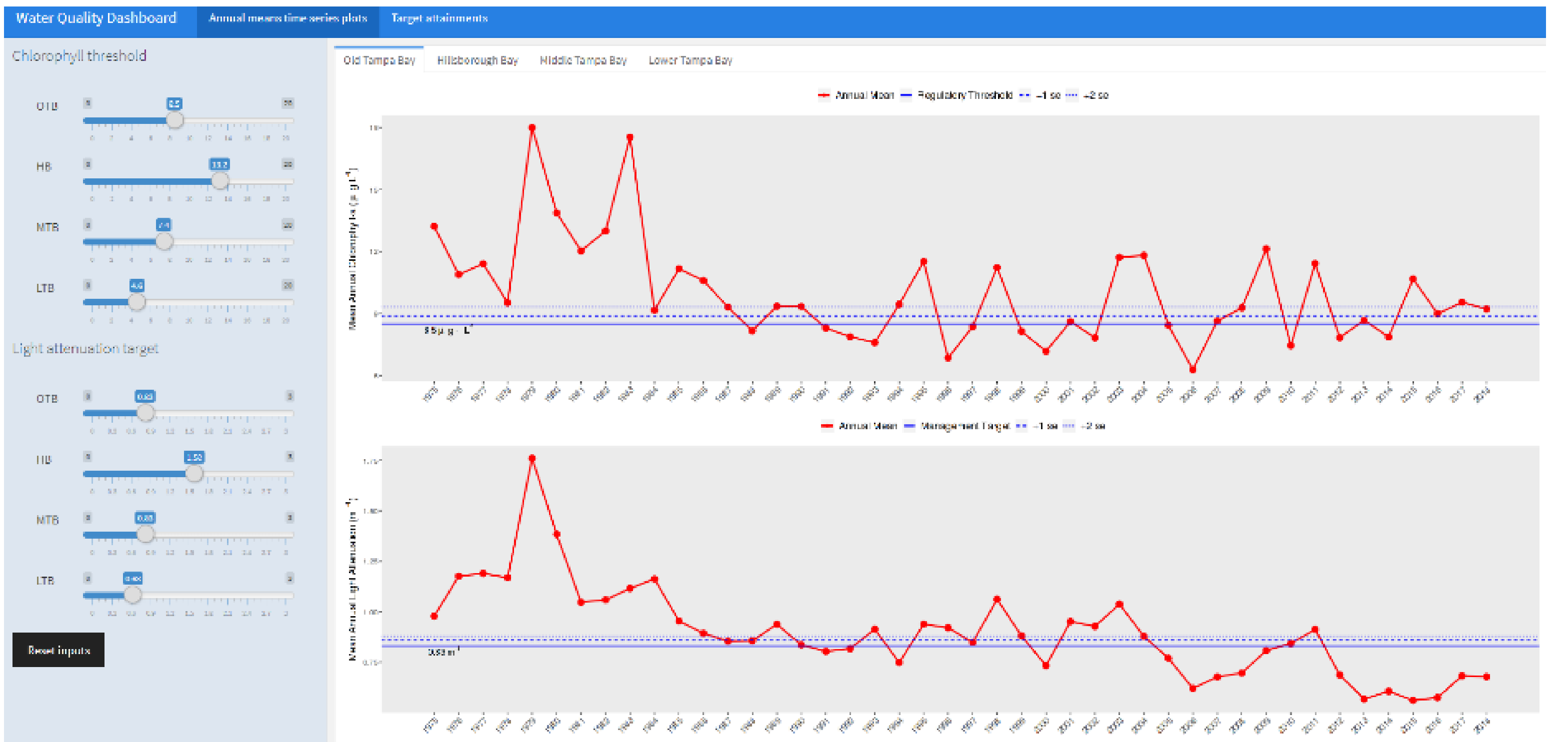
Open source software to ***retrieve, organize,*** and ***analyze*** Tampa Bay data



https://tbep-tech.github.io/tbeptools/

What is TBEP doing with open science?

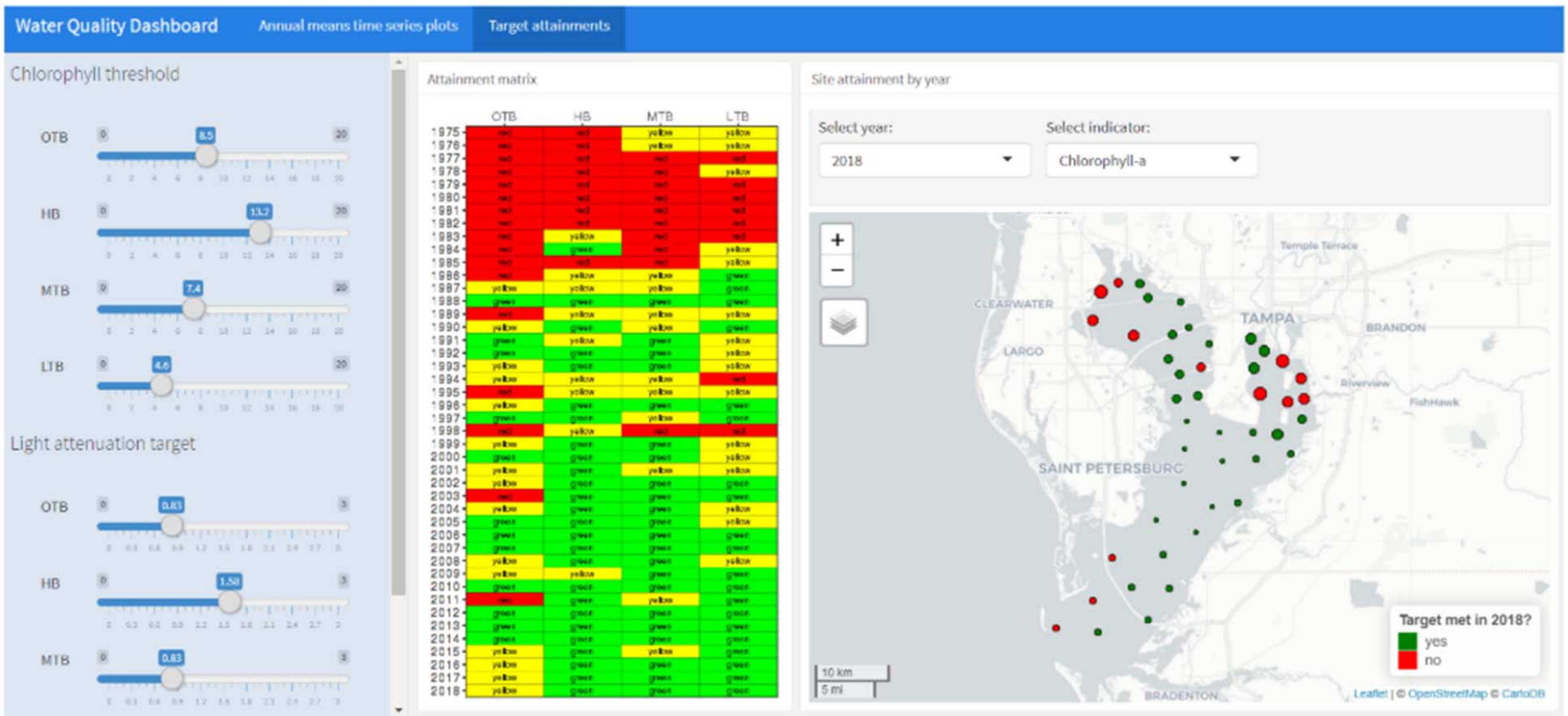
Interactive dashboards
update in real time



https://shiny.tbeptech.org/tbeptools/inst/wq-dash/wq-dash.Rmd

What is TBEP doing with open science?

Interactive dashboards
update in real time



https://shiny.tbeptech.org/tbeptools/inst/wq-dash/wq-dash.Rmd

MAKING SPACE FOR OPEN SCIENCE

Assess current level of open science knowledge

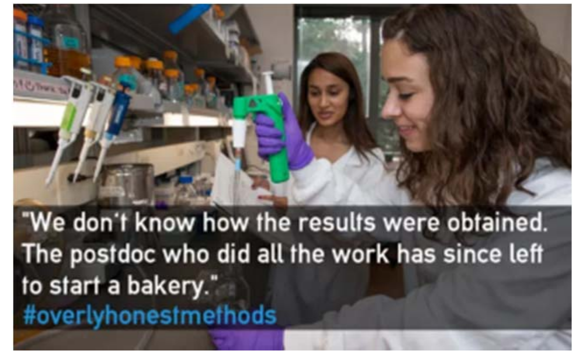
Communicate importance of open science to stakeholders

Develop interest and motivation for continued learning

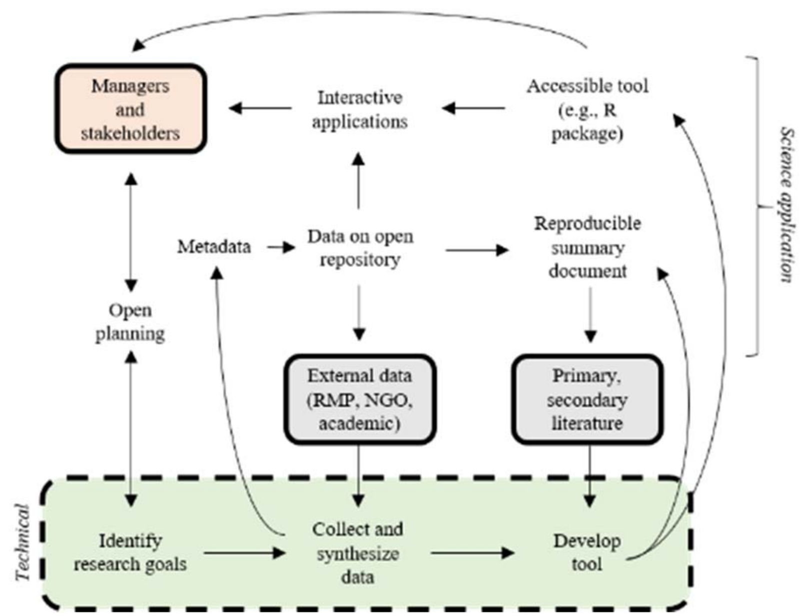
#TAMPABAYOPENSCI

https://docs.google.com/document/d/1kSY9eSn4le4vWusCmlQMRH6YcYOq3zEn2veNrOGRy_Y/edit?usp=sharing

OPEN SCIENCE WORKSHOP



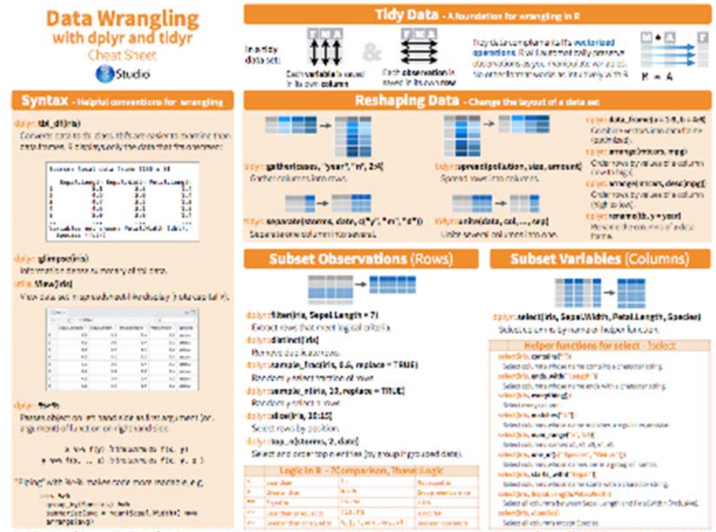
(b) Open bioassessment



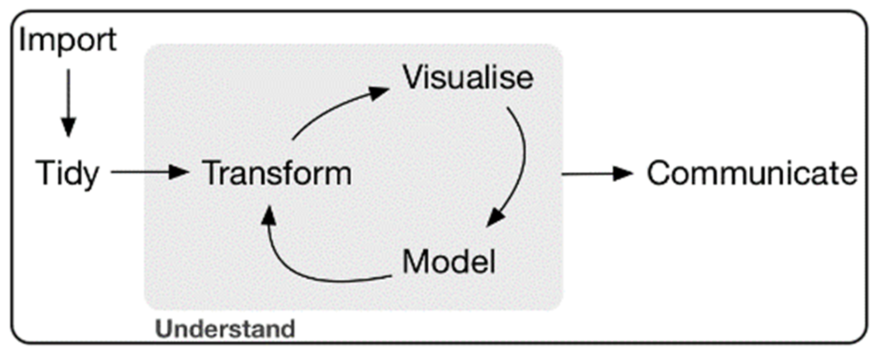
Beck: What is Open Science?

JANITOR WORK

Best: What is Open Science?

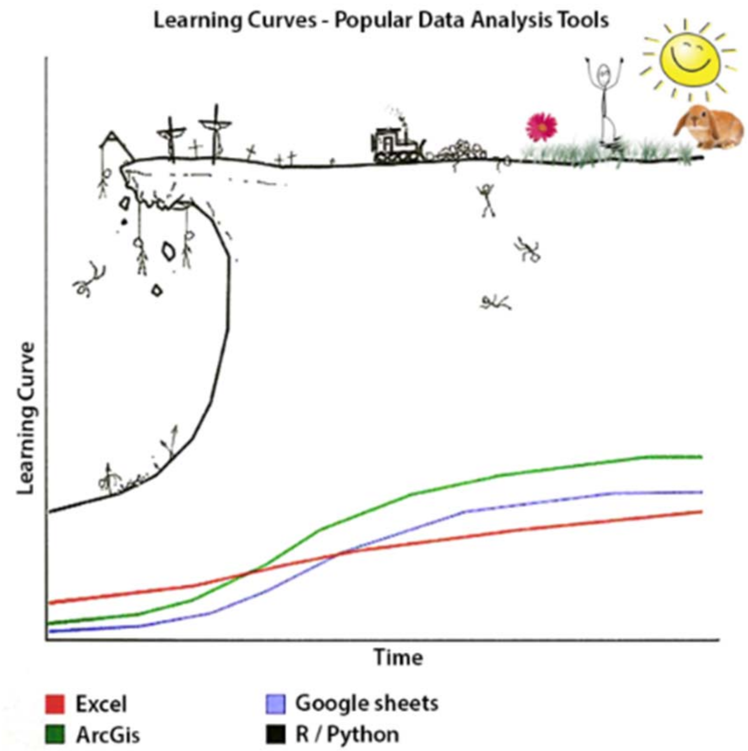


RStudio: Help > Cheatsheets >
Data Transformation with dplyr



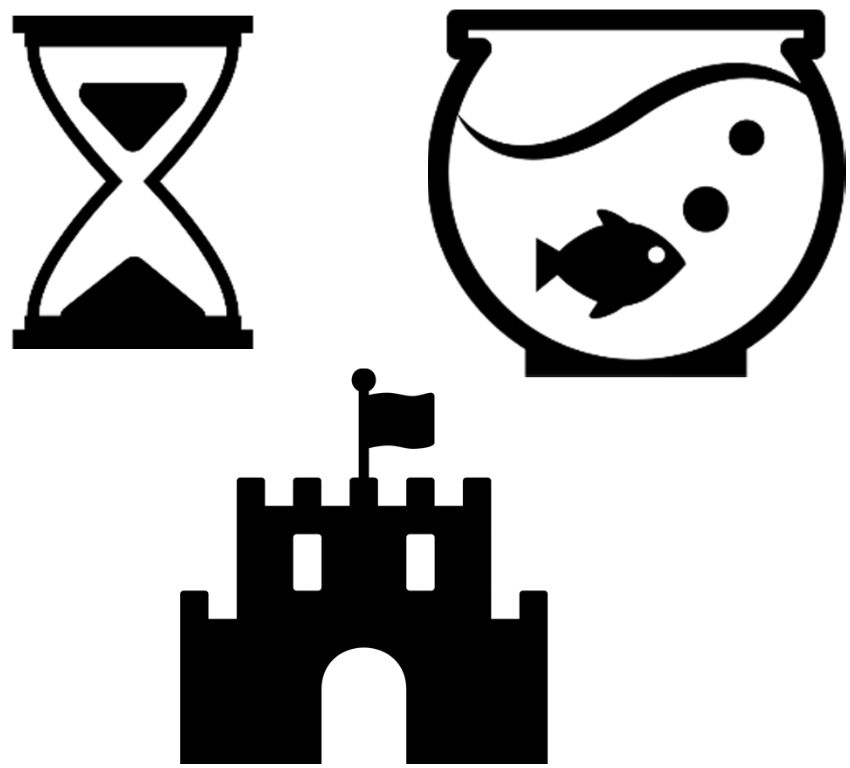
Grolemund & Wickham: https://r4ds.had.co.nz/

CHALLENGES

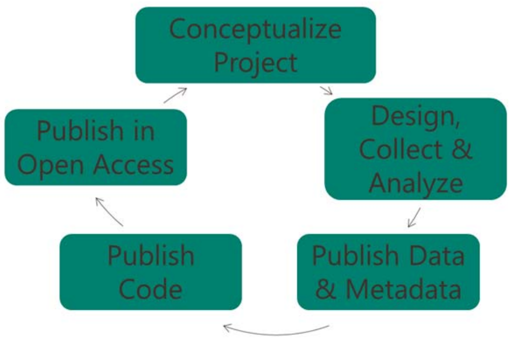


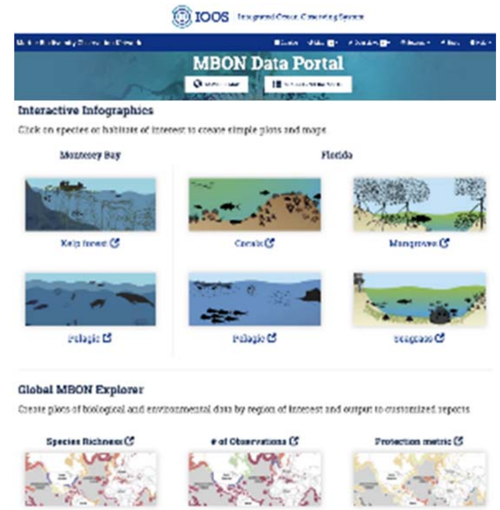
Beck: Open Science Challenges

Time, Visibility, Security

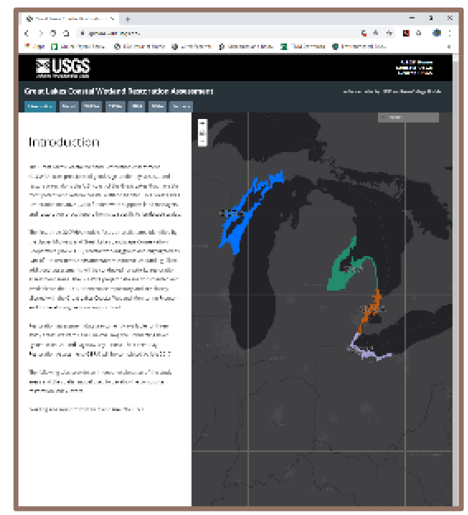


LIGHTNING ROUNDS



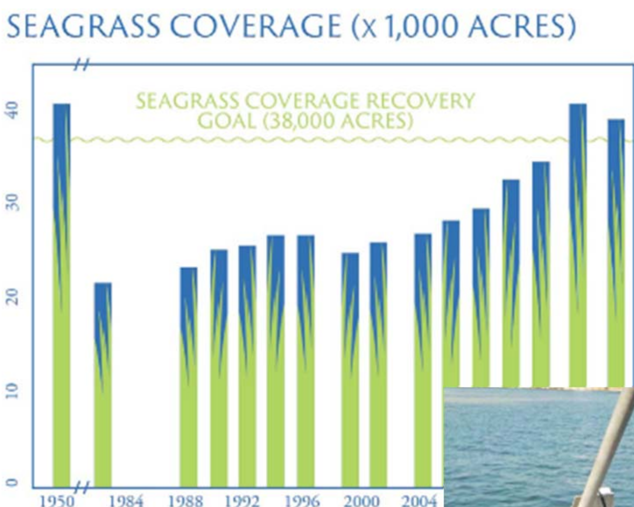


https://mbon.ioos.us



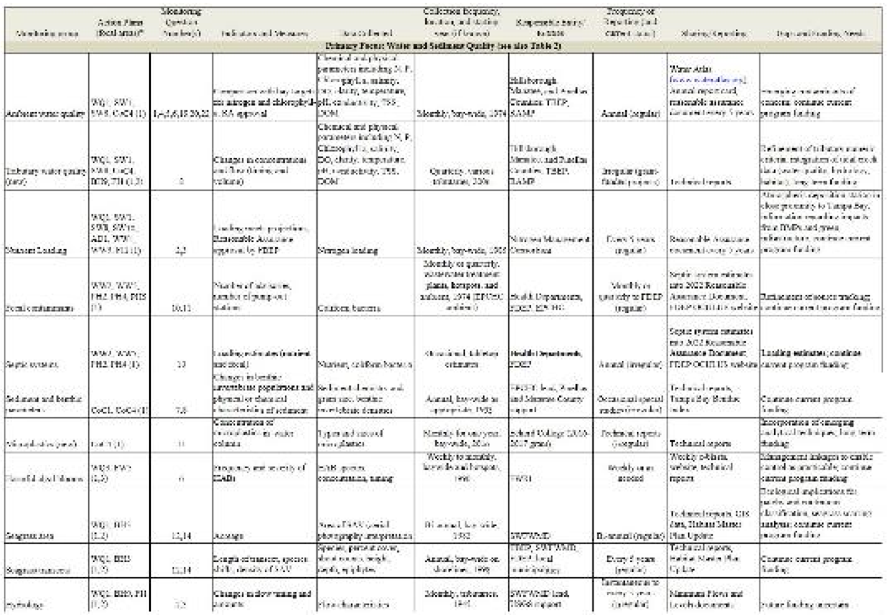
https://www.glsc.usgs.gov/MALMR/application.html

Indicators dive



Monitoring group	Action Plans (focal areas)*	Monitoring Question Number(s)	Indicators and Measures	Data Collected	Collection frequency, location, and starting year (if known)	Responsible Entity/ Entities	Frequency of Reporting (and current status)	Sharing/Reporting	Gaps and Funding Needs
Primary Focus: Water and Sediment Quality (see also Table 2)									
Ambient water quality	WQ1, SW1, SW8, CoC4 (2)	1,4,5,6,18-20,22	Comparison with bay targets for nitrogen and chlorophyll-a, RA renewal	Chemical and physical parameters including N, P, Chlorophyll a, salinity, DO, clarity, temperature, pH, conductivity, TSS, DOM	Monthly, bay-wide, 1974	Hillsborough, Manatee, and Pinellas Counties; TBEP, RAMP	Annual (regular)	Water Atlas (www.wateratlas.org), Annual report card, reasonable assurance document every 5 years	Emerging contaminants of concern, continue current program funding
Tributary water quality (new)	WQ2, SW1, SW8, CoC4, BH9, FH (1,2)	2	Changes in concentrations and flow (timing and volume)	Chemical and physical parameters including N, P, Chlorophyll a, salinity, DO, clarity, temperature, pH, conductivity, TSS, DOM	Quarterly, various tributaries, 2016	Hillsborough, Manatee, and Pinellas Counties; TBEP, RAMP	Irregular (grant funded projects)	Technical reports	Refinement of tributary numeric criteria, integration of tidal creek data (water quality, hydrology, habitat); long-term funding
Nutrient Loading	WQ1, SW1, SW8, SW10, AD1, WW1, WW3, [illegible] (5)	2,9	Loading meets projections, Reasonable Assurance approval by FDEP	Nitrogen loading	Monthly, bay-wide, 1985	Nitrogen Management Consortium	Every 5 years (regular)	Reasonable Assurance document every 5 years	Atmospheric deposition station in close proximity to Tampa Bay, information regarding impacts from BMPs and green infrastructure; continue current program funding
Fecal contaminants	WW2, WW5, PH2, PH4, [illegible] (1)	10,11	Number of advisories, number of pump-out stations	Coliform bacteria	Monthly or quarterly, wastewater treatment plants, hotspots, and ambient, 1974 (EPCHC ambient)	Health Departments, FDEP, EPCHC	Monthly or quarterly to FDEP (regular)	Septic system estimates into 2022 Reasonable Assurance Document, FDEP OCULUS website	Refinement of source tracking, continue current program funding
Septic systems	WW2, WW5, PH2, PH4 (1)	10	Loading estimates (nutrient and fecal)	Nutrient, coliform bacteria	Occasional, tabletop estimates	Health Departments, FDEP	Annual (irregular)	Septic system estimates into 2022 Reasonable Assurance Document, FDEP OCULUS website	Loading estimates; continue current program funding
Sediment and benthic parameters	CoC1, CoC4 (1)	7,8	Changes in benthic invertebrate populations and physical or chemical characteristics of sediment	Sediment chemistry and grain size, benthic invertebrate densities	Annual, bay-wide as appropriate, 1993	EPCHC lead, Pinellas and Manatee County support	Occasional special studies (irregular)	Technical reports, Tampa Bay Benthic Index	Continue current program funding
Microplastics (new)	CoC4 (1)	11	Concentration of microplastics in water column	Types and sizes of microplastics	Monthly for one year, bay-wide, 2016	Eckerd College (2016-2017 grant)	Technical reports (irregular)	Technical reports	Incorporation of emerging analytical techniques, long-term funding
Harmful algal blooms	WQ3, FW5 (1,3)	6	Frequency and severity of HABs	HAB species, concentration, timing	Weekly to monthly, bay-wide and hotspots, 1993	FWRI	Weekly or as needed	Weekly e-blasts, website, technical reports	Management linkages to enable control as practicable; continue current program funding
Seagrass area	WQ1, BH5 (1,2)	12,14	Acreage	Area of SAV (aerial photography interpretation)	Bi-annual, bay-wide, 1982	SWFWMD	Bi-annual (regular)	Technical reports, GIS data, Habitat Master Plan Update	Ecological implications for patchy and continuous classification, imagery scoring analysis; continue current program funding
Seagrass transects	WQ1, BH5 (1,2)	12,14	Length of transect, species shifts, density of SAV	Species, percent cover, shoot counts, height, depth, epiphytes	Annual, bay-wide on shorelines, 1998	TBEP, SWFWMD, FDEP, local municipalities	Every 5 years (regular)	Technical reports, Habitat Master Plan Update	Continue current program funding
Hydrology	WQ1, BH9, FH (1,2)	2,5	Changes in flow timing and amounts	Flow characteristics	Monthly, tributaries, 1945	SWFWMD lead, USGS support	Intermittent to every 5 years (irregular)	Minimum Flows and Levels documents	Future funding uncertain

WHY ARE WE DOING THIS?

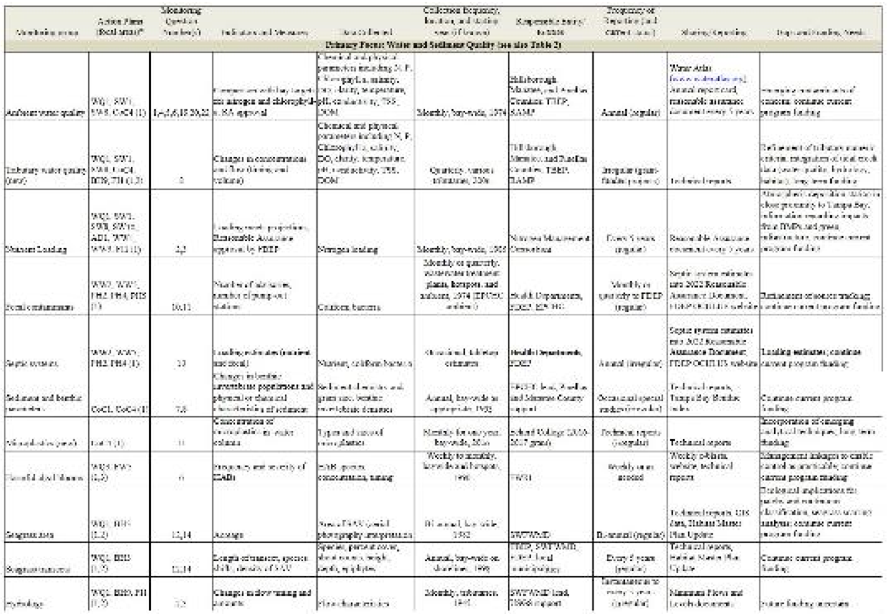


Comprehensive Conservation & Management Plan

Evaluate listed actions

Progress toward meeting goals and objectives

WHY ARE WE DOING THIS?



Monitoring Area	Action Plans (focal area)*	Monitoring Question Number(s)	Indicators and Measures	Data Collected	Collection frequency, location, and starting year (if known)	Responsible Entity/ies	Frequency of Reporting (and [illegible])	Sharing/Reporting	Gaps and Funding Needs
Primary Focus: Water and Sediment Quality (see also Table 2)									
Ambient water quality	WQ1, SW1, SW8, CoC4 (1)	[illegible]	[illegible] nitrogen and chlorophyll-a, RA approval	Chemical and physical parameters including N, P, Chlorophyll-a, salinity, [illegible], clarity, temperature, pH, conductivity, TSS, DOM	Monthly, bay-wide, 1974	Hillsborough, Manatee, and Pinellas Counties, TBEP, SAMP	Annual (regular)	Water Atlas ([illegible]), Annual report card, reasonable assurance [illegible]	[illegible]
Tributary water quality (new)	WQ1, SW1, SW8, CoC4, BH9, TH (1,3)	[illegible]	Changes in concentrations and flow (timing and volume)	Chemical and physical parameters including N, P, Chlorophyll-a, salinity, DO, clarity, temperature, pH, conductivity, TSS, DOM	Quarterly, various tributaries, 2006	Hillsborough, Manatee, and Pinellas Counties, TBEP, SAMP	Irregular (grant-funded projects)	Technical reports	[illegible]
Nutrient Loading	WQ1, SW1, SW8, SW1c, AD1, WW, WW3, PH1 (1)	2,3	Loading [illegible], Reasonable Assurance approval by FDEP	Nitrogen loading	Monthly, bay-wide, 1985	Nitrogen Management Consortium	Every 5 years (regular)	Reasonable Assurance [illegible] every 5 years	[illegible]
Fecal contaminants	WW2, WW3, PH2, PH4, PH5 (1)	10,11	Number of [illegible], number of pump-out stations	Coliform bacteria	Monthly or quarterly, wastewater treatment plants, hotspots, and [illegible], 1974 ([illegible])	Health Departments, FDEP, [illegible]	Monthly or quarterly to FDEP (regular)	[illegible] 2022 Reasonable Assurance Document, [illegible] website	[illegible]
Septic systems	WW2, WW3, PH2, PH4 (1)	10	Loading estimates (nutrient and fecal)	Nutrient, coliform bacteria	[illegible]	Health Departments, FDEP	Annual (irregular)	Septic system estimates into 2022 Reasonable Assurance Document, [illegible] website	Loading estimates; continue current program funding
Sediment and benthic [illegible]	CoC1, CoC4 (1)	7,8	Changes in benthic invertebrate populations and physical or chemical characteristics of sediment	[illegible]	Annual, bay-wide [illegible] 1993	[illegible] and Manatee County support	Occasional special studies ([illegible])	Technical reports, Tampa Bay Benthic Index	Continue current program funding
Microplastics (new)	[illegible]	[illegible]	Concentration of microplastics in water column	Types and sizes of microplastics	Monthly for one year, bay-wide, [illegible]	Eckerd College [illegible] grant)	Technical reports (irregular)	Technical reports	Incorporation of emerging analytical techniques, long term funding
Harmful algal blooms	WQ3, FW3 (1,3)	6	Frequency and severity of HABs	HAB species concentrations, timing	Weekly to monthly, known bloom hotspots, [illegible]	FWRI	Weekly or as needed	Weekly e-blasts, website, technical reports	Management linkages to enable control as practicable; continue current program funding
Seagrass area	WQ1, BH5 (1,2)	12,14	Acreage	[illegible] (aerial photography interpretation)	Bi-annual, bay-wide, 1982	SWFWMD	Bi-annual (regular)	Technical reports, GIS data, Habitat Master Plan Update	[illegible] analysis; continue current program funding
Seagrass transects	WQ1, BH5 (1,2)	12,14	Length of transect, species shift, density of SAV	Species, percent cover, [illegible], depth, epiphytes	Annual, bay-wide on [illegible], 1998	TBEP, SWFWMD, [illegible] local municipalities	Every 5 years (regular)	Technical reports, Habitat Master Plan Update	Continue current program funding
Hydrology	WQ1, BH9, PH (1,2)	[illegible]	Changes in flow timing and amounts	Flow characteristics	Monthly, tributaries, [illegible]	SWFWMD lead, USGS support	[illegible]	Minimum Flows and Levels documents	Future funding uncertain

Monitoring & Indicators Plan

CCMP Actions

What is measured

Parameters

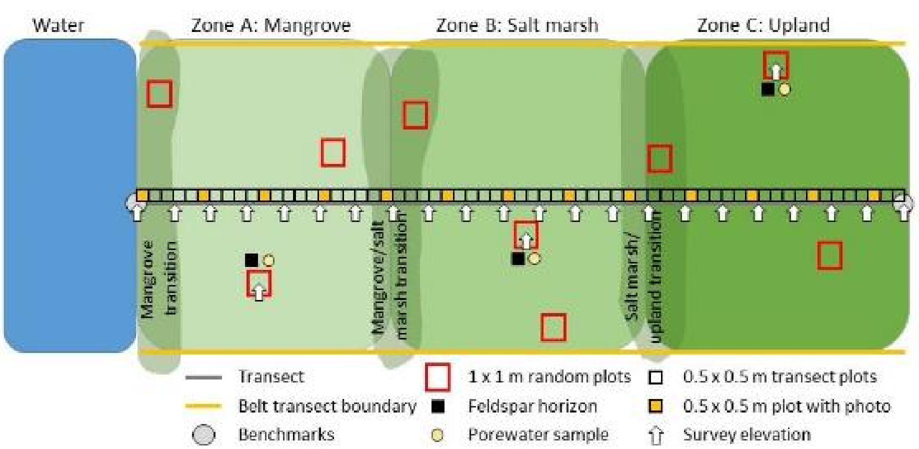
Frequency, location

Partners

Reporting

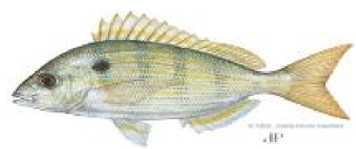
Funding Needs

INDICATORS

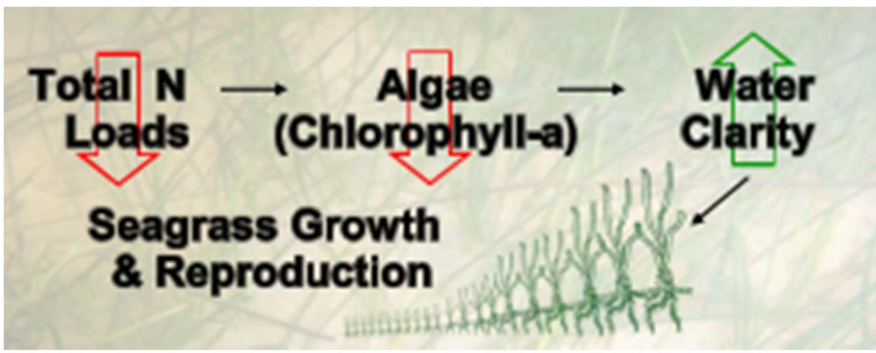


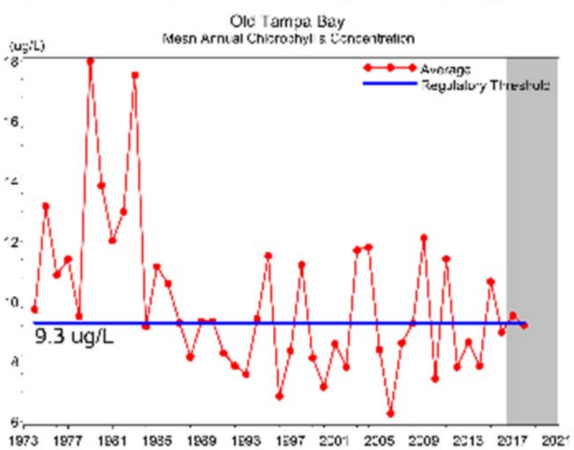
https://docs.google.com/document/d/1W3ub8RqCWoZbI2haQc1ya-v7u3iJTn3iVyixW5N1kw4/edit?usp=sharing

Identifying roadblocks, needs, and solutions



CREATING INDICATORS FOR TAMPA BAY





Identify the problem

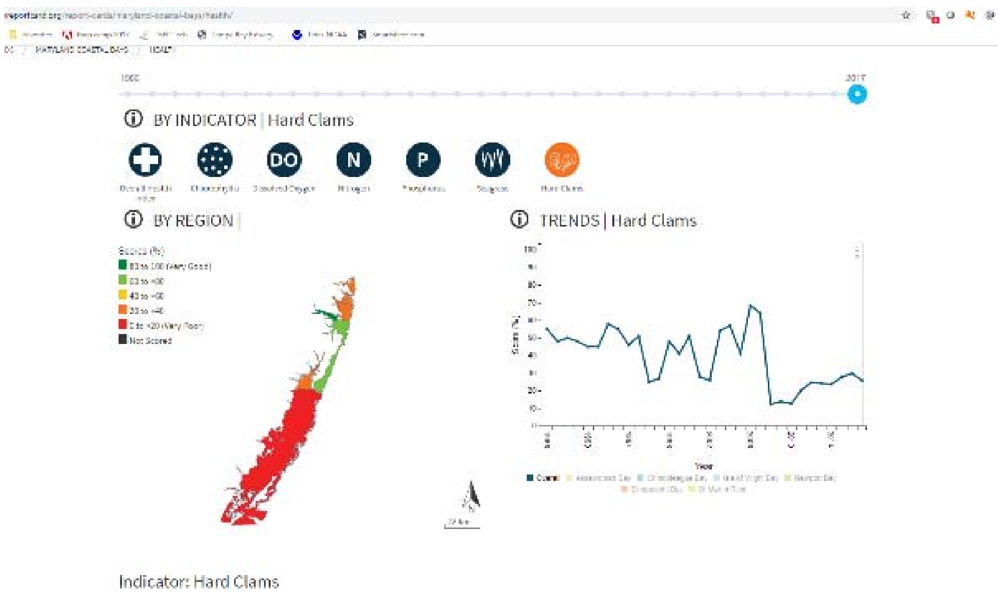
Data collection (including historical and gap)

Data Analysis

Identify management actions

Iterate!

USING INDICATORS



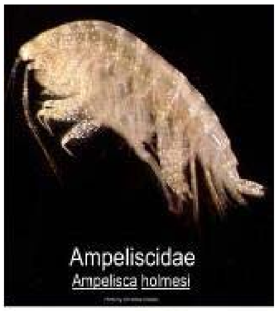
https://ecoreportcard.org/report-cards/maryland-coastal-bays/health/

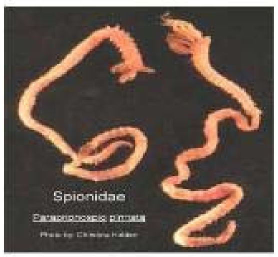
Determine useful ways to present data to interested communities

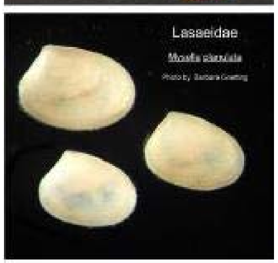
Create the roll-out plan

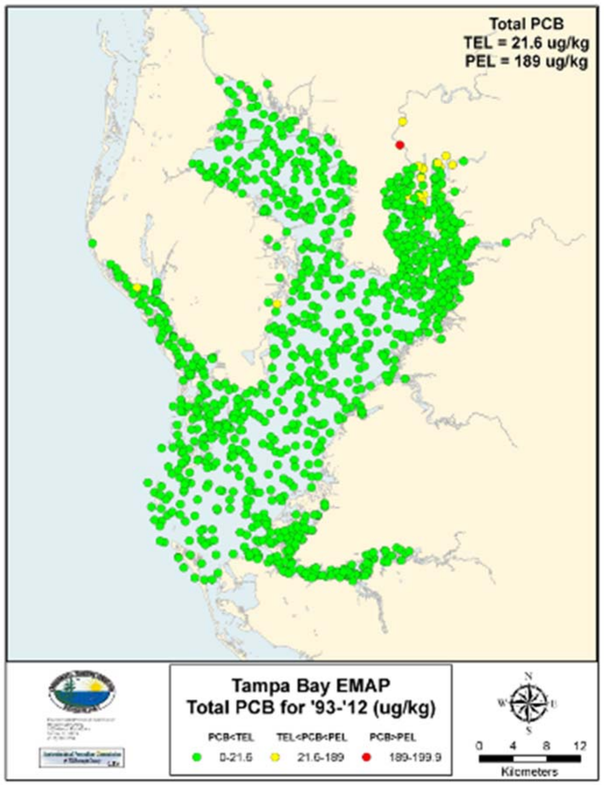
https://vitalsigns.pugetsoundinfo.wa.gov/

BENTHIC INDEX









Identify hotspots of sediment contamination

Assess health of benthic habitats

Bioaccumulation

Health risks to fish, other wildlife, & humans

BENTHIC

Dredge Hole	PEL Quotient	TBBI Fall 2016	TBBI Spring 2017	Silt Clay Fall 2016	Silt Clay Spring 2017	DO Mean Score	Benthic Rank
Skyway Causeway South	0.02	94.8	95.0	4.0	4.0	5.5	1
Venetian Isles	0.02	91.9	89.4	3.6	4.4	2.5	2
Skyway Causeway North	0.01	87.5	89.1	6.0	4.5	7.0	3
Georgetown	0.04	85.8	84.4	11.9	18.4	1.5	4
Culbreath Bayou North	0.06	85.5	85.5	12.3	10.2	4.0	5
Culbreath Bayou South	0.10	58.4	78.0	51.5	58.2	1.0	6
Ft. De Soto	0.01	47.2	68.3	7.4	13.2	9.0	6
MacDill Beach	0.06	49.1	84.9	21.0	30.4	7.0	8
MacDill Docks	0.17	80.1	67.4	54.5	30.5	2.5	9
Bay Point	0.10	69.3	52.7	53.9	60.2	10.0	10

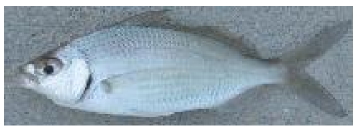
Tampa Bay Benthic Index

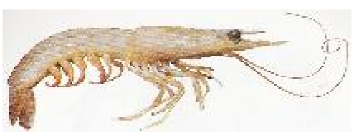
Sediment Toxicity

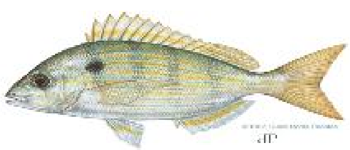
Silt/clay

Dissolved oxygen

NEKTON INDEX







Fish used as indicators in

Streams, Lakes, Estuaries

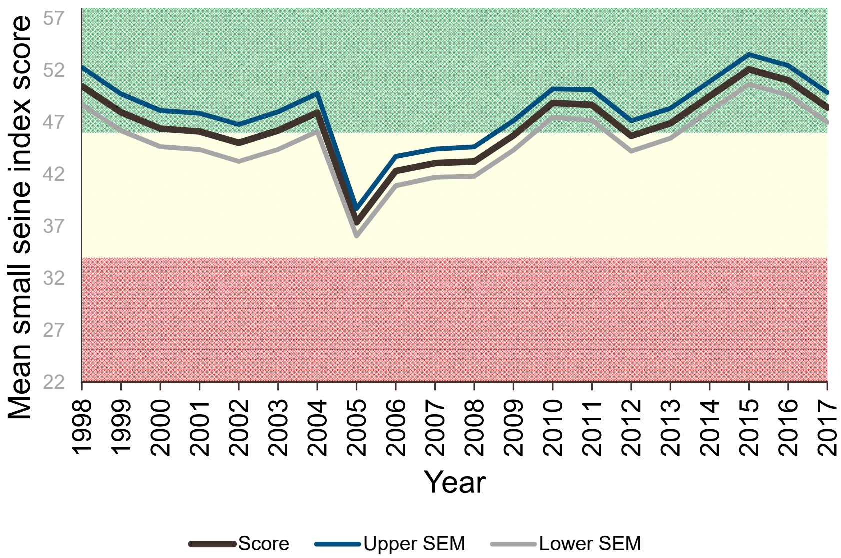
Valuable for:

Monitoring

Identifying research needs

Provides simple way to communicate bay health

NEKTON INDEX



[FWRI 2018. Tampa Bay Nekton Index]

FWRI

Abundance, Diversity, Focal/Selected, Forage, Habitat, Estuary use

Stressor events seen with rebounds

FIM Database

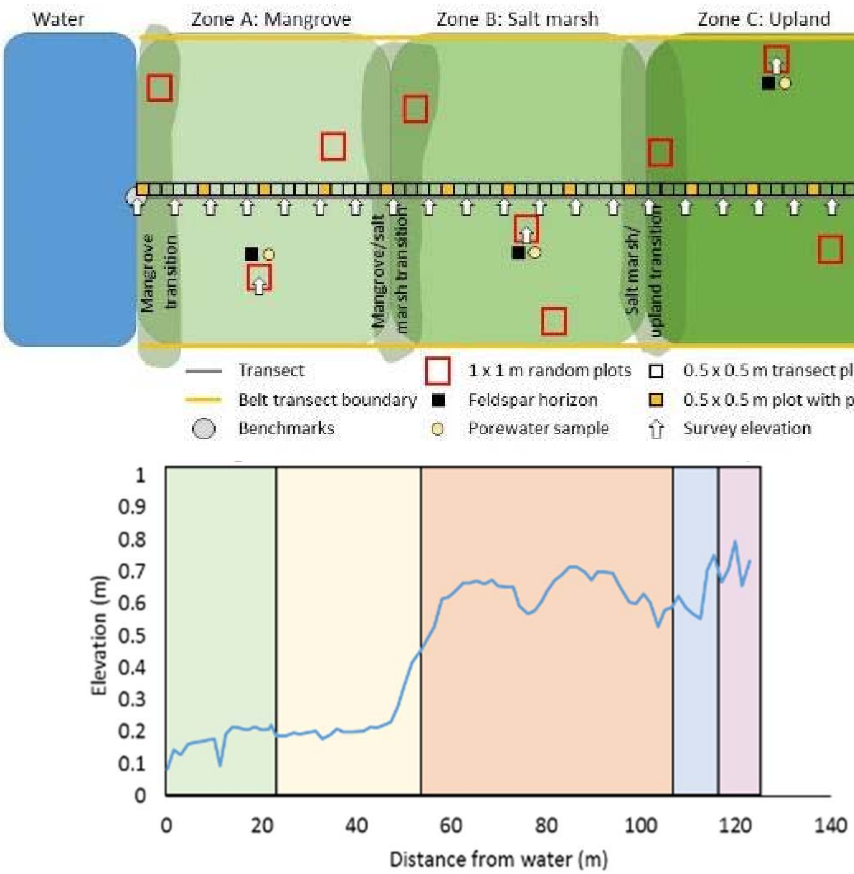
HABITAT CHANGE

Progress in restoring and protecting key coastal habitats in Tampa Bay.

Decadal Habitat Master Plan

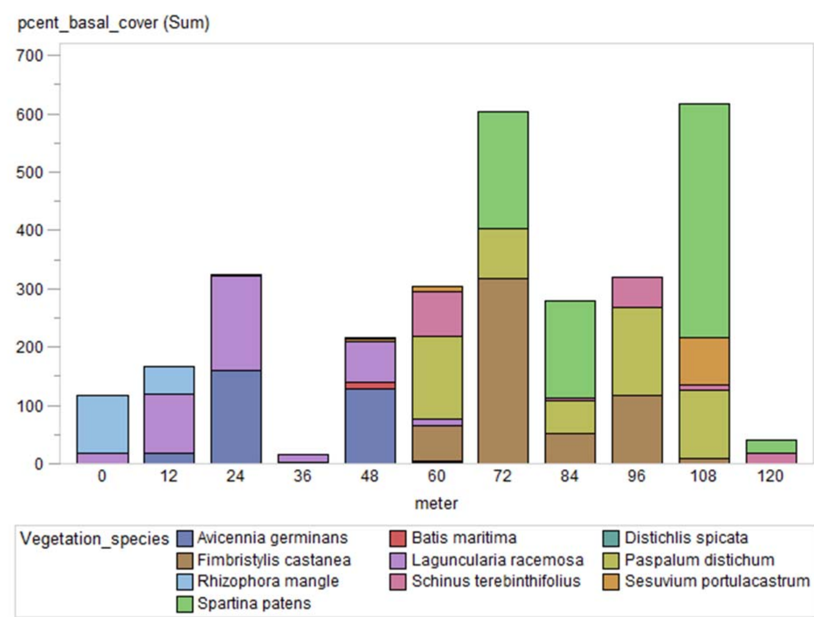
Restoration and Protection Targets

HABITAT CHANGE



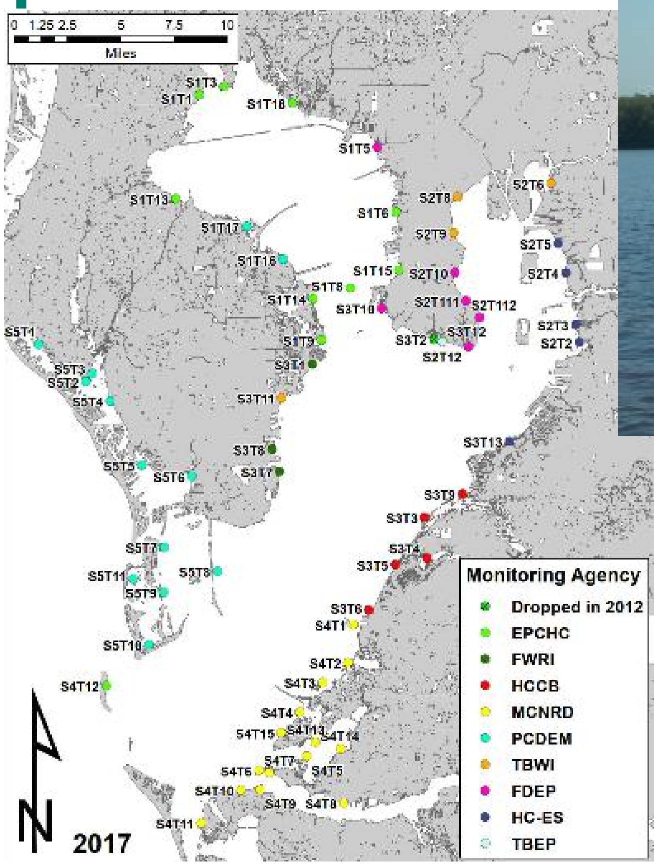
Critical Coastal Habitat Assessment

Monitor climate change impacts



FWRI 2017. Phase 2: Critical Coastal Habitat Assessment Final Report.

SEAGRASS



Seagrasses are a keystone species for TBEP

Integrator of water quality

Fisheries habitat

Extrapolate species coverage by Bay segment

SEAGRASS

302 SHERWOOD, GREENING, JOHANSSON, KAUFMAN, AND RAULERSON

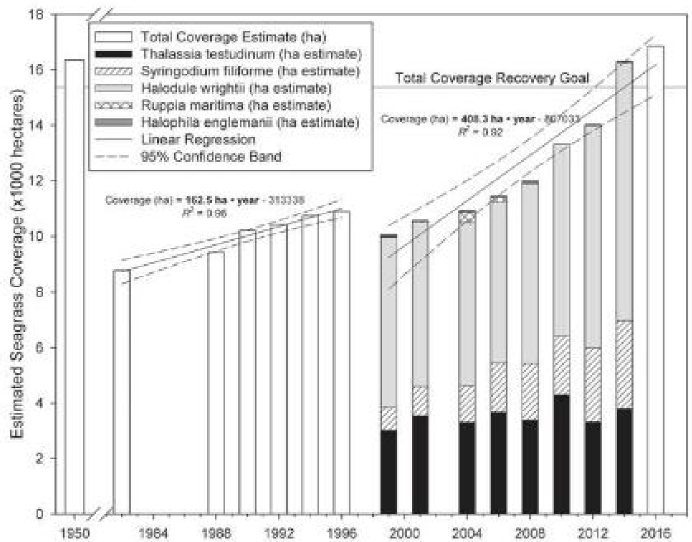


Figure 2. Historic and contemporary estimates of seagrass coverage (1950–2016). Contemporary estimates (1999–2014) of individual seagrass species cover were derived from mean baywide estimates of a particular species' frequency of occurrence, as determined from available, annually monitored transect sites (see Table 1). Linear regressions with 95% confidence intervals describing the total coverage recovery trajectories over two distinct time periods (1982–1996 vs. 1999–2016) are also included and suggest a more rapid recovery over recent periods. Data source: TBEP and SWFWMD.

[Sherwood et al. 2017. SE Geographer]

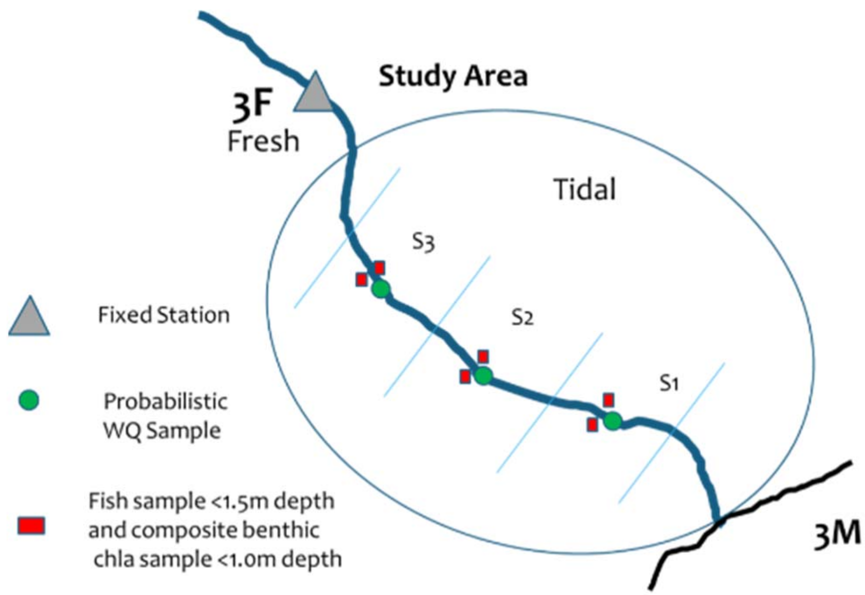
Species

Frequency of Occurrence

Deep edge

New Field Tool

TIDAL TRIBUTARIES



Janicki Environmental and Mote Marine Laboratory, 2016

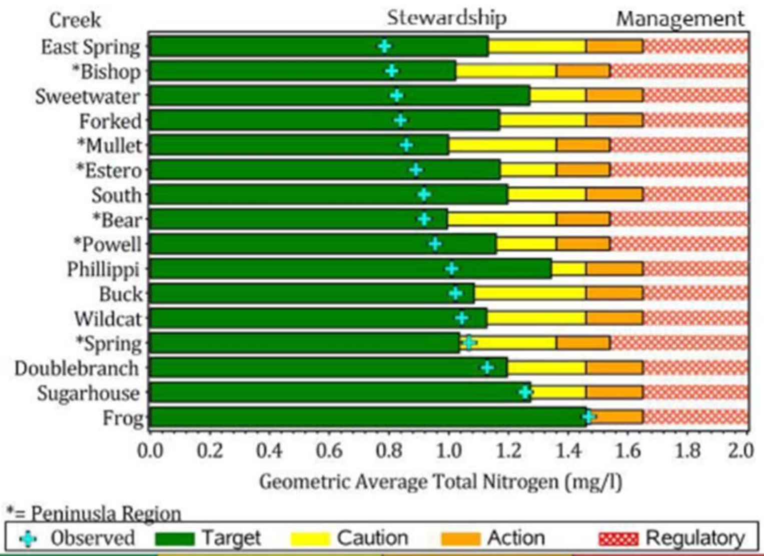
Water quality

Sediments

Fish (not current study)

SBEP, CHNEP, TBEP, Janicki, Mote

TIDAL TRIBUTARIES



Target	Caution Level	Management Action Plan	Regulatory (NNC)
Running geometric average	Running geometric average	2:5	1:3

Janicki Environmental and Mote Marine Laboratory, 2016

Data not regularly collected

Made some progress in water quality data, but need to create metrics for flashiness, ungaged systems

WORKSHOP FEEDBACK

"***Great exposure*** to a range tools, together with a solid intro of the philosophical underpinnings of Open Science"

"I was unaware of some of the data reporting capabilities that now exist. ***It's exciting!***"

"I have a much ***better understanding*** of open science, and absolutely know where to look for resources."

WORKSHOP FEEDBACK

"I really liked the interactive nature of presentations. However, as a beginner in coding and open science at times ***I felt it moved at a very fast pace***."

"I liked the group discussion at the end of the workshop. I would have liked to have ***more hands-on*** with Rstudio and Github."

"This was a good introduction, but I think a ***hands-on follow-up*** is needed."

TBEP and its partners can:

General and actionable

The public

- Educational materials
- Fact sheets
- Web resources

Managers

- Interactive dashboards
- Automated report cards
- Prioritization tools

Research community

- Technical documents
- Analysis/source code
- Open data

Specific and foundational

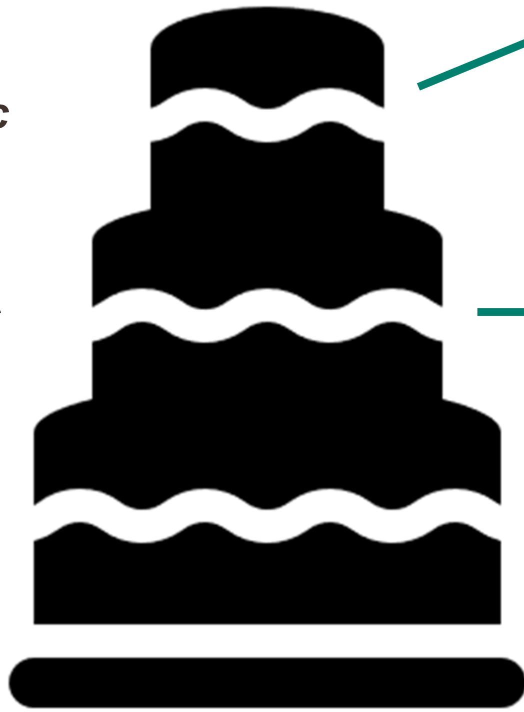


Image courtesy M. Beck, TBEP

NEXT STEPS?

http://clipart-library.com/

How do we continue the conversation?

Additional workshops?

Digging in?

Indicators and update?

THANK YOU

graulerson@tbep.org

www.tbep.org