



# Technical Cooperation Project: *Overview of the Environmental State of Guanabara Bay*

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April 29<sup>th</sup>, 2016



THE MOST INCREDIBLE THING  
WE'VE ENGINEERED IS **OUR TEAM**

# AGENDA



**Next steps**

**Experience of  
Maryland with  
Chesapeake Bay**



**Overview of the  
Status of  
Guanabara Bay**



**Objectives of  
this workshop**



**Technical  
Cooperation  
Project**



# Technical Cooperation Project Objectives



To clearly explain to interested sectors of society of the State of Rio de Janeiro:

- The current state of Guanabara Bay
- The **main threats** impacting the health of the Bay
- A plan of action with **short**, medium and long terms milestones to restore the Bay

# Technical Cooperation Project Approach



# Technical Cooperation Project Approach



ecoreportcard.org/report-cards/baía-de-guanabara/saúde

## A sua Baía de Guanabara é saudável?

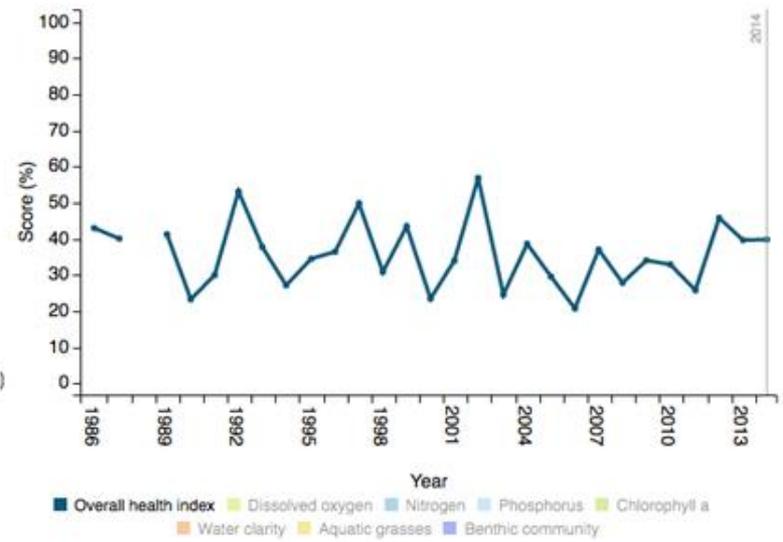
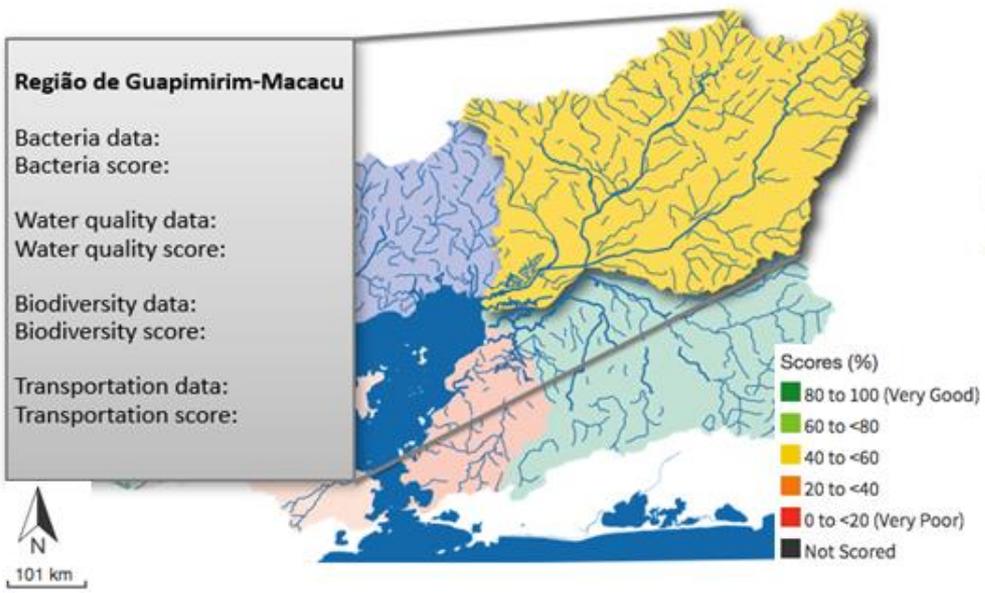
2014

### ① POR INDICADOR



### ① POR REGIÃO / Região de Guapimirim-Macacu

### TENDÊNCIAS / Região de Guapimirim-Macacu



# Technical Cooperation Project Methodology



- These objectives will be accomplished **with stakeholder input and incorporation of public comments** at each step of the project.

## 1º Workshop - (TODAY)

Overview of the State of the Bay and initial selection of environmental indicators

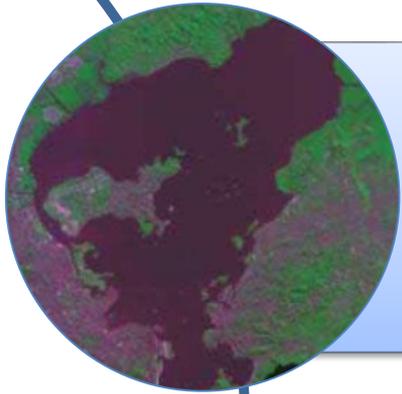
## 2º Workshop

Discussion of the restoration actions needed and their priorities

## 3º Workshop

Presentation and discussion of the recommended action plan and digital platform

# 1<sup>st</sup> workshop objectives



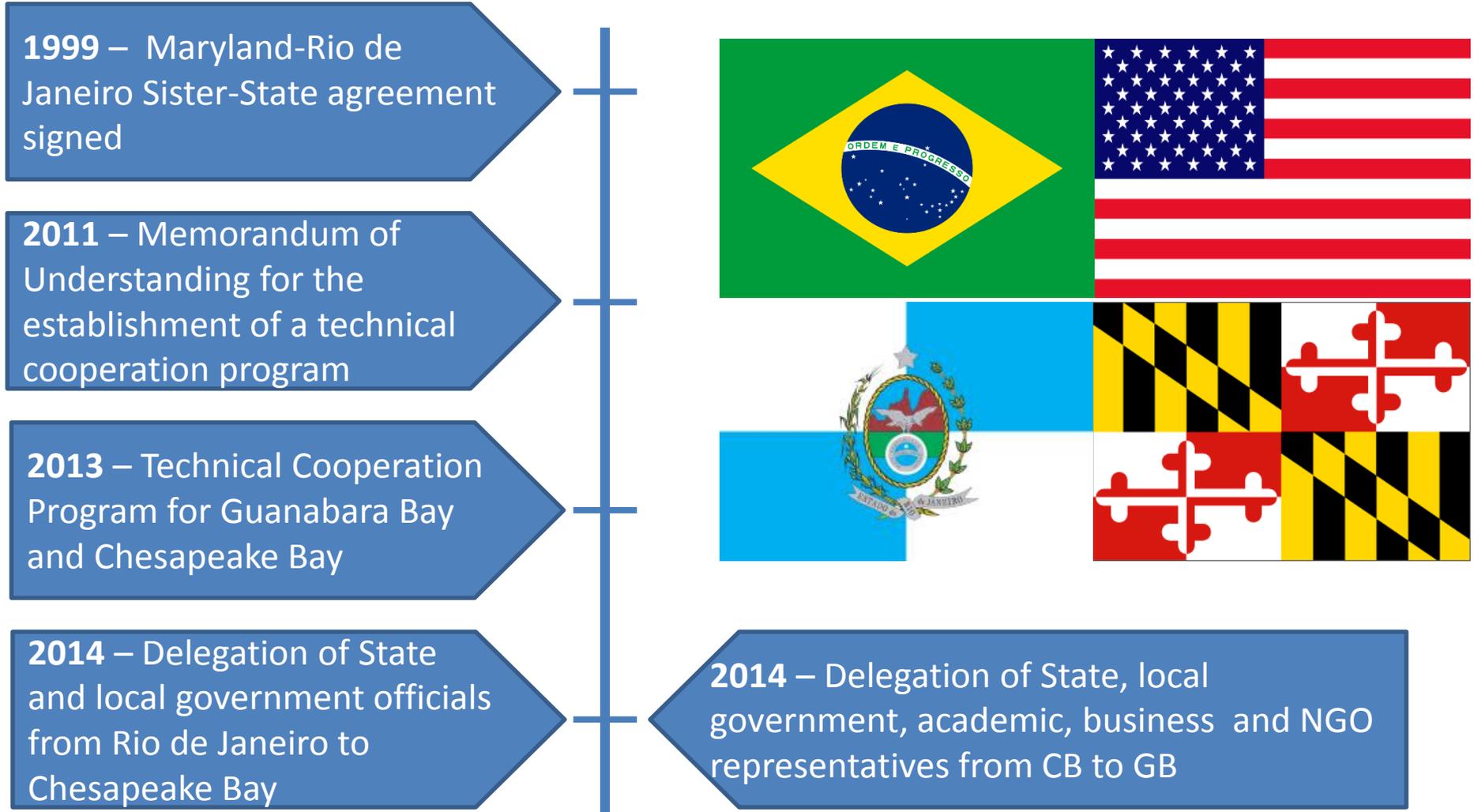
To receive your recommendation and achieve consensus to the extent possible on the current environmental condition and the main factors affecting the health of Guanabara Bay



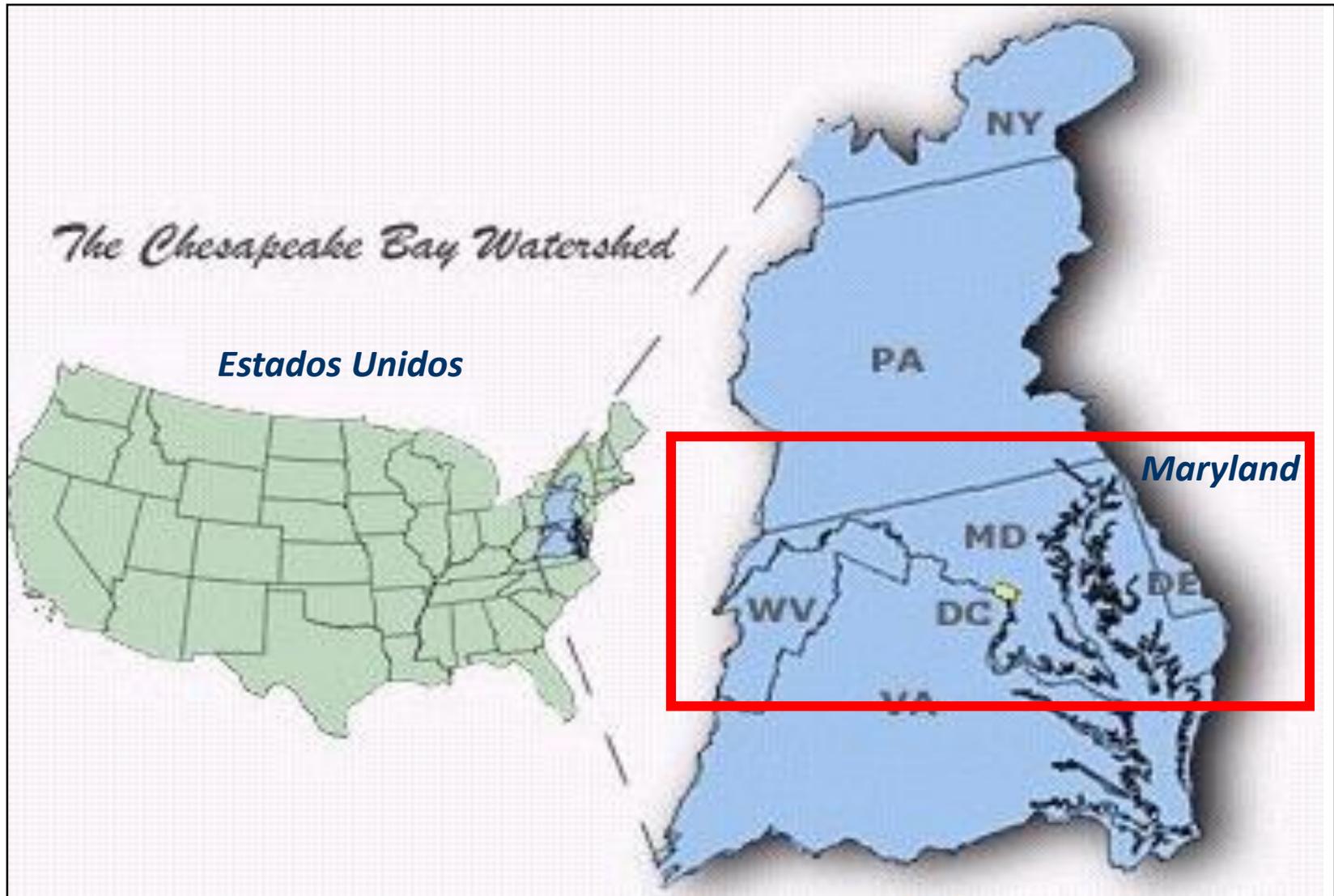
To identify the most appropriate indicators of environmental conditions that must be monitored to measure and track restoration progress

# Why are we here?

## Maryland-Rio de Janeiro Sister-State Agreement



# Where is Chesapeake Bay?



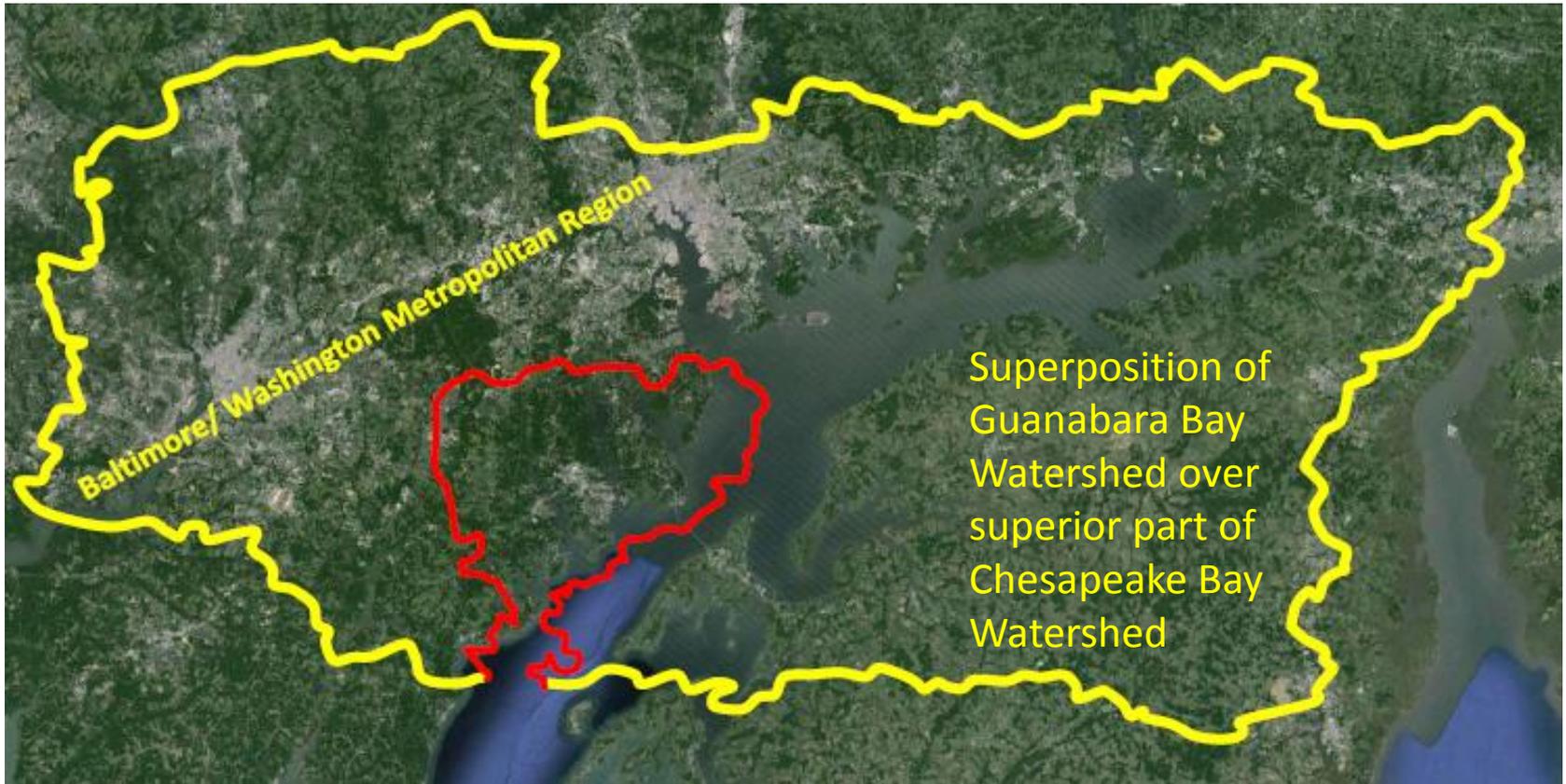
# Why Look at Chesapeake Bay?



- Chesapeake Bay shares many of the same challenges as Guanabara Bay
- Chesapeake Bay is further along in the restoration process and may provide some helpful insights to benefit the Guanabara Bay restoration
- The watershed is much more densely populated
- Guanabara Bay is closer to the ocean and is better flushed
- Guanabara Bay and its watershed are much smaller than Chesapeake Bay



# GB Watershed is also similar to the Baltimore - Washington Metro area (RMBW)



- Drainage area
- Population
- Dense urbanization
- Pollution sources
- Water quality problems

# Comparison to Baltimore – Washington Metropolitan Region (RMBW)



## ■ Population

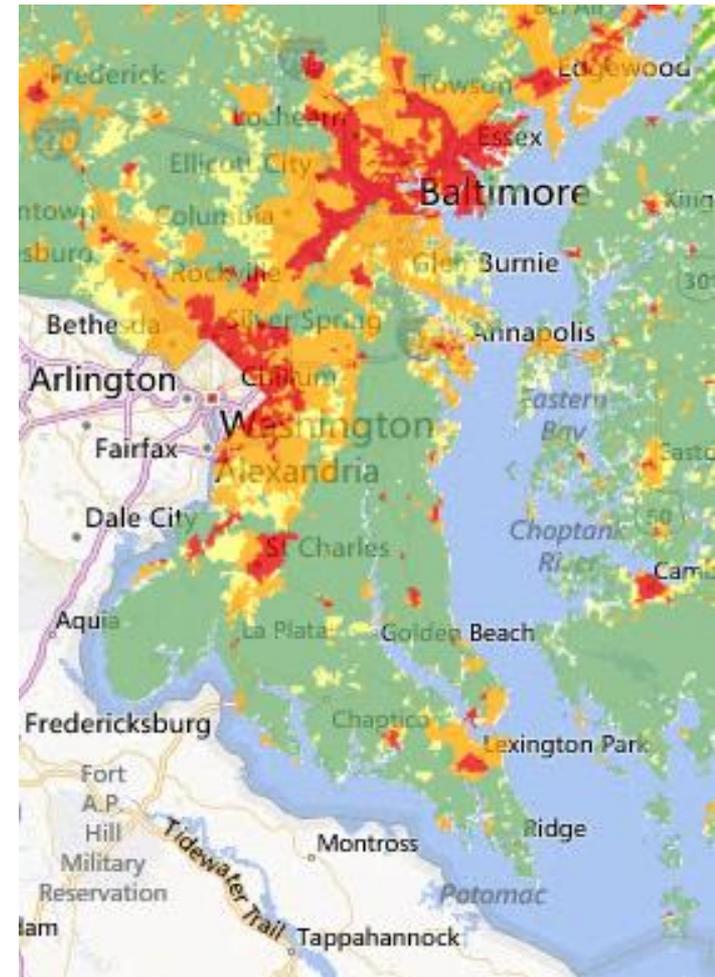
- BWMR – 9.3 million
- RJMR – 8.6 million (GB Watershed)

## ■ Political

- BWMR – 2 states, 13 counties and 3 major municipalities
- RJMR – 1 state, 15 municipalities

## ■ Sanitation problems

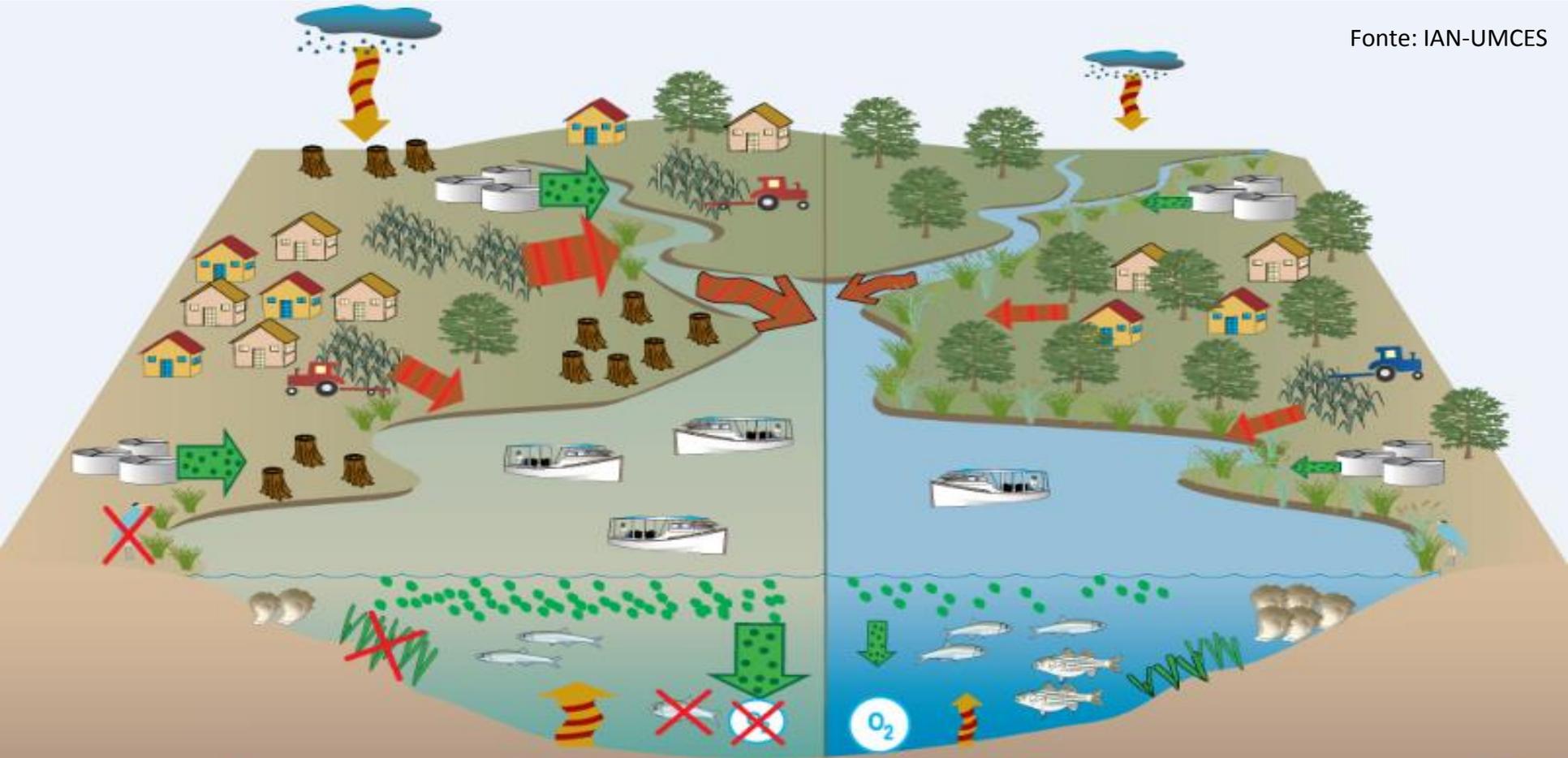
- BWMR - CSOs & SSOs, \$4.8 B sewage/drainage system restoration underway
- RJMR – 70-80% of sewage untreated, major infrastructure development underway



# Chesapeake Bay Restoration Challenges



Fonte: IAN-UMCES



Intense farming and development increase nutrients and sediment ; nitrogen and phosphorus inputs ; and organic matter which promote large algal blooms that consume oxygen and decrease water quality.



# Chesapeake Bay Restoration



- Long-term commitment and strong public support
- Started in 1972, with the signing of the US Clean Water Act
- Extensive scientific studies into the causes for the decline of the Bay
- The original **1983 Chesapeake Bay Agreement** was a simple, one-page pledge signed by political leaders to establish the governance structure of the Chesapeake Bay Program
- **The 2014 Agreement** builds upon a long history of restoration efforts
- Our work is still not done.



**Chesapeake Bay Program**  
*A Watershed Partnership*

# From Chesapeake Bay experience: Long-term goals alone are not enough...



Two prior commitments for Bay Restoration were not met:

- 1987: 40% nutrient reduction by 2000
- 2000: Water quality restoration to be achieved by 2010 or TMDL would ensue

Decade long commitments don't seem to be effective, so short-term 2-year milestones have been set to track progress: 2011, 2013, 2015, 2017 ... 2025



# Chesapeake Bay: Comprehensive Restoration Plan



2014 Chesapeake Bay Agreement includes specific goals for:

- Pollution reduction, watershed restoration, aquatic habitat, fisheries, land conservation
- Public access, community engagement, environmental education

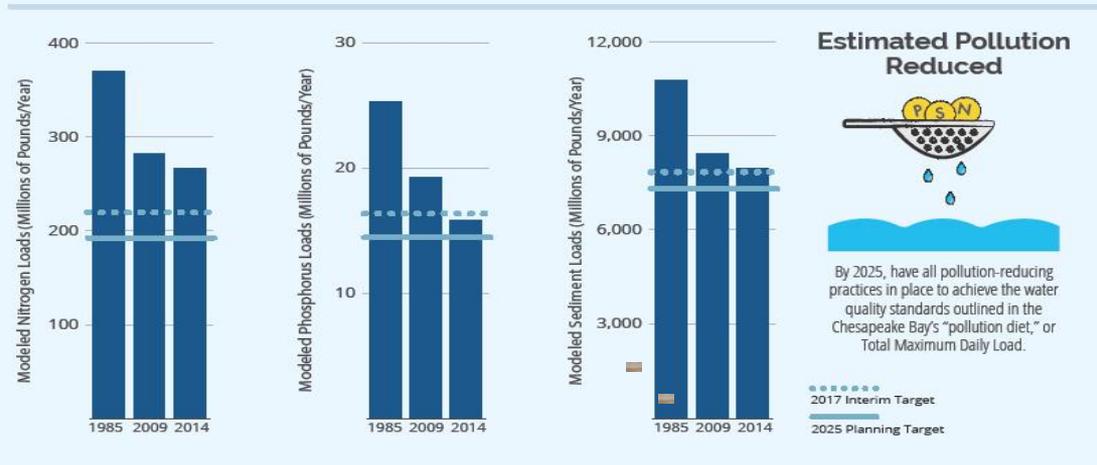
Implementation teams include government, academic, business, NGO and citizen members working cooperatively

Federal, state and local government, business and NGO funding for staff and implementation

# Transparent Public Reports Available On-line



## BAY BAROMETER 2014-2015

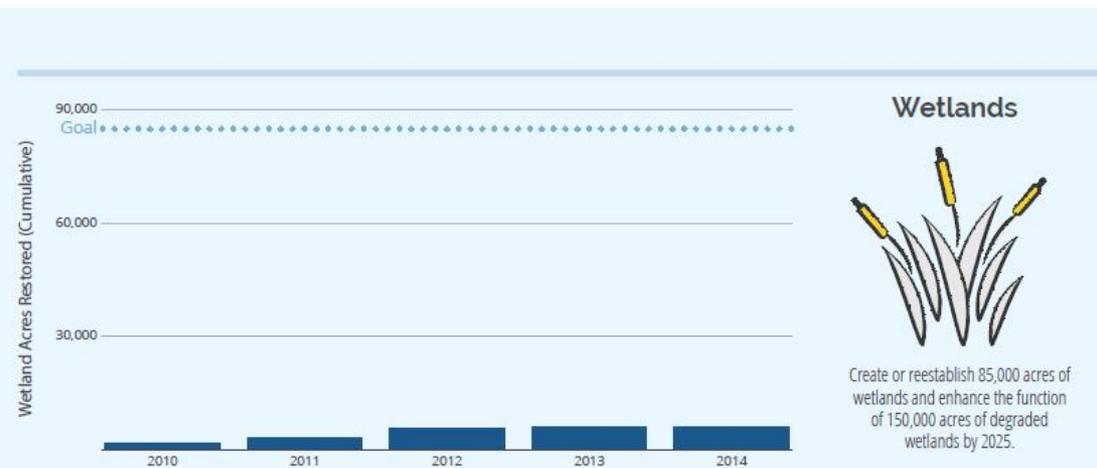


### Clean Water

Reduce pollution and restore water quality to support living resources and protect human health.



Provide details of the restoration efforts.



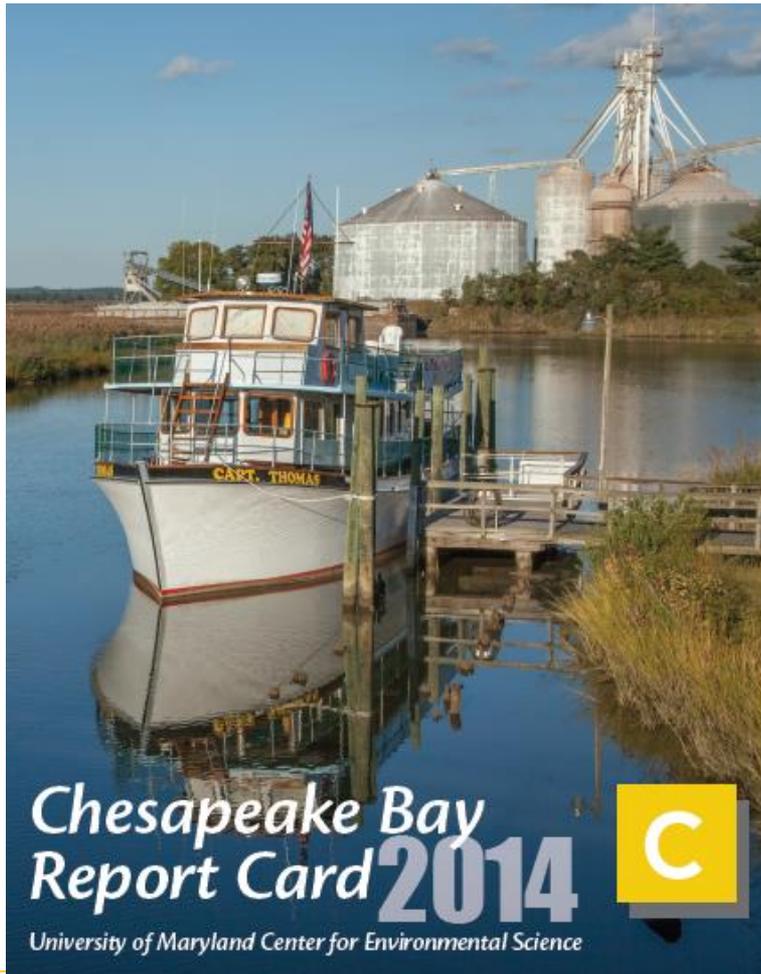
### Abundant Life: Habitats

Protect and restore land and water habitats to support fish, wildlife and clean water and offer scenic and recreational benefits.

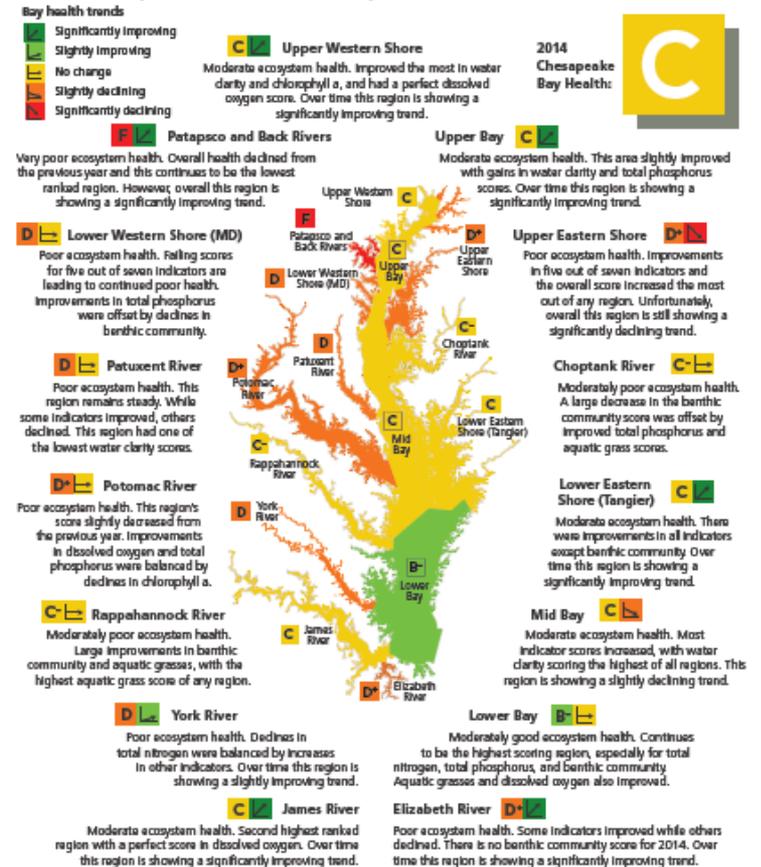
# Annual "Report Card"



So citizens can follow the restoration progress and ensure actions are being taken.



## Overall improvement but still poor to moderate conditions



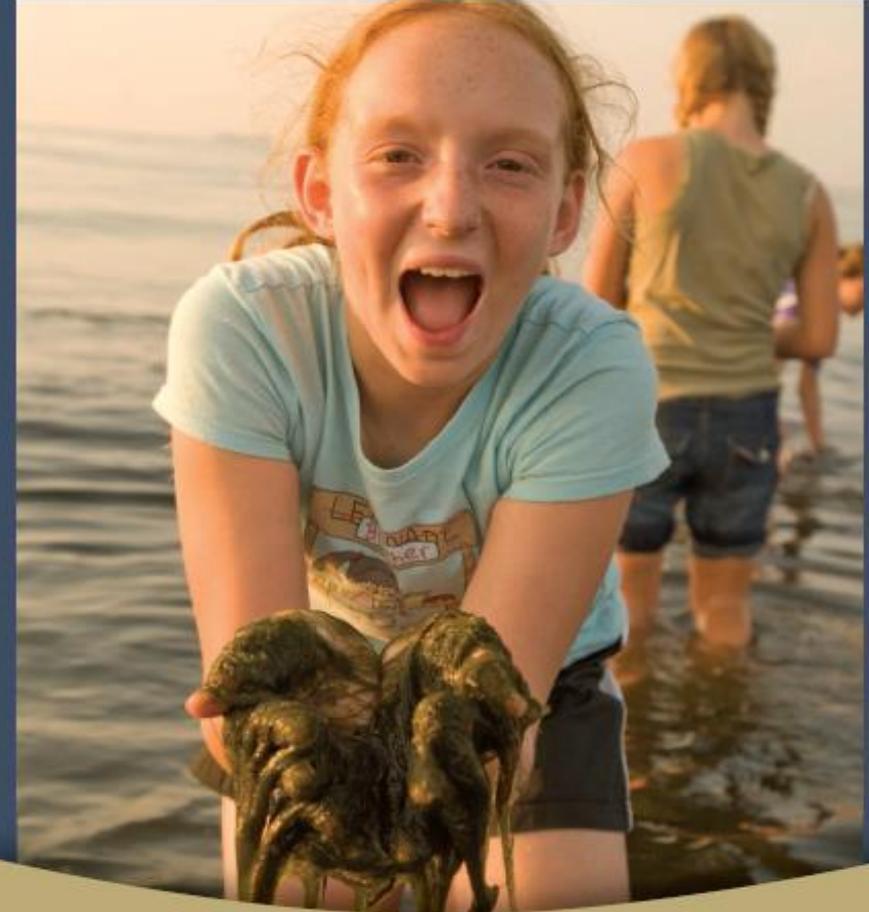
# Environmental Education Curriculum



Chesapeake Bay Program  
SCIENCE • RESTORATION • PARTNERSHIP

[chesapeakebay.net/groups/group/education\\_workgroup](http://chesapeakebay.net/groups/group/education_workgroup)

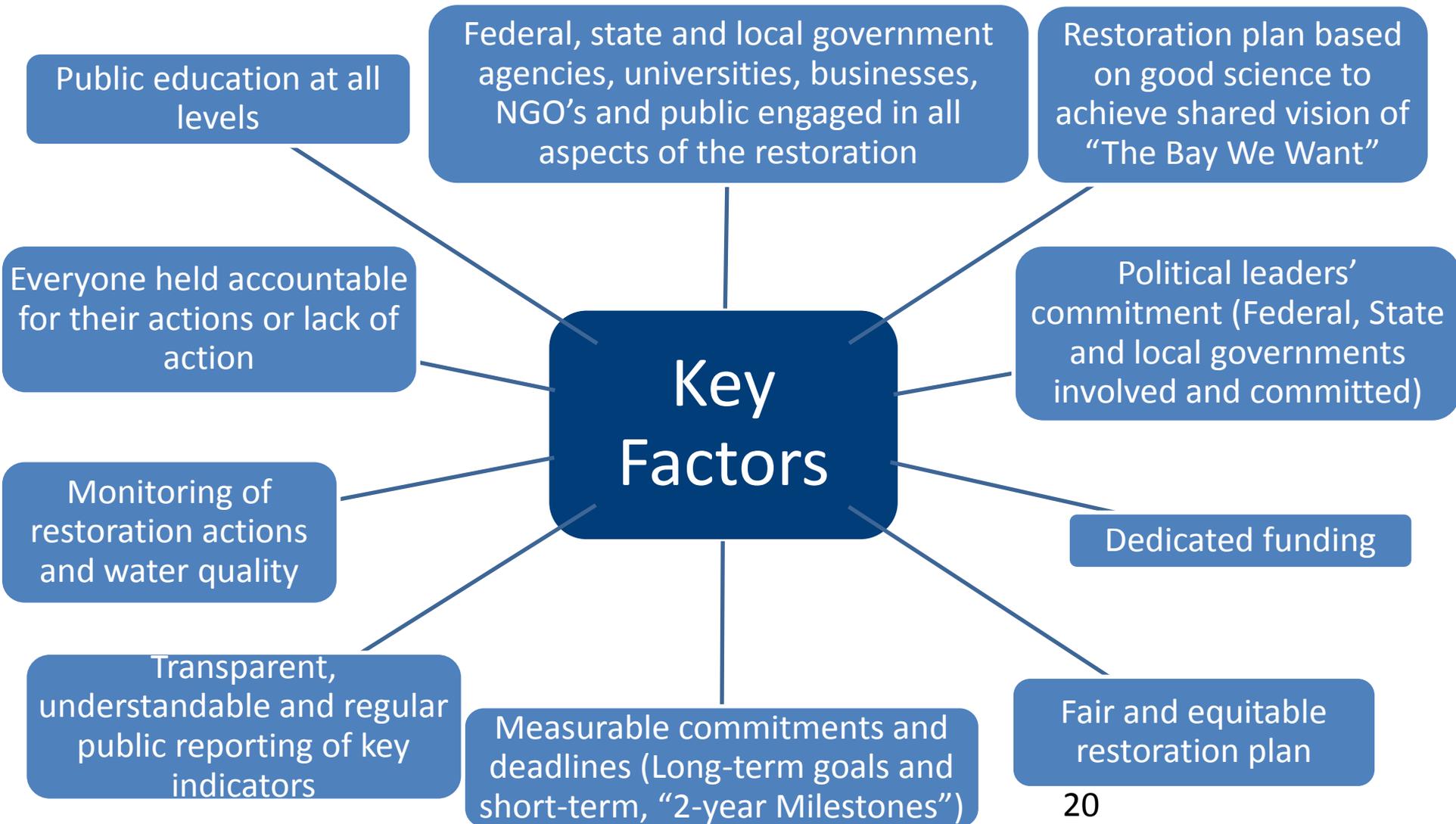
Education of the next generation is the key to long-term success!



MID-ATLANTIC ELEMENTARY AND SECONDARY  
ENVIRONMENTAL LITERACY STRATEGY

Executive Summary

# Keys to a Successful Bay Restoration



# Current State of Guanabara Bay

- Rio de Janeiro is world famous for its beautiful subtropical scenery and beaches, but...

Fonte: IAN-UMCES, 2015

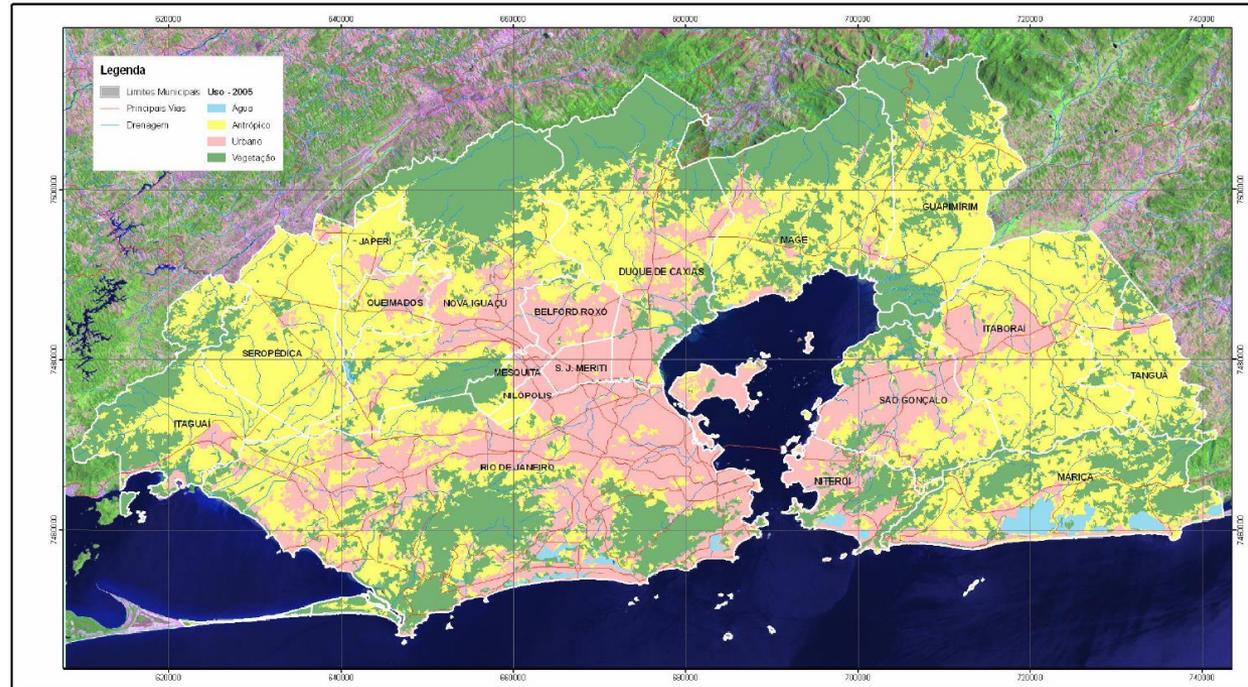


Diagrama conceitual da Baía de Guanabara e sua Bacia Hidrográfica.

# Guanabara Bay Watershed: Land Use



- Highly urbanized
- Urban areas close to Bay
- Rapidly growing



Urban

Agriculture, mining,  
silviculture, other  
human uses

Natural  
vegetation

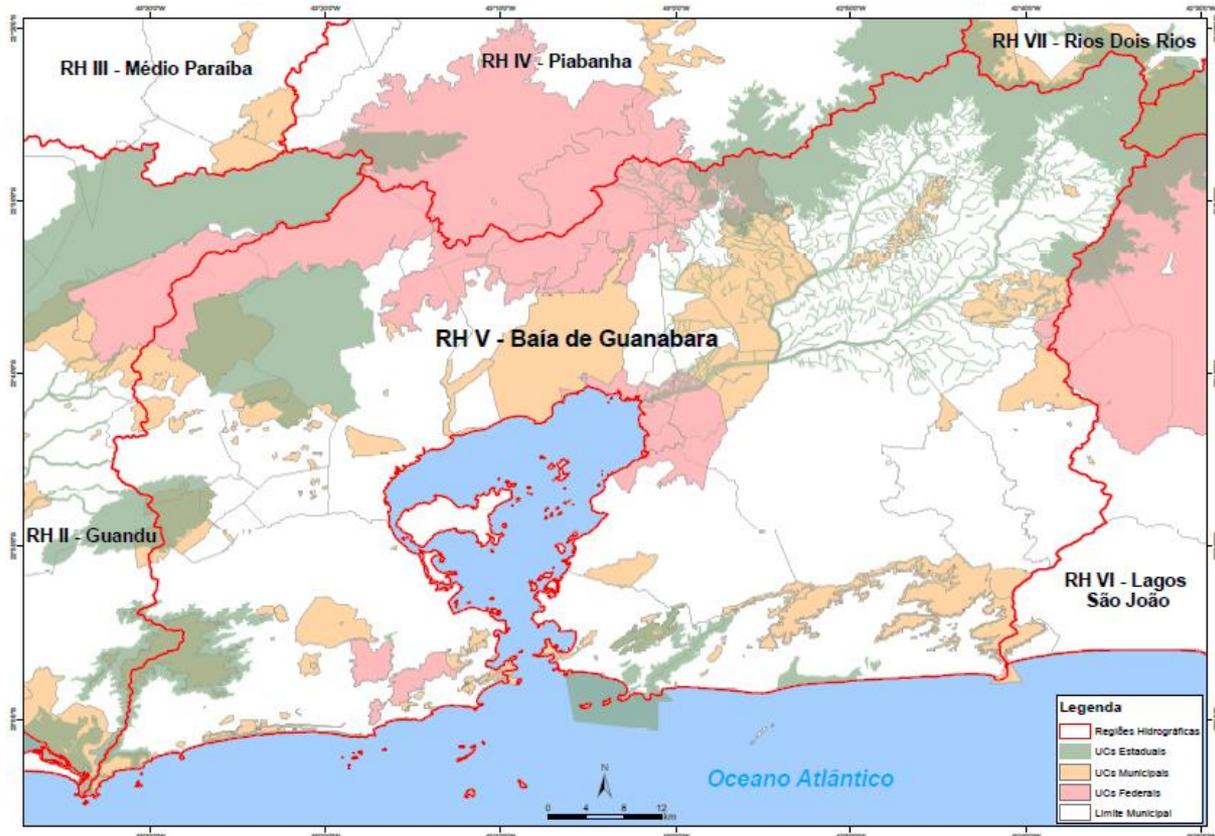
# Guanabara Bay Watershed: Land conservation areas



**Before colonization, Rio de Janeiro State had 97% of its territory covered with vegetation**

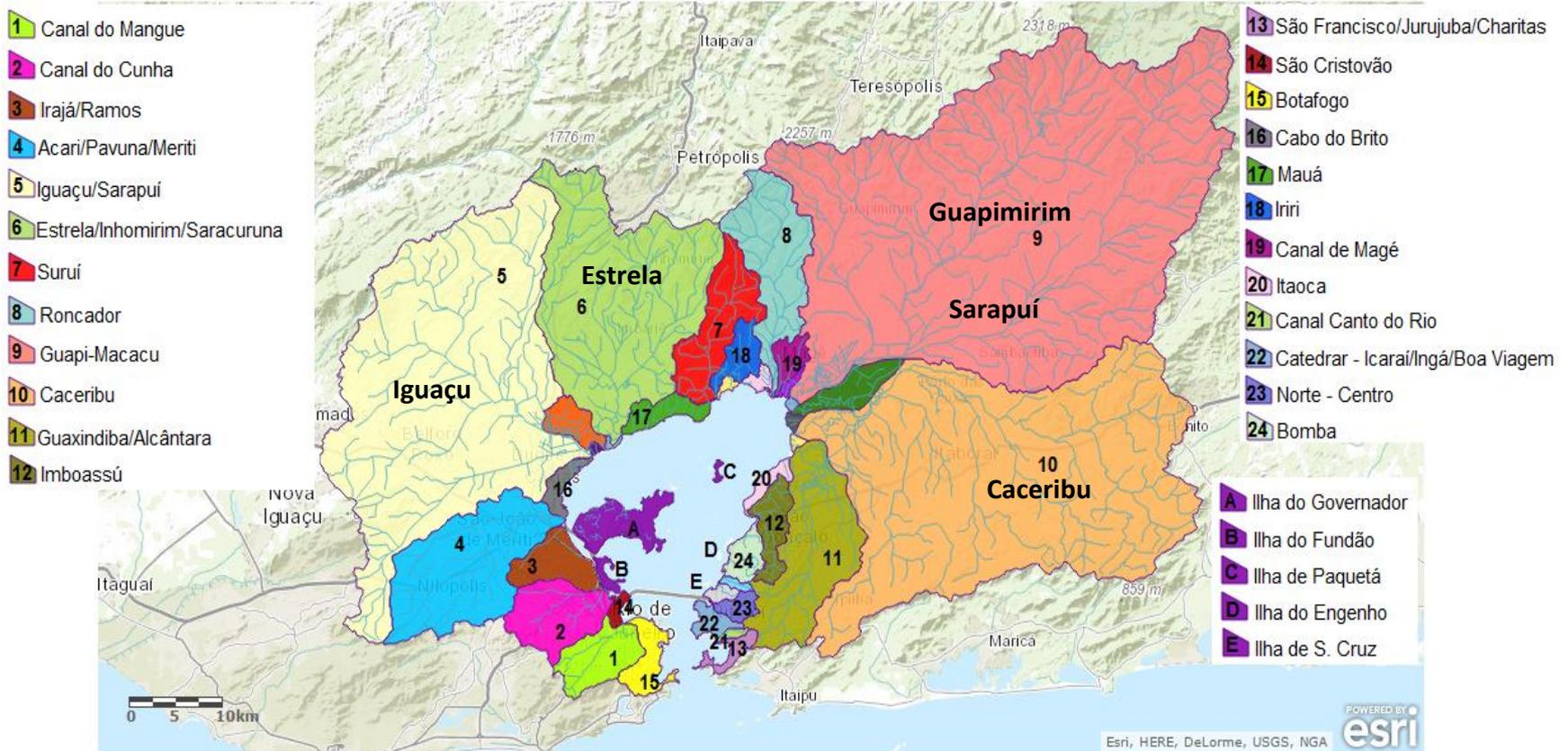
Conservation areas, partially or totally included in the Guanabara Bay Watershed:

- Federal: 5
- State: 4
- Municipal: 121
- Private: 7



Source: INEA, 2016

# Guanabara Bay Watershed: Major River Basins



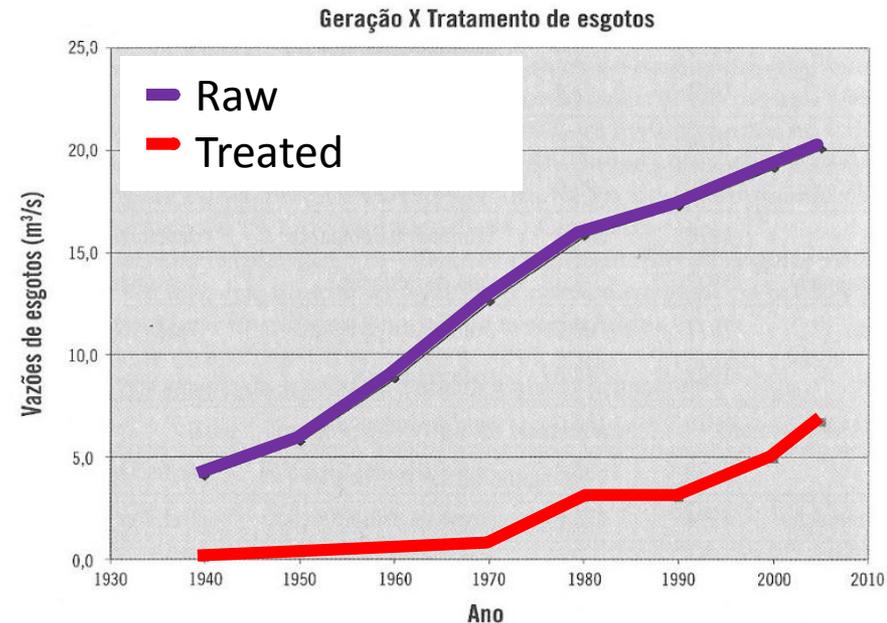
Sub-basins of Guanabara Bay Hydrographic Region. Source: Modified from <http://cbh-bg.maps.arcgis.com>

- The five largest rivers contribute 70% of the fresh water flow to the Bay
- Estimated river flow into the Bay is 100-200 m<sup>3</sup>/second
- Limited information on flow and pollution loading from rivers

# Guanabara Bay Watershed: Sanitation



- Over the last 50 years, sewage infrastructure has fallen behind population growth
- Old urban sewage collection systems are not able to handle higher flows
- No system improvements were made between 1980 and 1990
- Since 1990, the pace of sewage system improvements has increased due to PDBG and now PSAM, but sewage system improvements are just barely keeping pace with population growth
- In 2014, PSAM estimates 21% of the population is served by sewage treatment
  - Projects are underway to bring that up to 35% by 2018



Sewage generation and treatment in Guanabara Bay Hydrographic Basin.  
Source: Coelho, 2007

# Guanabara Bay Watershed: Solid Waste



Poor handling of solid waste

Illegal dumping

Visual pollution

Odors

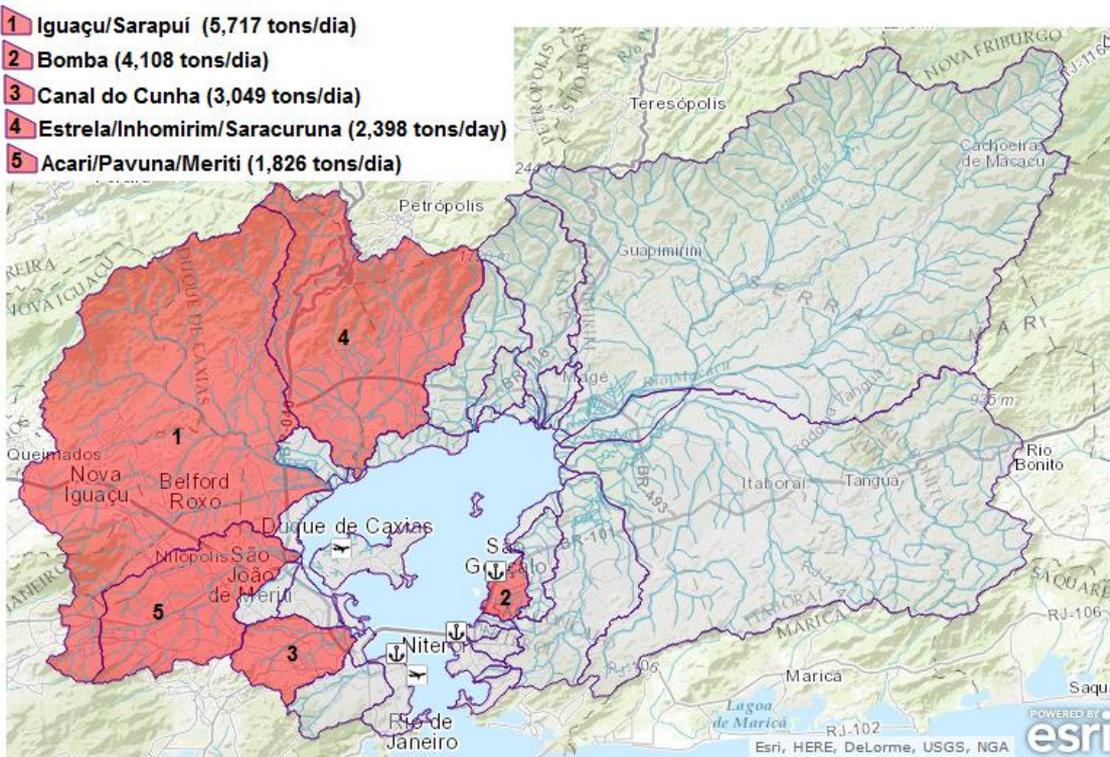
Disease vector

Barrier to recreation and boat traffic

Hazard to wildlife



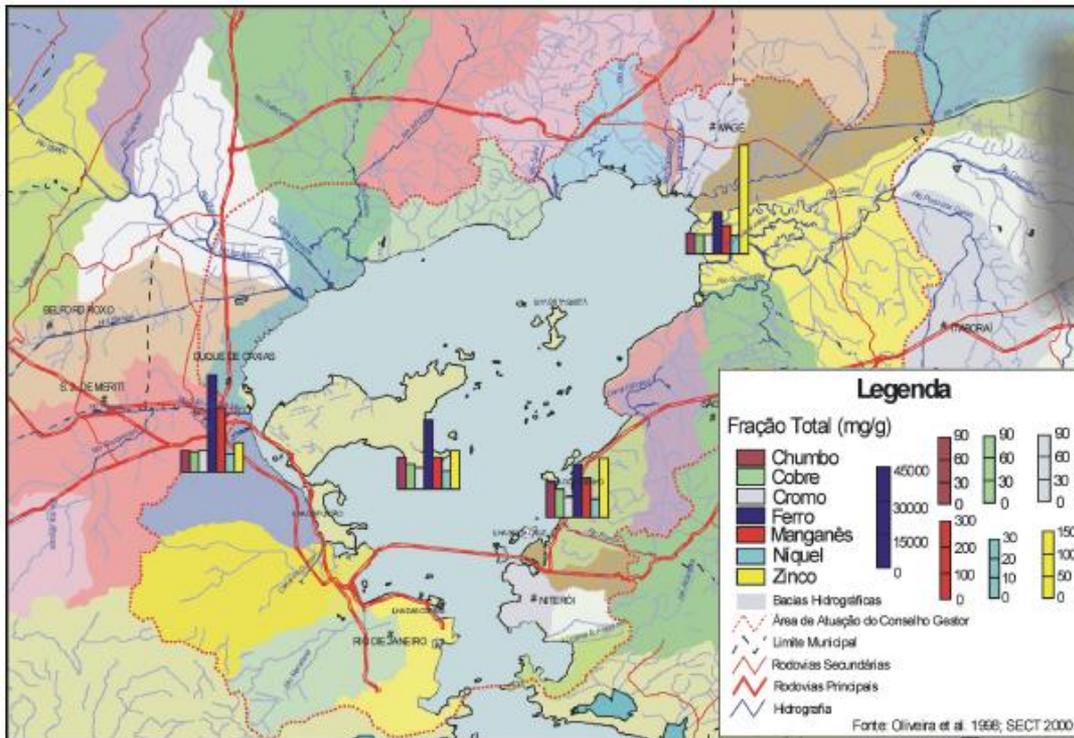
# Guanabara Bay Watershed: Industries



- Main sectors: Chemical, petrochemical, non-metallic minerals and metallurgical, food and beverage, textile, transportation material.
- Responsible for ~10% of organic load and almost the entire toxic load.

The sub-basins that most contribute for industrial organic load according information from 2000. Source: Pacific Consultants International, 2003.

# Heavy Metals

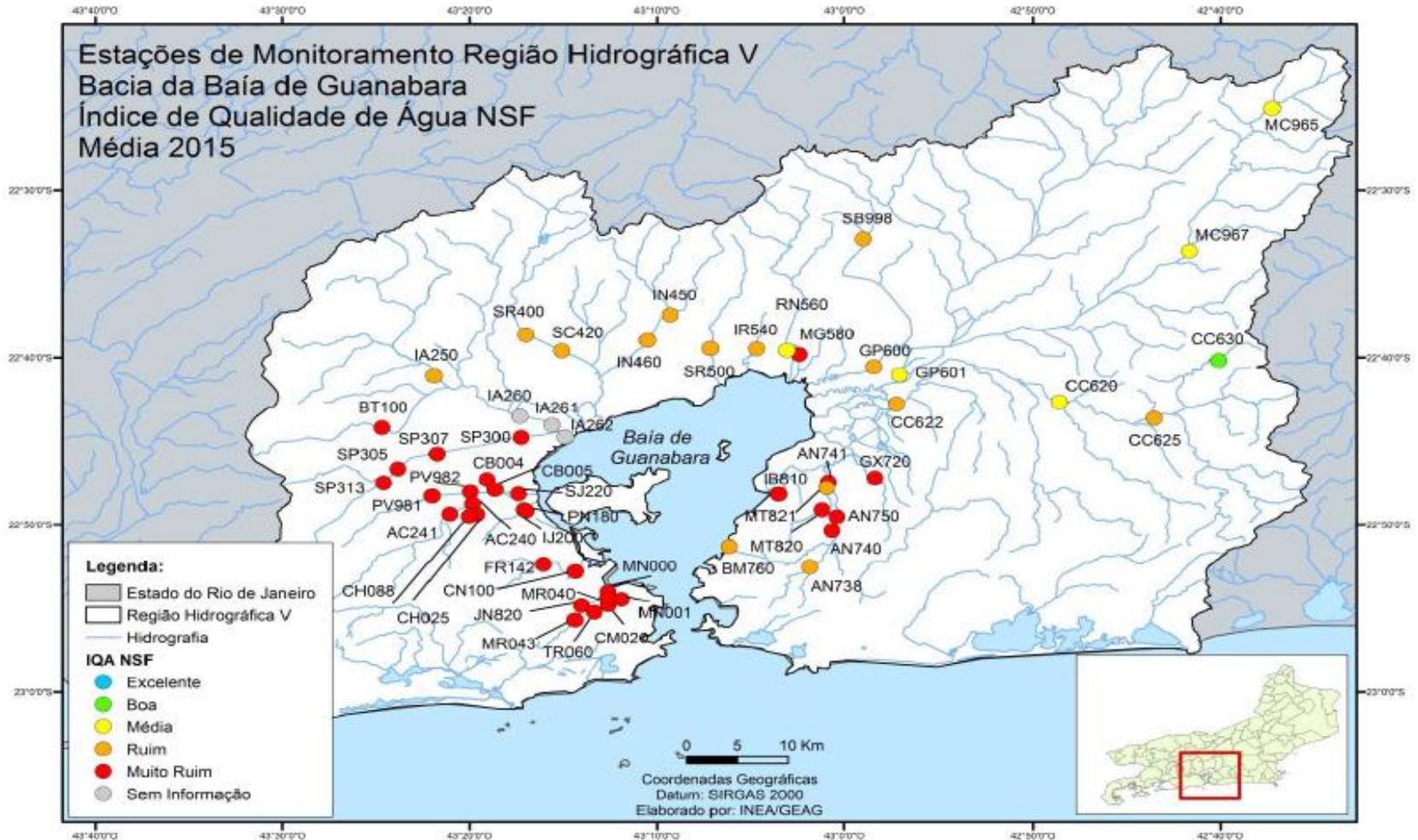


- > concentrations: northwest
- < concentrations: entrance
- **Areas of concern:**
  - Northwest portion
    - Outfall of River Meriti
  - Rio de Janeiro Port
  - Niterói Port
  - Mangroves in REDUC area
  - Guapimirim mangroves

The areas with significant presence of heavy metals.

Source: ITPA (n.d.).

# Guanabara Bay Watershed 2015 Median Water Quality Index



Source: INEA/GEAG, 2016

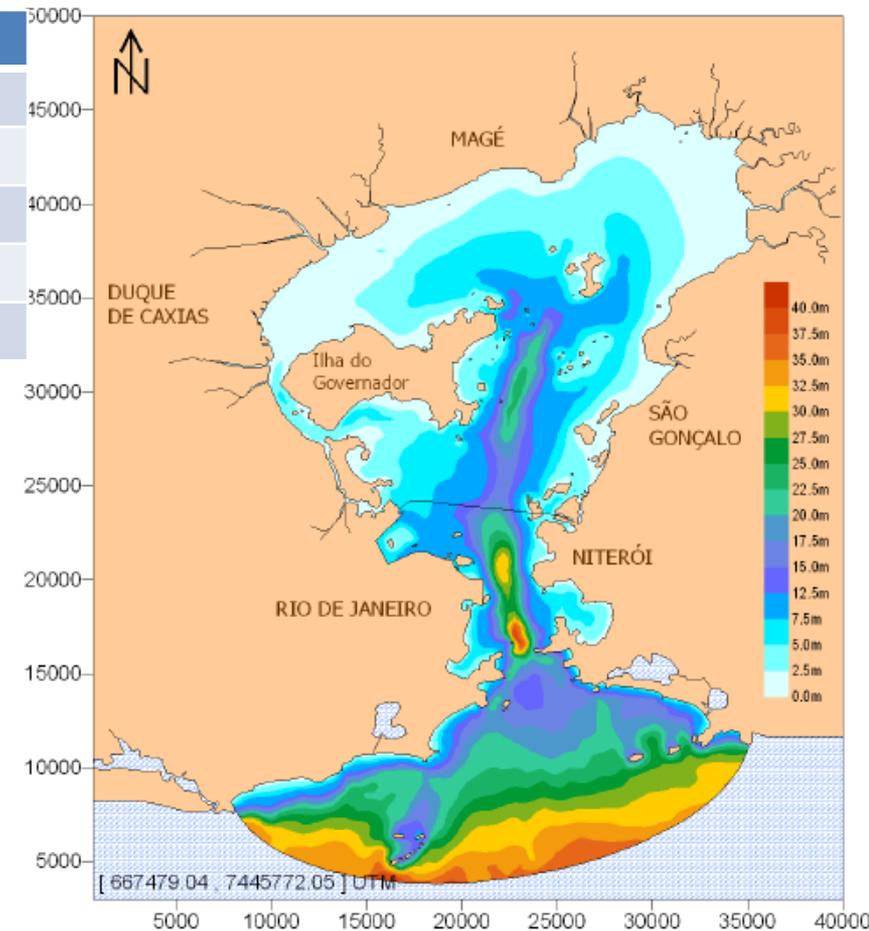
# Guanabara Bay

## Physical Characteristics



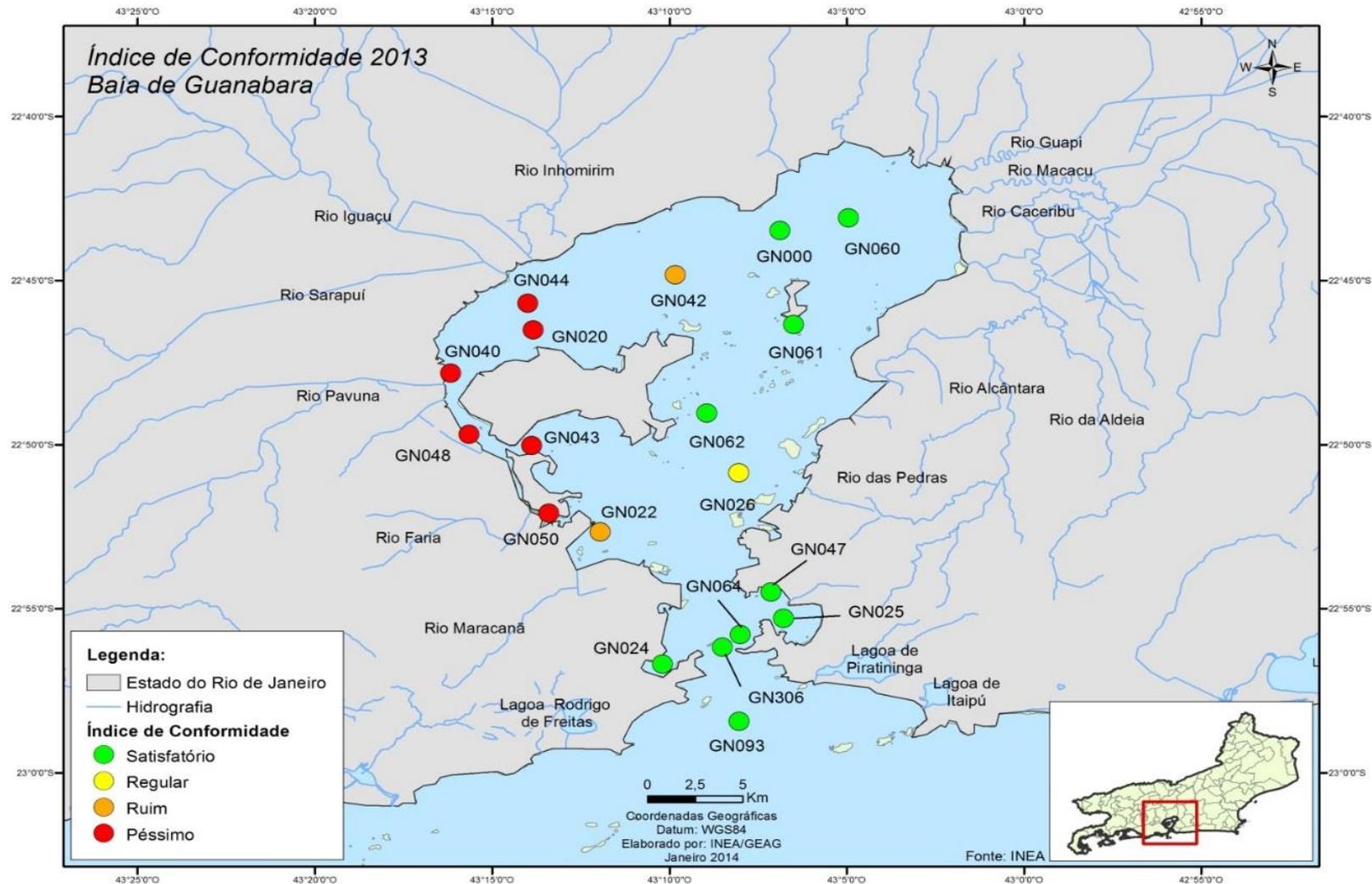
Guanabara Bay	
Surface Area	328 km <sup>2</sup>
Depth	84% < 10 meters
Watershed Area	4,080 square kilometers
Average river inflow	100-200 m <sup>3</sup> /s
Population of watershed	8.6 million

- Water circulation is primarily controlled by tidal currents
- 2-layer circulation with cooler, salty ocean water flowing in at depth and warmer, fresher water flowing out at the surface
- High tidal flows bring sand into the Bay mouth area
- The inner portions of the Bay are silt and clays transported by rivers entering the Bay



Guanabara Bay Bathymetry. Source: Sampaio, M. (2003)

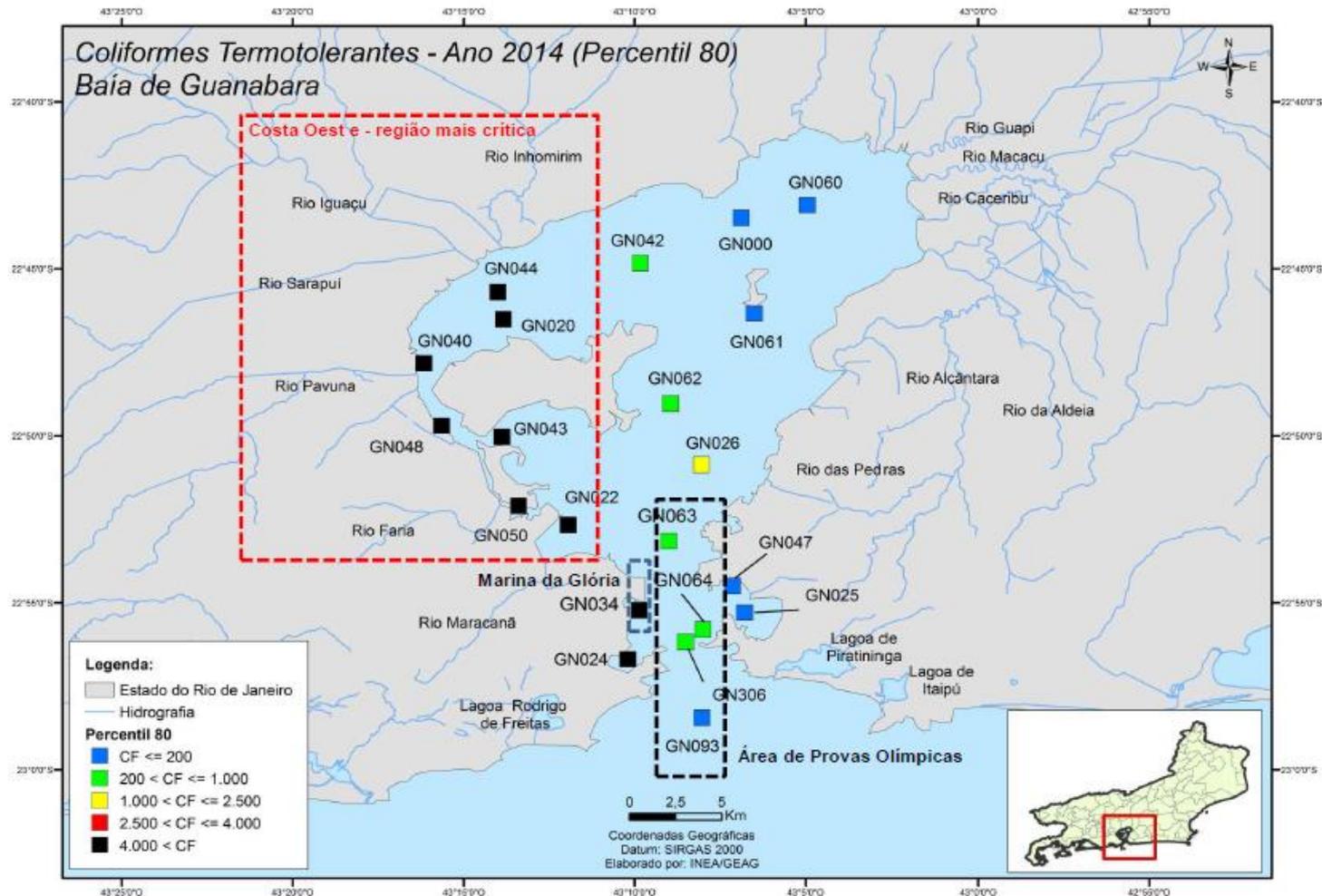
# Guanabara Bay 2013 Conformity Index



Source: INEA/GEAG, 2014

# Guanabara Bay

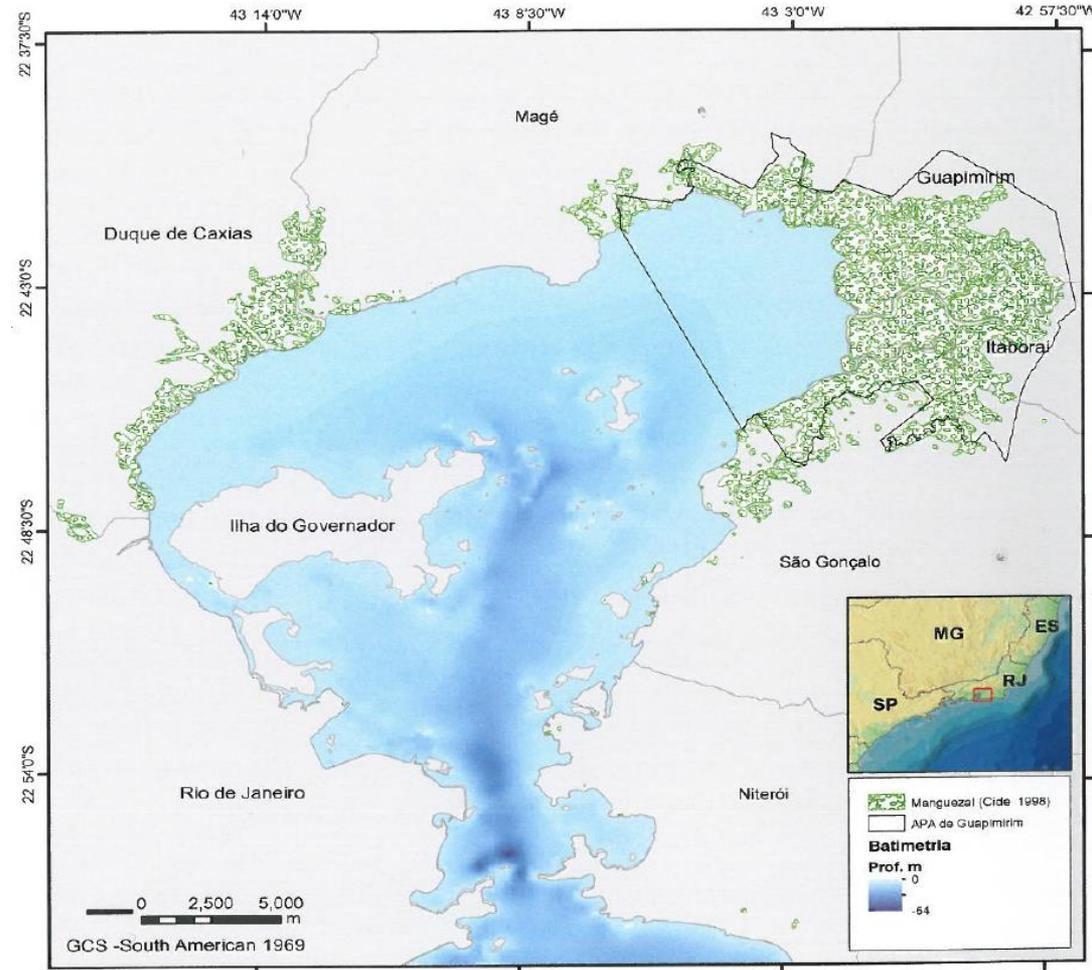
## 2014 Coliform Levels (80<sup>th</sup> percentile)



Source: INEA/GEAG, 2014

# Mangroves

- Mangroves filter out pollution and are critical to the health of Guanabara Bay and its ecosystem
- Estimated 262 km<sup>2</sup> of mangrove vegetation originally observed before the Portuguese colonization in the 16th century
- Less than 1/3 of the original is still present in the region

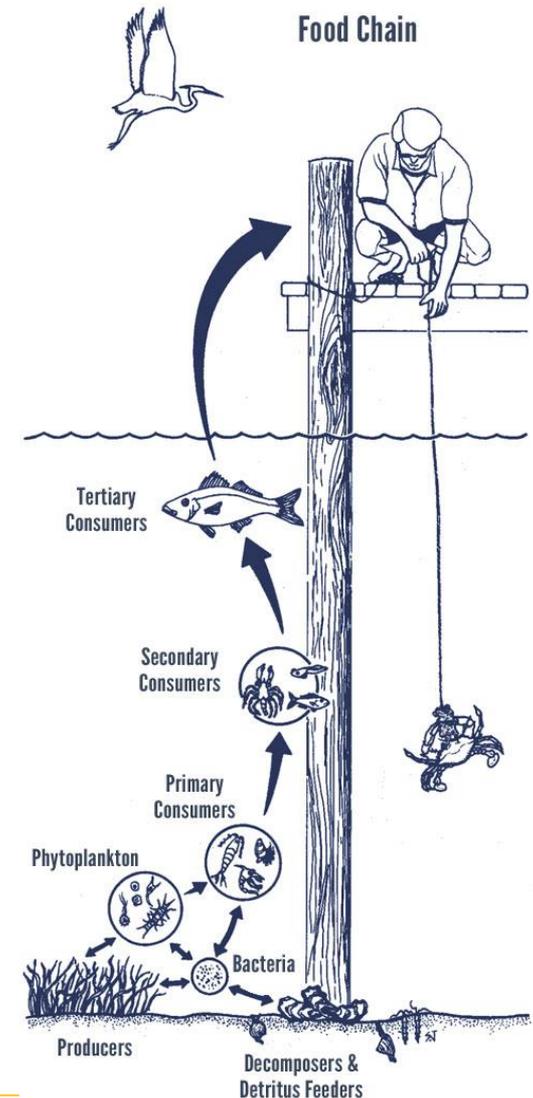


(Source: Amador, 2012)

Source: Baía de Guanabara: Síntese do Conhecimento Ambiental, 2012)

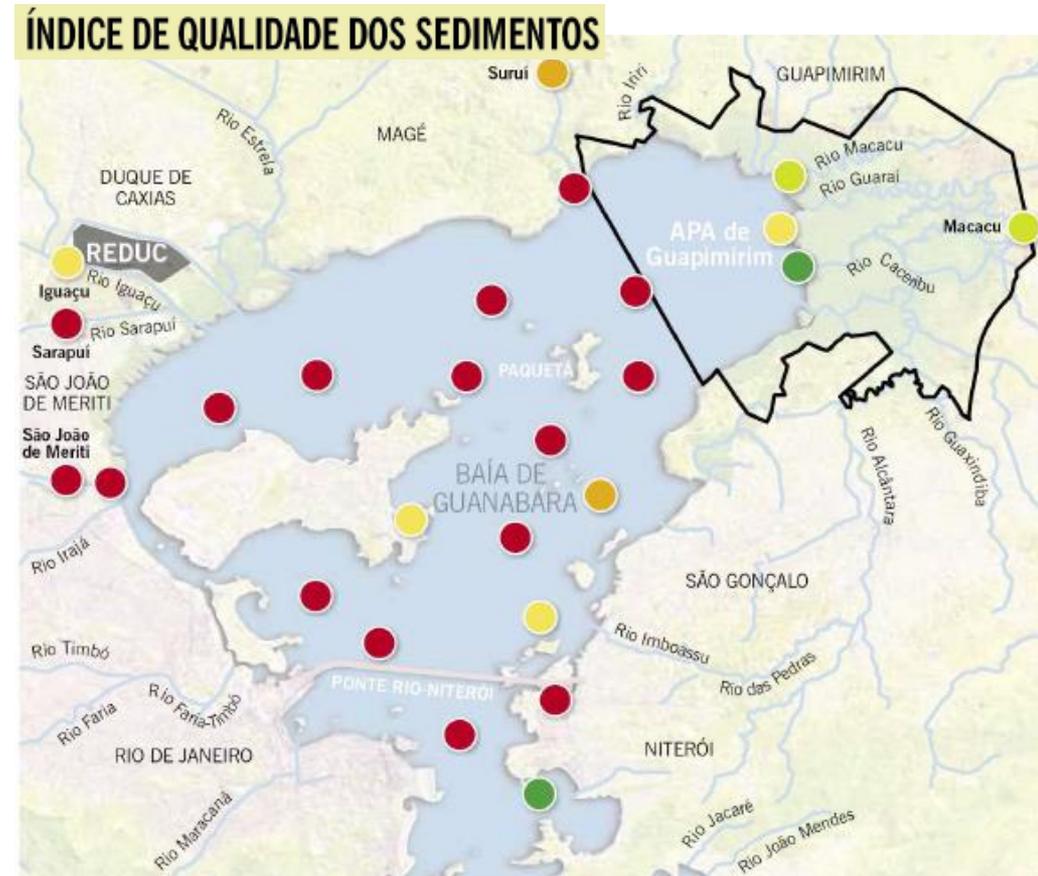
# Ecosystem Impacts

- Guanabara Bay ecosystem is overloaded with organic pollution from untreated sewage, wastewater from industries and ships and other sources, trash and other contamination from the land carried by rainfall runoff to the rivers.
- Plants and animals living in the Bay are stressed and populations are not healthy, particularly in the inner parts of the Bay further from the ocean.
- A healthy ecosystem is essential to water quality and to support the fisheries in the Bay and the nearby ocean.



# Ecosystem Impacts - Benthos

- Plants and animals living in the sandy sediments near the mouth of the Bay are reasonably healthy
- The inner and intermediate regions of the Bay where bottom sediments are contaminated have low biodiversity and high biomass with a predominance of opportunistic species tolerant to pollution
- Contamination by petroleum hydrocarbons is pervasive
- Contamination of some mangroves can be observed in the high concentration of PAHs found in crabs collected in the area.



Source: O Globo – Planeta Terra, 2011

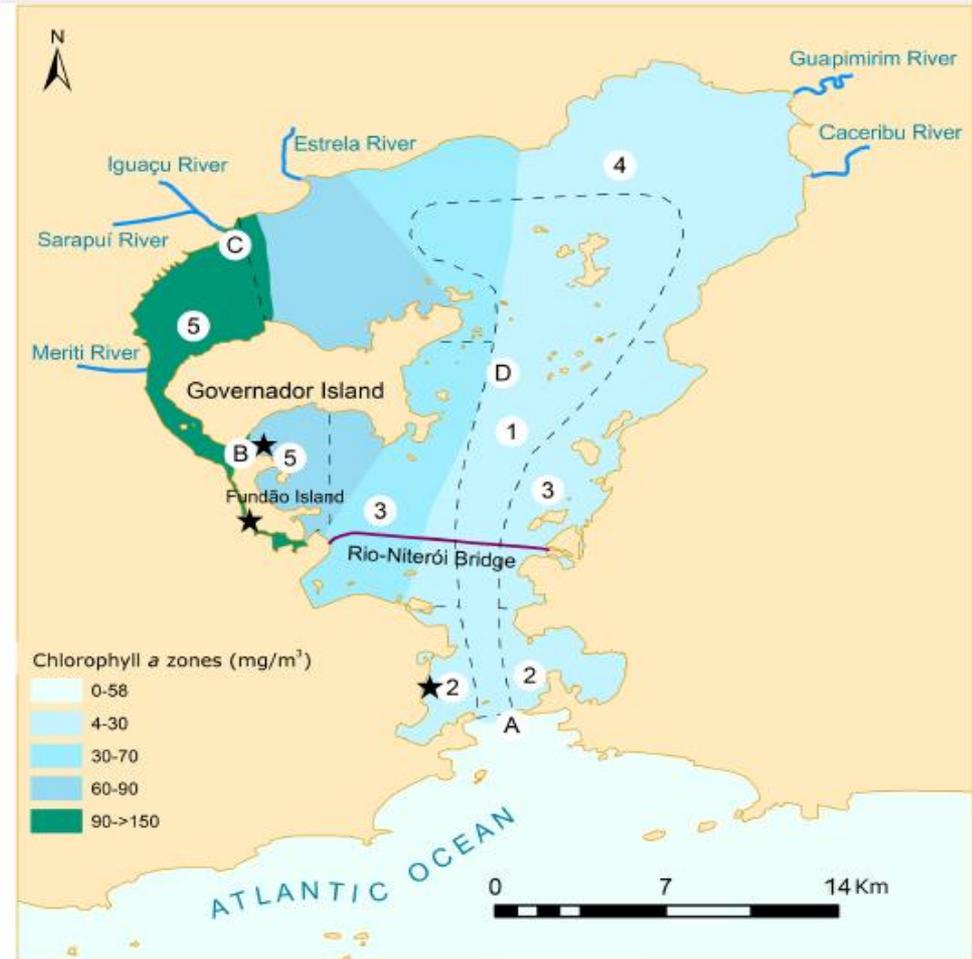
# Ecosystem Impacts - Phytoplankton

- Areas near the mouth of the Bay are healthier and have greater biodiversity of phytoplankton communities due to **large marine influence** and greater transparency of the water
- Lower biodiversity and opportunistic species like the cyanobacteria occur in the internal areas of the Bay under influence of polluted tributaries

(Amador, 2012)

- Harmful algal species that produce the neurotoxin domoic acid are present in the system.

(Villac and Tenenbaum, 2010; Guanabara Bay: Summary of Environmental Knowledge, 2012; Santos et al., 2007)



Source: Fistarol et al., 2015.

# Ecosystem Impacts - Fisheries

- Guanabara Bay is an important nursery for many fish species that use the habitat provided by the bay for reproduction
- Shoals of various fish such as mullet, sea bass, true sardines, catfish, yellowtail, sea bass, *paratis* and *aracás* were found in the Bay in a 1979 survey
- Poor water quality and bad ecosystem quality impacts negatively fishing activities in the Bay and adjacent coastal areas

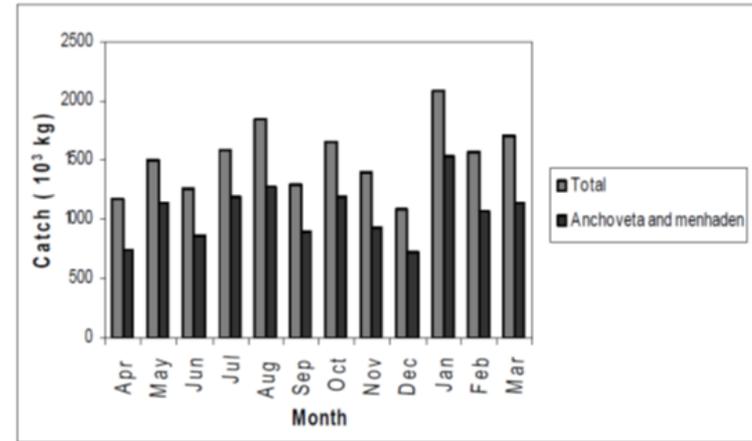


Figure 3 - Monthly variation of total landings when compared to those of Atlantic anchoveta and Brazilian menhaden (*Cetengraulis edentulus* and *Brevoortia* spp.) in Guanabara Bay, between April 2001 and March 2002.



# Many Restoration Needs



Renovate existing and construct new sewage collection and treatment systems

Enforce and strengthen industrial pollution laws

Prevent further expansion of favelas into steep slopes, flood plains, mangroves, etc.

Correct drainage and flooding by relocating favela residents, restoring flood plains and river channels

Improve solid waste collection and disposal

Remove contaminated sediments from canals and Bay

Protect and restore mangroves, fauna and flora



# What's different this time?

**Shared** public vision for the Bay – “The Bay We Want””

Restoration plan developed with **public input and support**

Short-term milestones to demonstrate **progress**

**Credibility** through simple, highly visible metrics

**Transparency** through regular public reporting

Federal, state and local government, universities and public **working together**



Museum of Tomorrow

# Next Steps



**Listen to your comments and suggestions on the:**  
Technical Cooperation Project  
State of Guanabara Bay  
Goals for the restoration

**2<sup>nd</sup> Public Workshop:**  
Discuss key features of a successful restoration plan

**3<sup>rd</sup> Public Workshop**  
Review proposed restoration plan and Guanabara Bay “scorecard”