



DEVELOPMENT OF A LARGE-SCALE RESTORATION PLAN FOR RIO DE JANEIRO'S GUANABARA BAY BASED ON MARYLAND'S CHESAPEAKE BAY EXPERIENCE



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State of Guanabara Bay

Rio de Janeiro, Brazil



- Rio de Janeiro is world famous for its beautiful sub-tropical scenery and beaches, but...
 - 8.6 million people living in the Bay's watershed
 - highly urbanized
 - poor sanitation and solid waste handling
 - industrial contamination
 - floating debris
 - high bacteria - health risks
 - high BOD, nutrients
 - algal blooms, low DO
 - sediment contamination
 - fisheries very limited



View of the City of Rio de Janeiro from Guanabara Bay in the area where the Olympic sailing events will take place.

Guanabara Bay Depollution Program (PDBG)



- Phase I initiated in 1993 with a joint loan by the Inter-American Development Bank and the Japan International Cooperation Agency
- Construction of sewage collection and treatment facilities began in 1997
 - Objective to reduce BOD load to Guanabara Bay
 - Three new sewage plants (Alegria, Pavuna and Sarapui)
 - 33% utilization due to incomplete collection system
 - 8-10% reduction in BOD from sewage as of 2012
 - “no visible positive impacts” on Guanabara Bay



Alegria Waste Water Treatment Plant

Source: Ex-Post Evaluation of Japanese ODA Loan - Guanabara Bay Basin Sewerage System Construction Project External Evaluator: Hajime Sonoda - July, 2013

2016 Olympic Commitments



- As part of its Olympic bid, the State of Rio de Janeiro committed to reduce sewage flow into Guanabara Bay by 80%
- Close garbage dumps and create sanitary landfills
- Install eco-barriers at river mouths to capture floating debris
- Operate eco-boats to collect floating debris from the Bay
- Restore of 33 km² of mangroves and plant 7 million Atlantic forest seedlings



Rodrigo de Freitas Lake where Olympic rowing events will be held, as seen from the Christ the Redeemer Statue.

Maryland - Rio de Janeiro Sister - State Agreement



1999 – Maryland-Rio de Janeiro Sister-State agreement signed
2011 – Memorandum of Understanding for the establishment of a technical cooperation program.
2013 – Technical Cooperation Program for Guanabara Bay and Chesapeake Bay



2014 – Delegation of State and local government officials from Rio de Janeiro to Chesapeake Bay
2014 – Delegation of State, local government, academic, business and NGO representatives from CB to GB

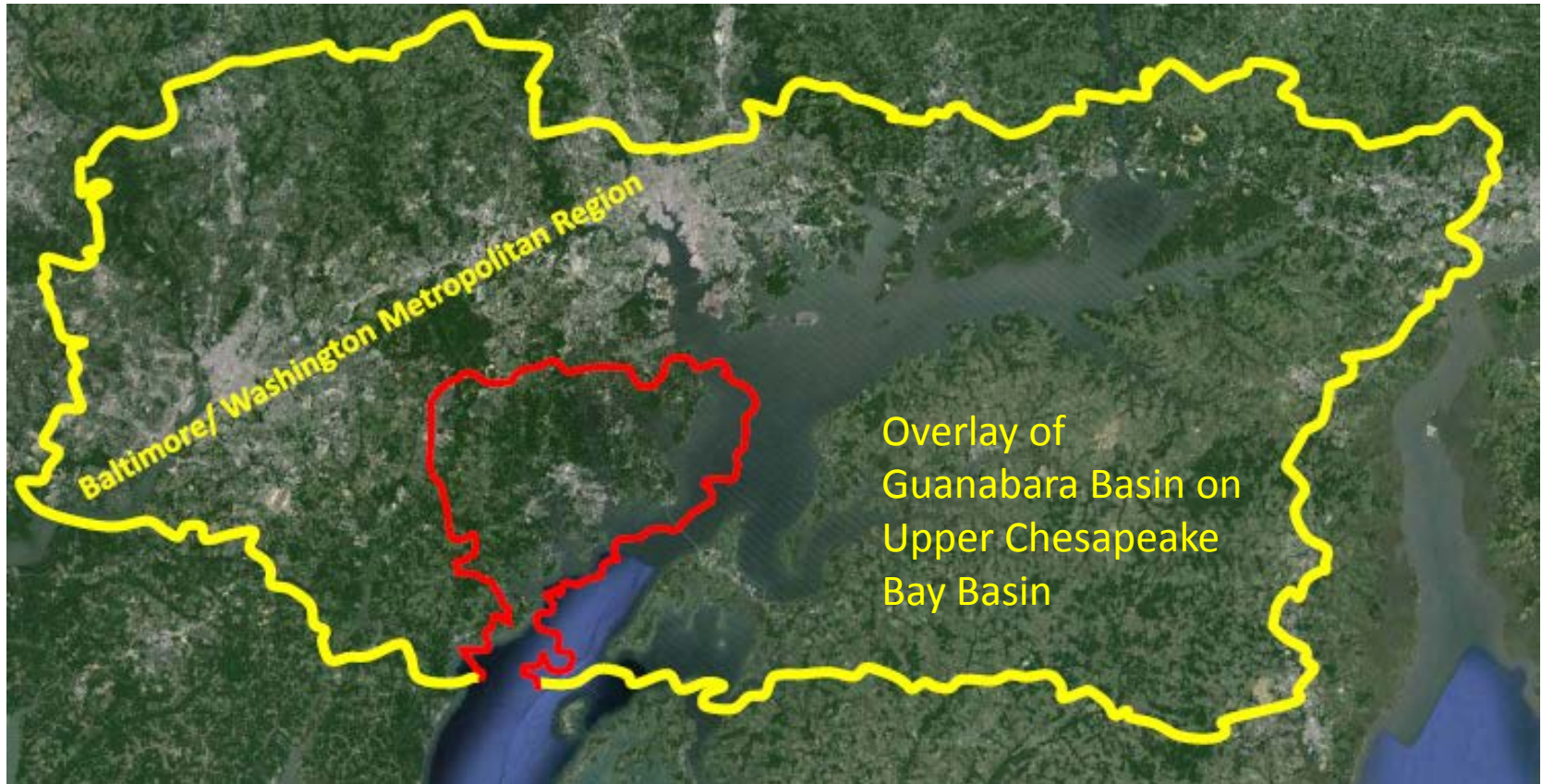
Why Look at Chesapeake Bay?



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



GB Watershed is also similar to the Baltimore – Washington Metro area

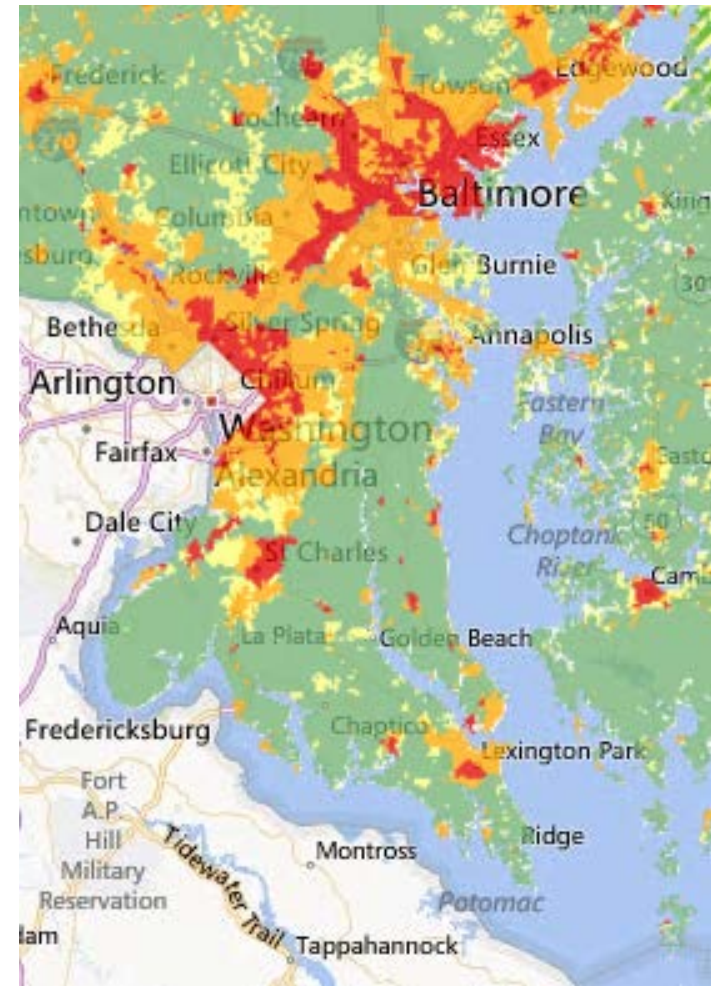


- Drainage area
- Population
- Dense urbanization
- Pollution sources
- Water quality problems

Comparison to Baltimore – Washington Metropolitan Region



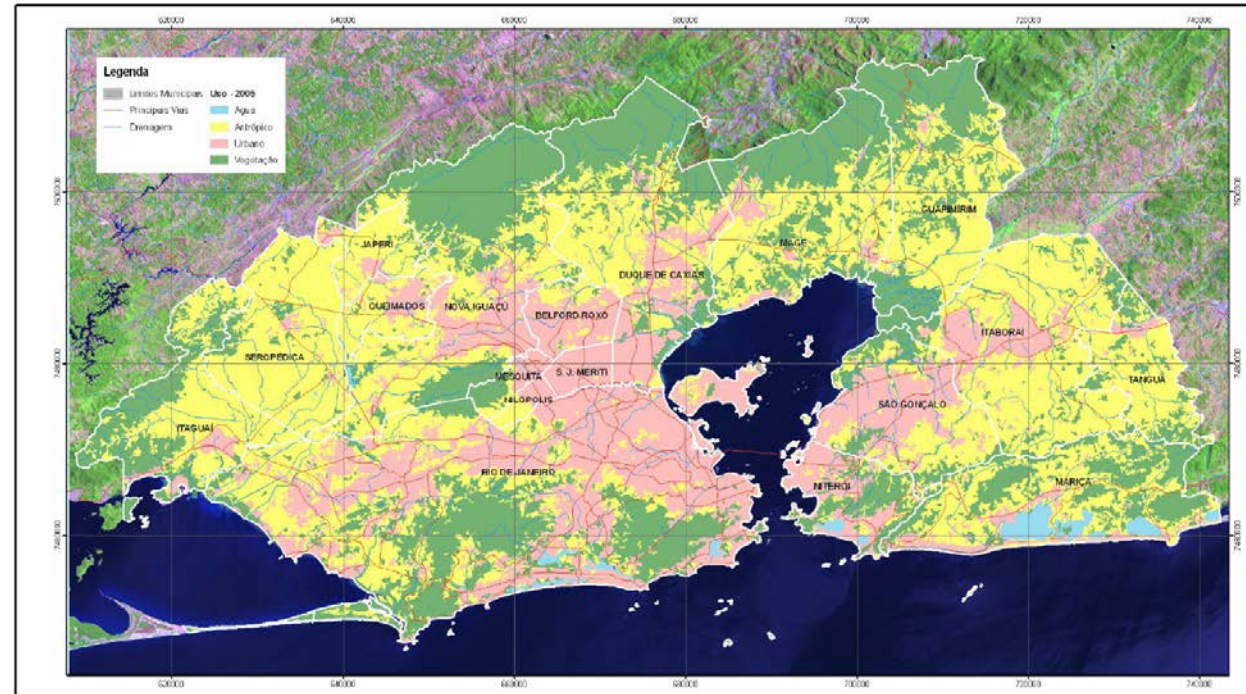
- **Population**
 - BWMR – 9.3 million
 - RJMR – 8.6 million
- **Political**
 - BWMR – 2 states, 13 counties and 3 major municipalities
 - RJMR – 1 state, 15 municipalities
- **Sanitation problems**
 - BWMR - CSOs & SSOs, \$4.8 B sewage/drainage system restoration underway
 - RJMR – 70-80% of sewage untreated, major infrastructure development underway



Land use in Guanabara Bay Watershed



- Highly urbanized
 - 2100 people/km²
- Urban areas close to Bay
- Rapidly growing
 - 30% growth 1990 to 2005
 - Much lower (3%) projected growth 2005 to 2020



Urban

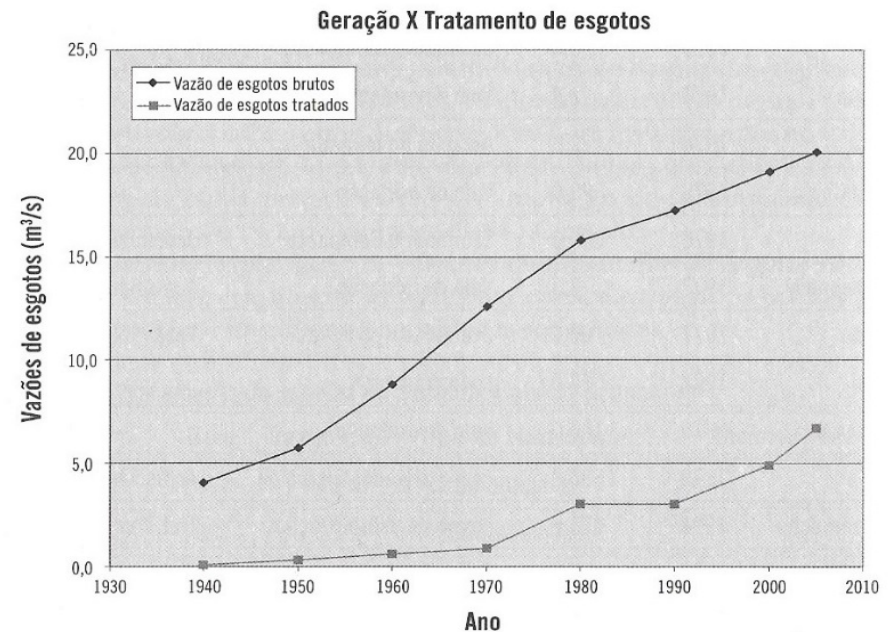
Agriculture, mining, silviculture, other human uses

Natural vegetation

Sanitation in the Guanabara Bay Watershed



- 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, 21% of the population is served by sewage treatment and projects are underway to bring that up to 35% by 2018

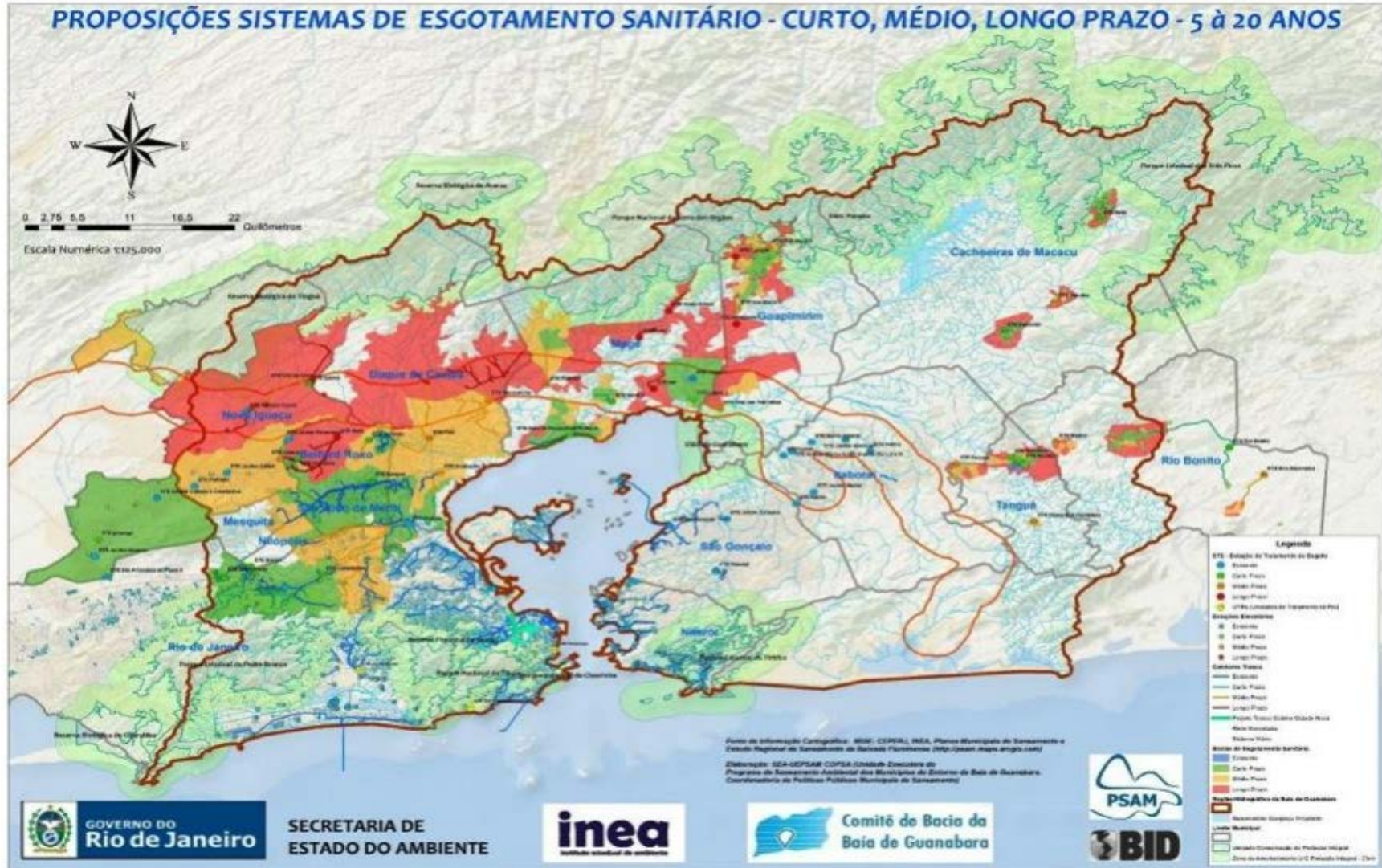


Sewage generation and treatment in Guanabara Bay Hydrographic Basin. Coelho, 2007

Short-term treatment plan



Short-term, medium-term and long-term treatment plans



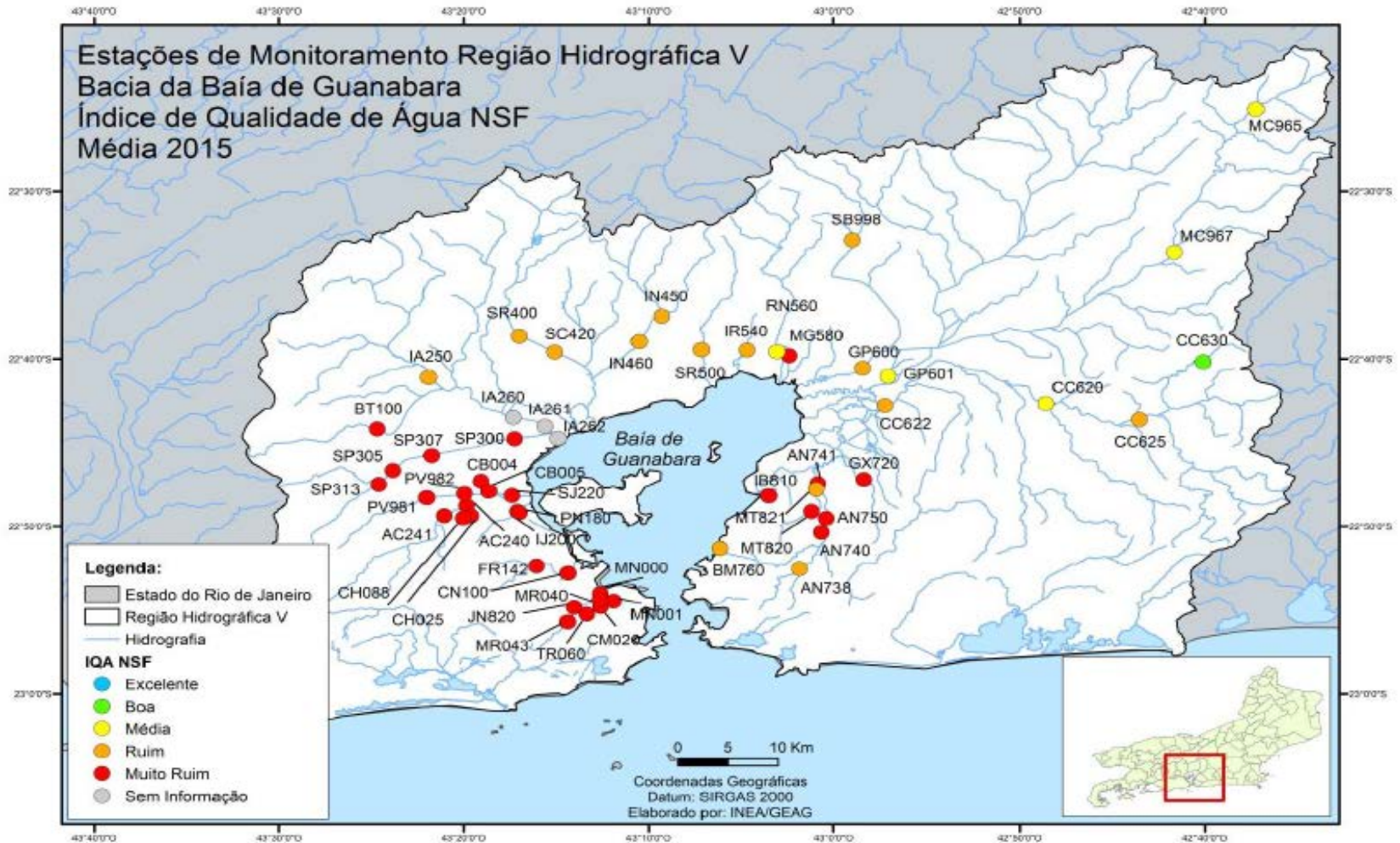
Solid Waste in Gunabara Bay



- Poor handling of solid waste
 - 73% of households have solid waste collection services
 - Estimated that approximately 3,800 tons/day is not uncollected
- Illegal dumping
 - particularly in waterways, causing flooding
 - Graef (2015) reports an estimated 80-100 tons/day enters Bay
- Visual pollution
- Odors
- Disease vector
- Barrier to recreation and boat traffic
- Hazard to wildlife



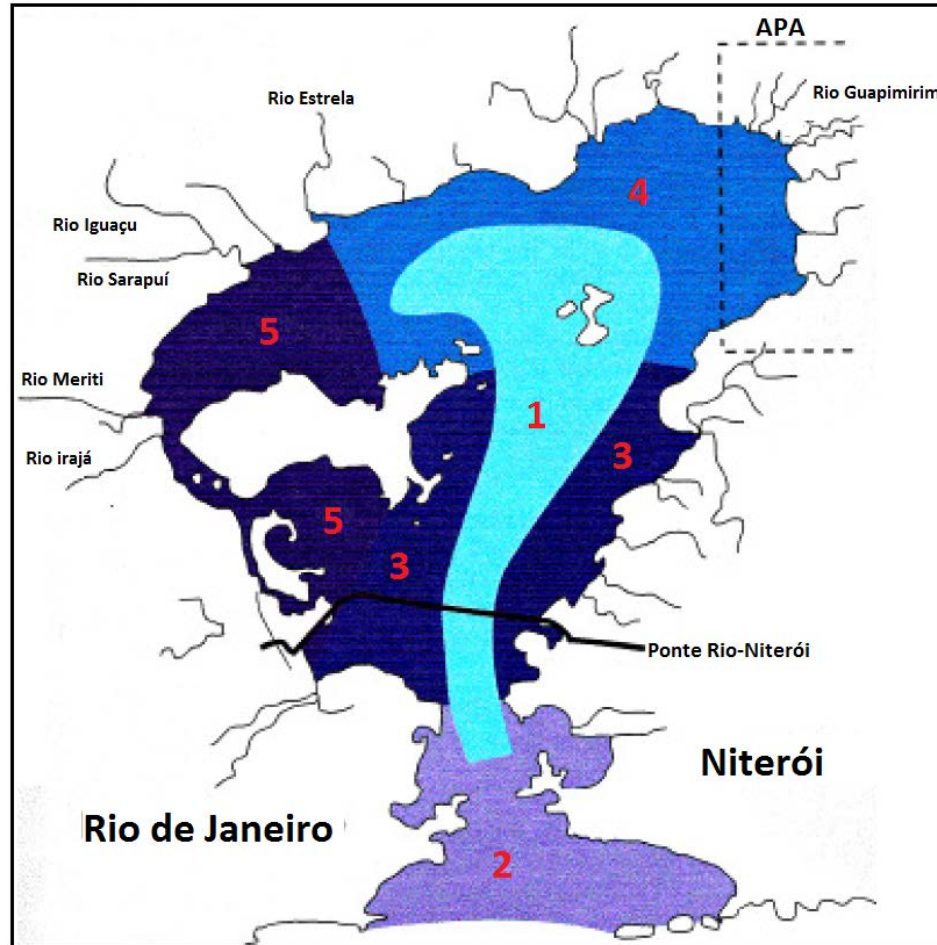
Guanabara Bay Basin 2015 Median Water Quality Index



Hydrographic Division of Guanabara Bay

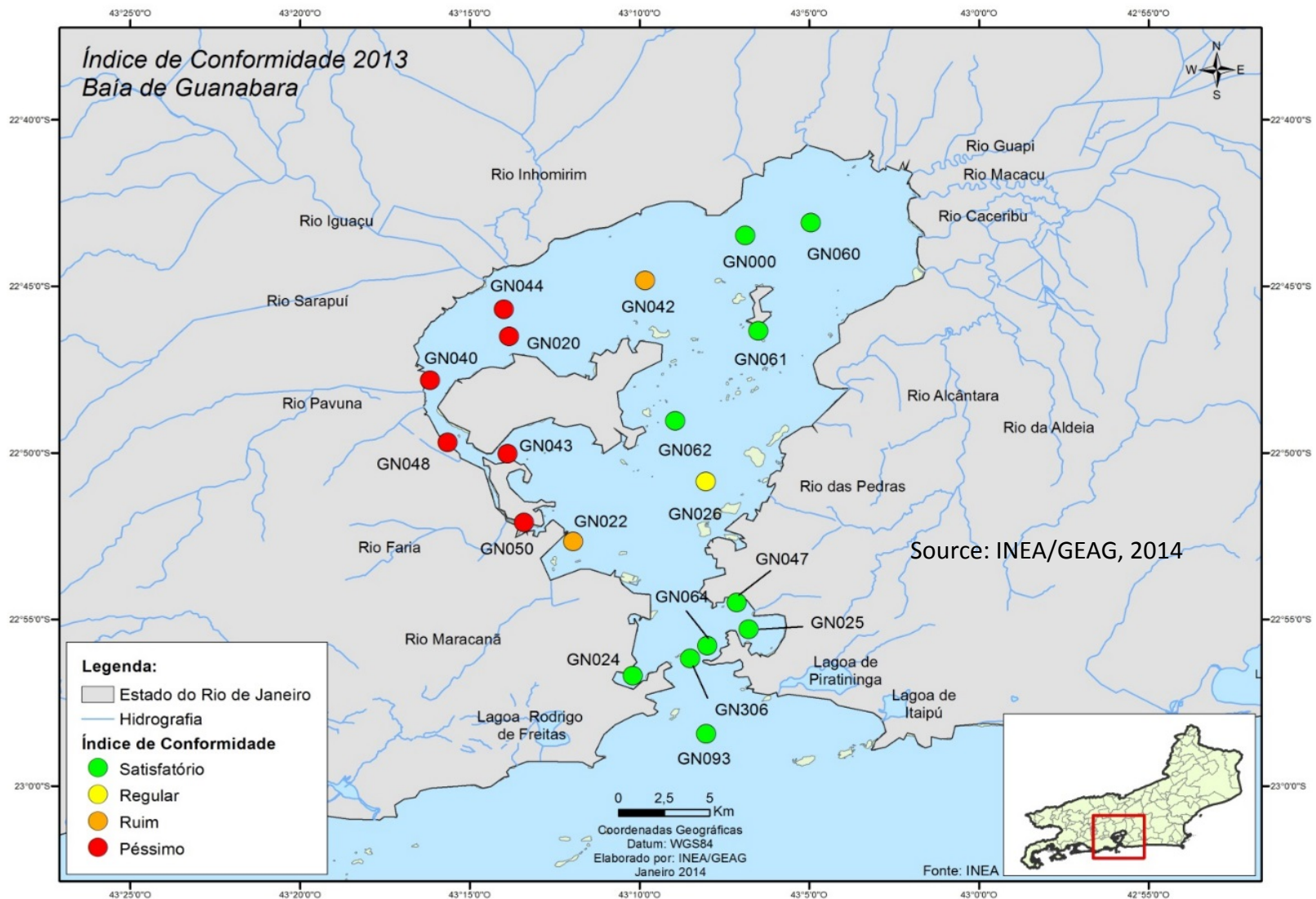


- Region 1: Main channel well flushed by ocean exchange
- Region 2: Well flushed by ocean, but very high loading from adjacent urban areas
- Region 3: degraded by sewage, industrial and port activities
- Region 4: less polluted rivers and environmental preservation of mangroves
- Region 5: most degraded area due to high urban and industrial pollution loads



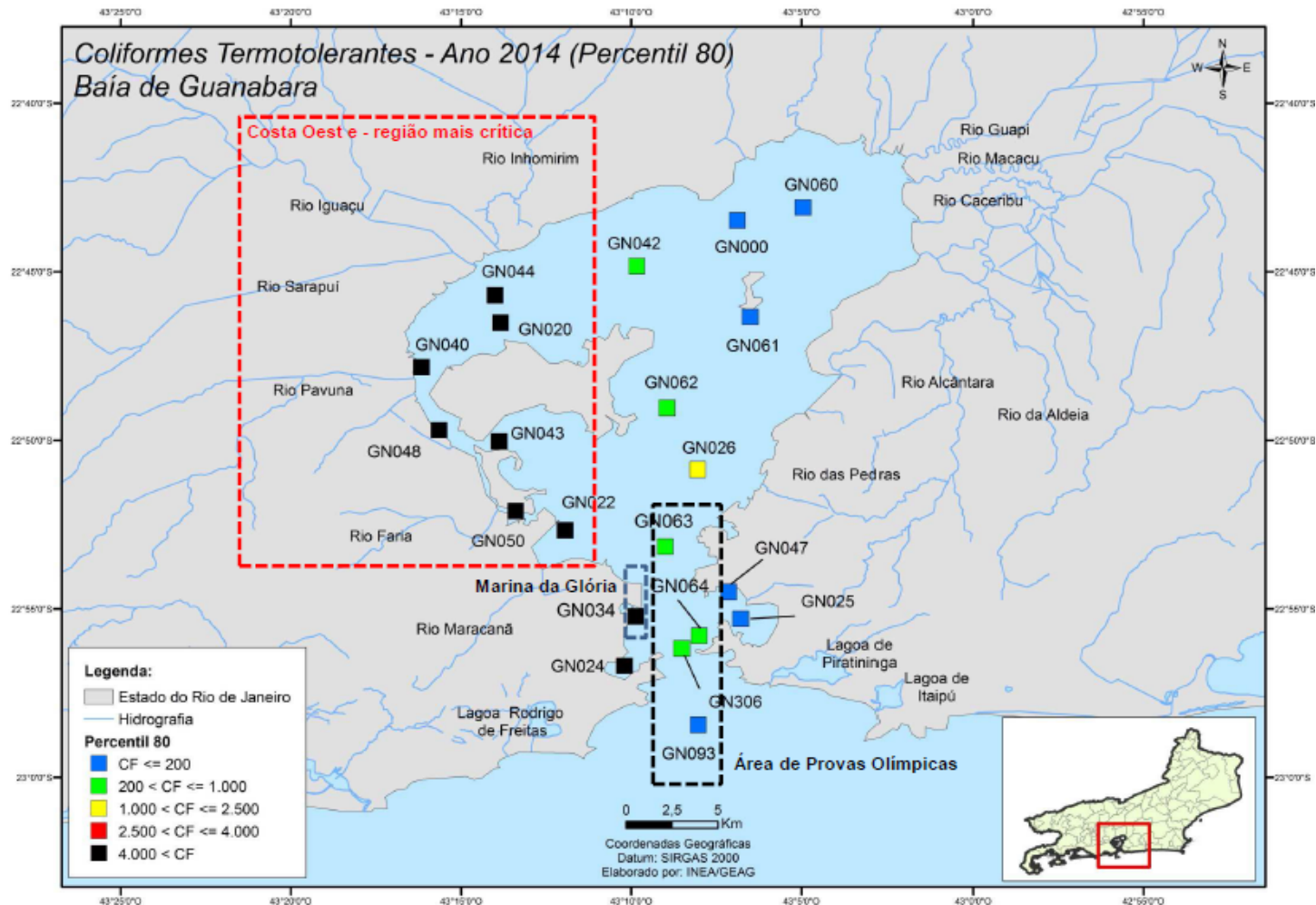
Hydrographic division of Guanabara Bay as suggested by Mayr et al., 1989.

2013 Conformity Index for Guanabara Bay Monitoring Stations



Guanabara Bay

2014 Coliform Levels (80th percentile)



Pathogenic Bacteria Threaten Public Health



- *“Potentially pathogenic bacteria are found in higher abundance in the inner bay.*
- *The identified bacterial taxa (e.g. burkholderias, vibrios, pseudomonas, klebsiellas) may represent a serious threat to human and animal health.*
- *Multidrug resistant bacteria have been isolated from GB areas, indicating a further threat to human health.*
- *The spread of organic matter rich and anoxic regions around the Fundão and Governador islands may further contribute to the dissemination of important pathogenic microbes in the GB.”*



Many Restoration Needs



- Renovate existing sewage collection and treatment system
- Build new collection and treatment capacity
- Enforce 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



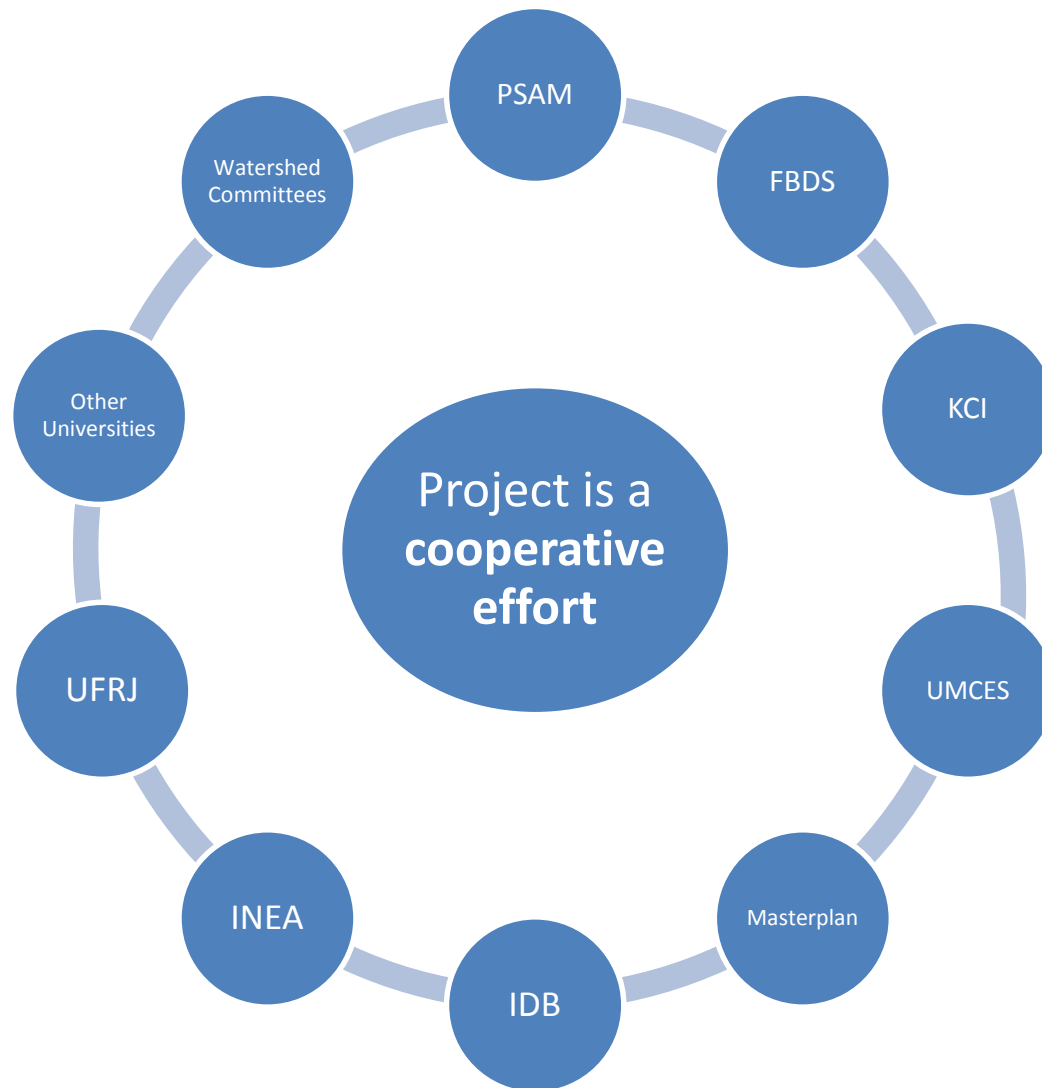
Technical Cooperation Project Objectives



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-term milestones that must be achieved to restore the Bay and demonstrate to all sectors of society that the progress is being achieved on schedule

Technical Cooperation Project Approach



Technical Cooperation Project Approach



- Results will be presented in a publically accessible, on-line “scorecard” for Guanabara Bay similar to the Chesapeake Bay Report Card.
- The scorecard will provide a framework that Rio’s government agencies, the UFRJ and other universities, the Watershed Committees and other interested citizens of Rio de Janeiro can build upon in the future to guide and publically report progress on the environmental restoration of Guanabara Bay.

Technical Cooperation Project

Next Steps



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

1^o Workshop - (4-29-16)

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

2^o Workshop

Discussion of the restoration actions needed and their priorities

3^o Workshop

Presentation and discussion of the recommended action plan and digital platform

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
- Simple, highly visible metrics
- Regular public reporting
- Federal, state and local government, universities and public working together



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