COASTAL WETLAND RESTORATION TO ENHANCE FISHERIES PRODUCTION AND FLOOD RESILIENCE: THE VICTORIA POND ECO-HYDROLOGY PROJECT, THE BAHAMAS

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WHAT IS ECOHYDROLOGY? UNITED NATIONS PROGRAMME TO ADDRESS INTEGRATE WATER RESOURCE MANAGEMENT

ecohydrology
programme

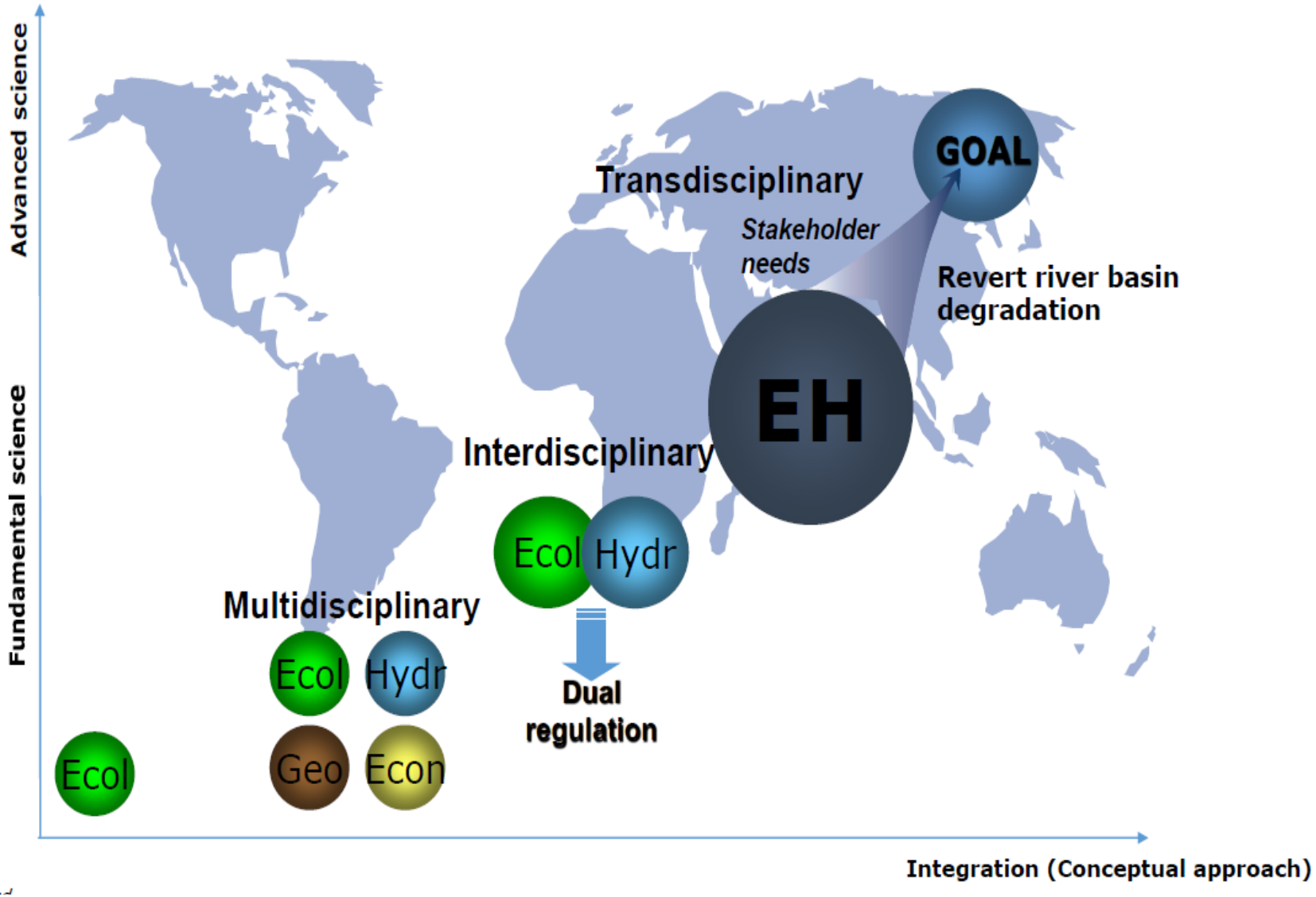
Mission statement

A scientific programme to understand and elucidate the dynamic relationships between hydrological, social and ecological systems; to consider how these act upon each other, and to seek new ways to balance human and environmental needs for water resources.

Aim of the programme

- To advance the integration of social, ecological and hydrological research, and
- To generate the development of effective policies and practices.

Ecohydrology - from multi to transdisciplinary stage



from FRCE, Poland

Water Resource Management is cutting across six Sustainable Development Goals

A story in four parts…

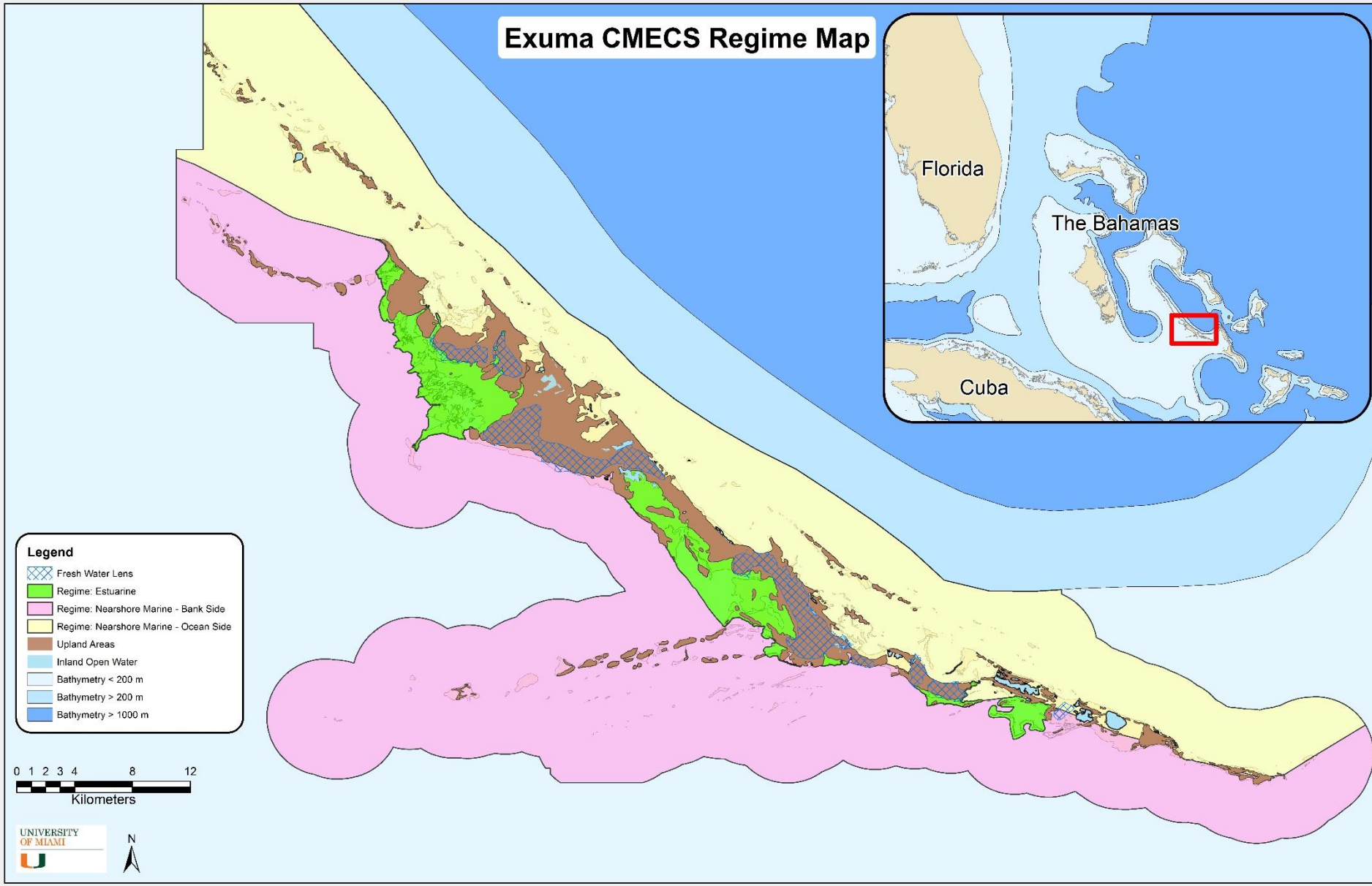
Part 1: Can we just get the trash out of the mangroves?

Part 2: Can mangroves help clean up the water?

Part 3: Where is all the nitrogen coming from?

Part 4: Flooding is really making this problem worse, what can we do?

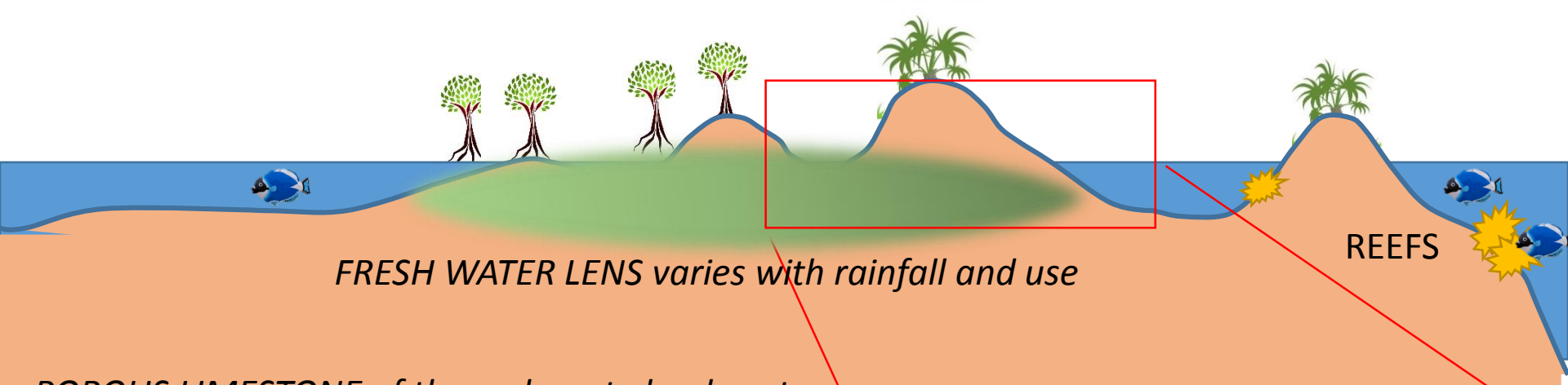
Introduction to a beautiful island with about 8,000 people and growing…



ISLAND HYDROLOGY OF GREAT EXUMA

SHALLOW BANKS

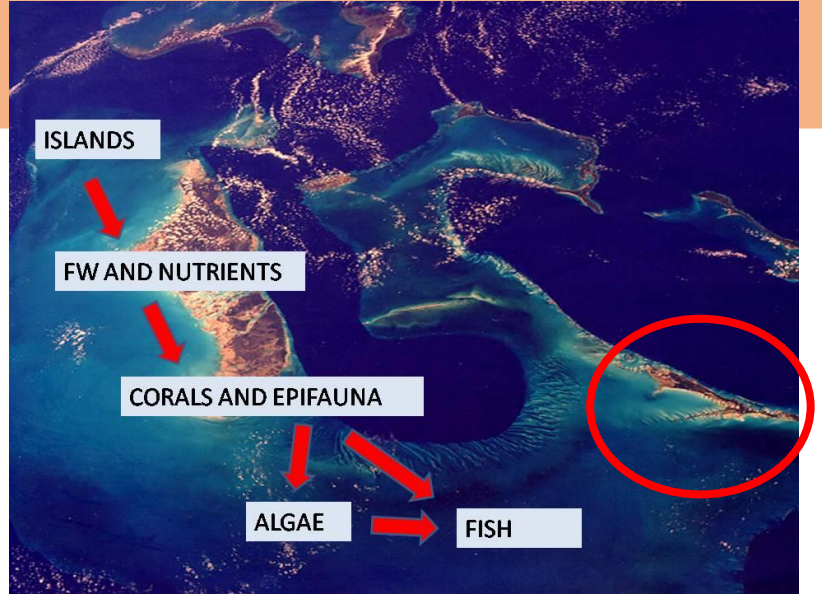
OPEN OCEAN EXUMA SOUND

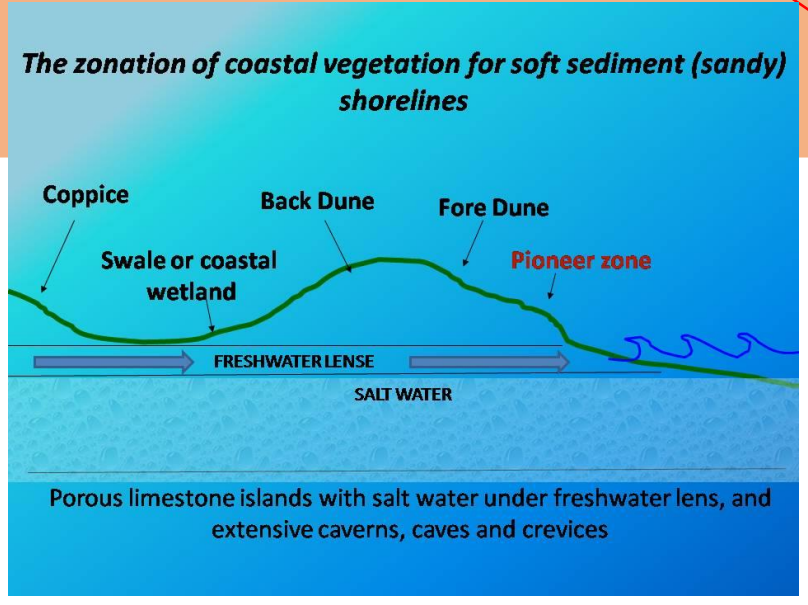


REEFS

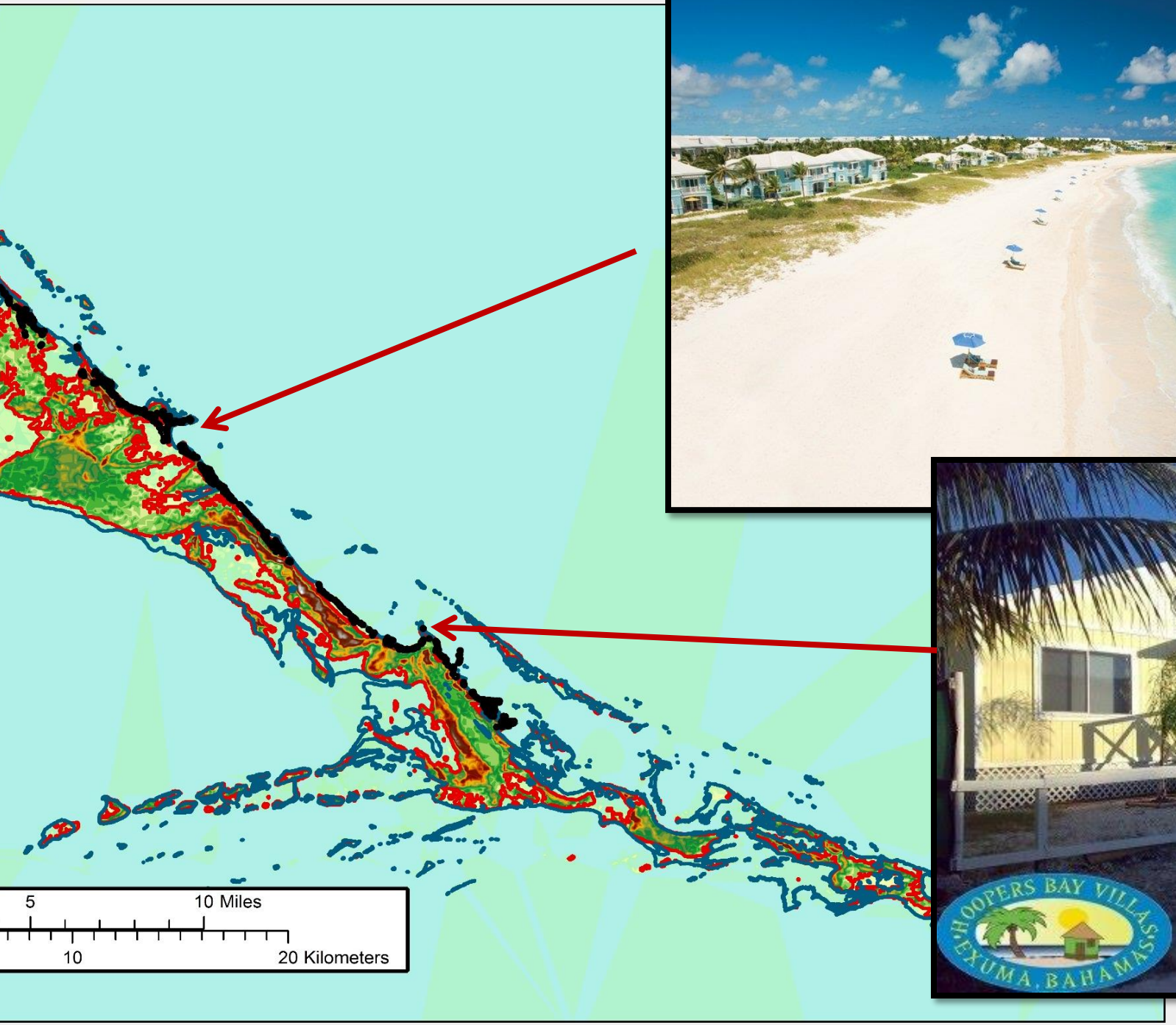
FRESH WATER LENS varies with rainfall and use

POROUS LIMESTONE of the carbonate bank system

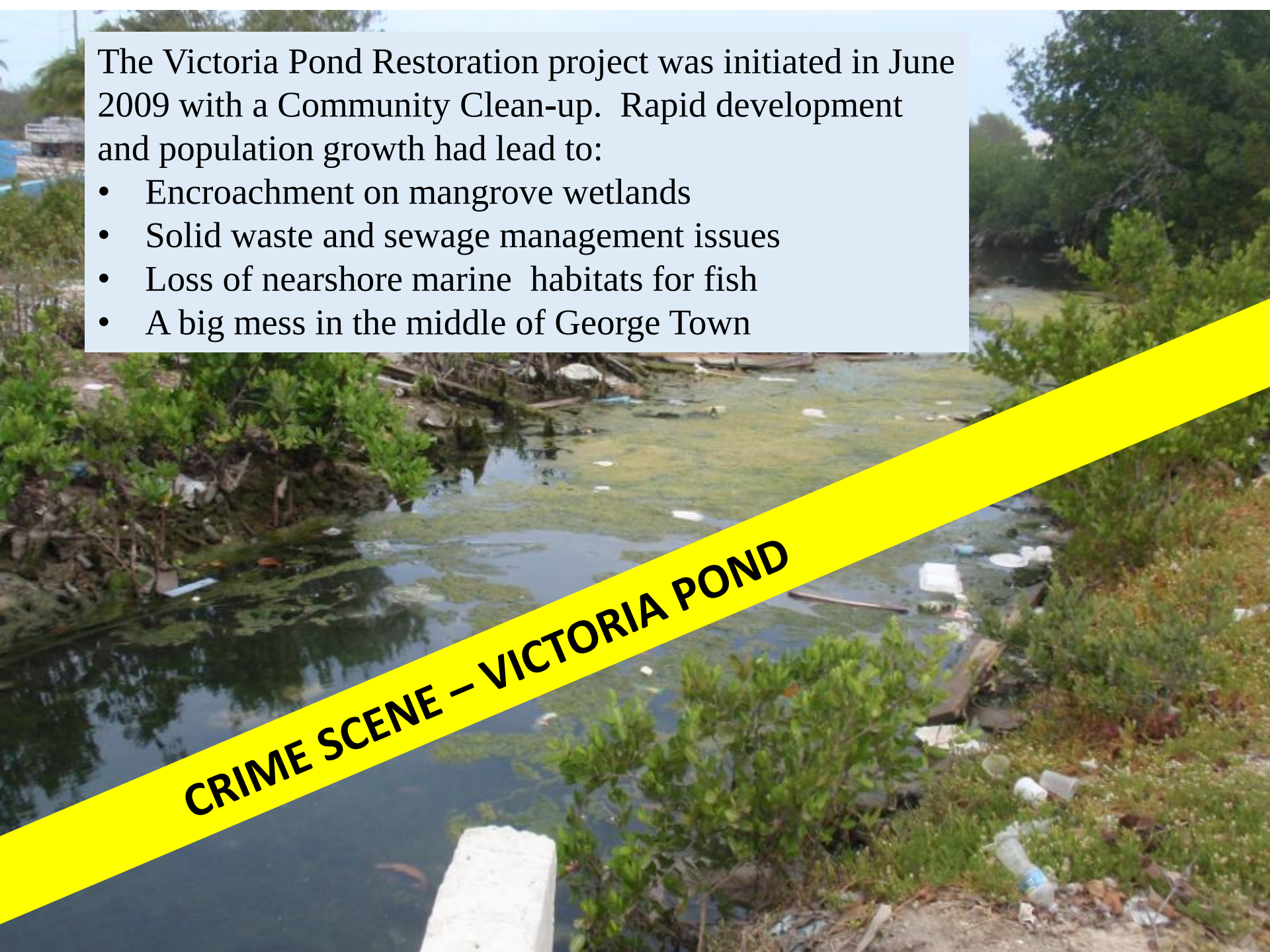




FRESH WATER IS TRAPPED IN GROUND WATER LENSES, THEN SEEPS INTO THE SEA AT THE SHORELINE. COASTAL WETLANDS ARE A CRITICAL PART OF MAINTAINING CLEAR, OLIGOTROPHIC WATERS


5
10 Miles
10
20 Kilometers

HOOPERS BAY VILLAS
EXUMA, BAHAMAS



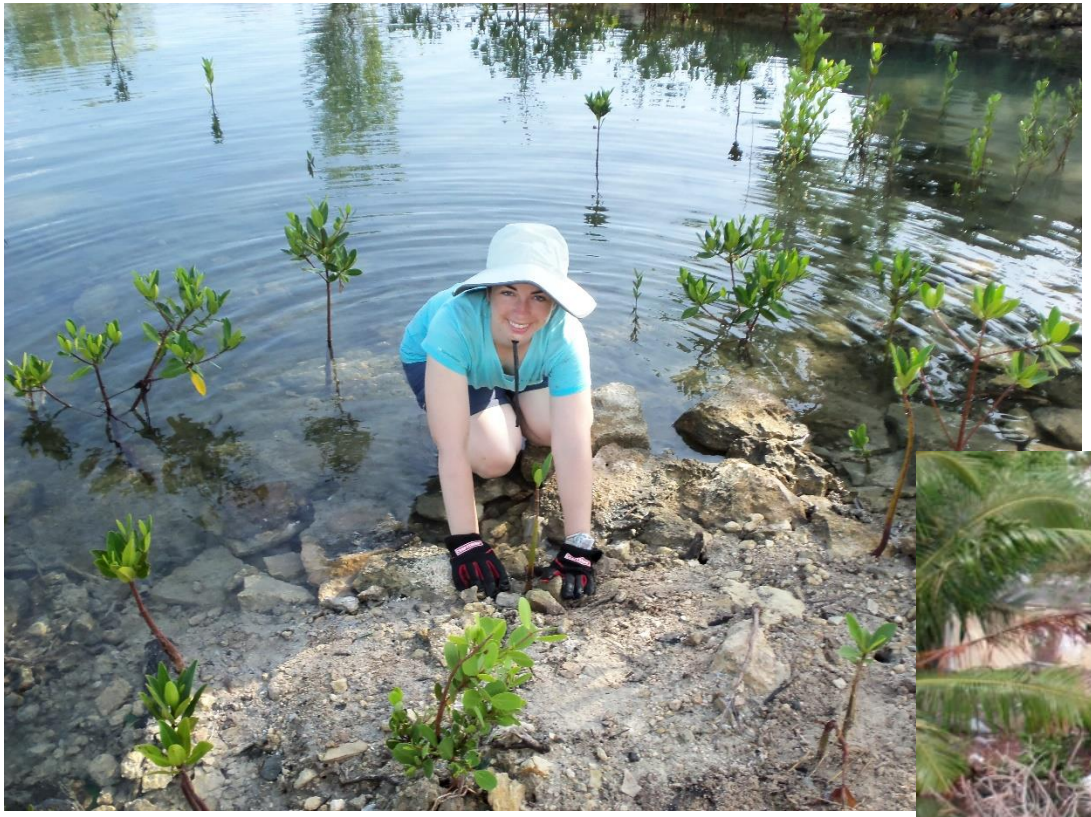
The Victoria Pond Restoration project was initiated in June 2009 with a Community Clean-up. Rapid development and population growth had lead to:

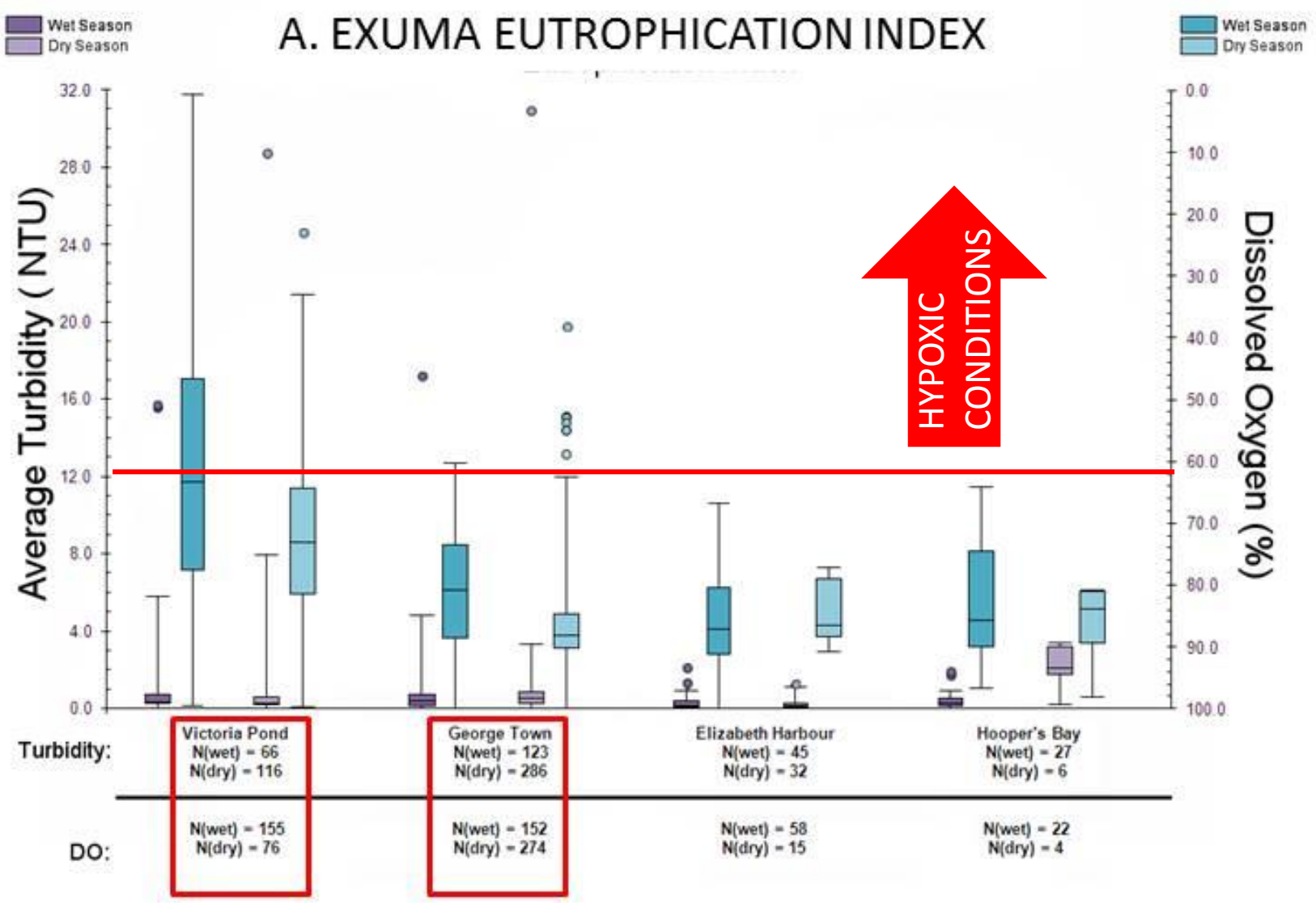
- Encroachment on mangrove wetlands
- Solid waste and sewage management issues
- Loss of nearshore marine habitats for fish
- A big mess in the middle of George Town

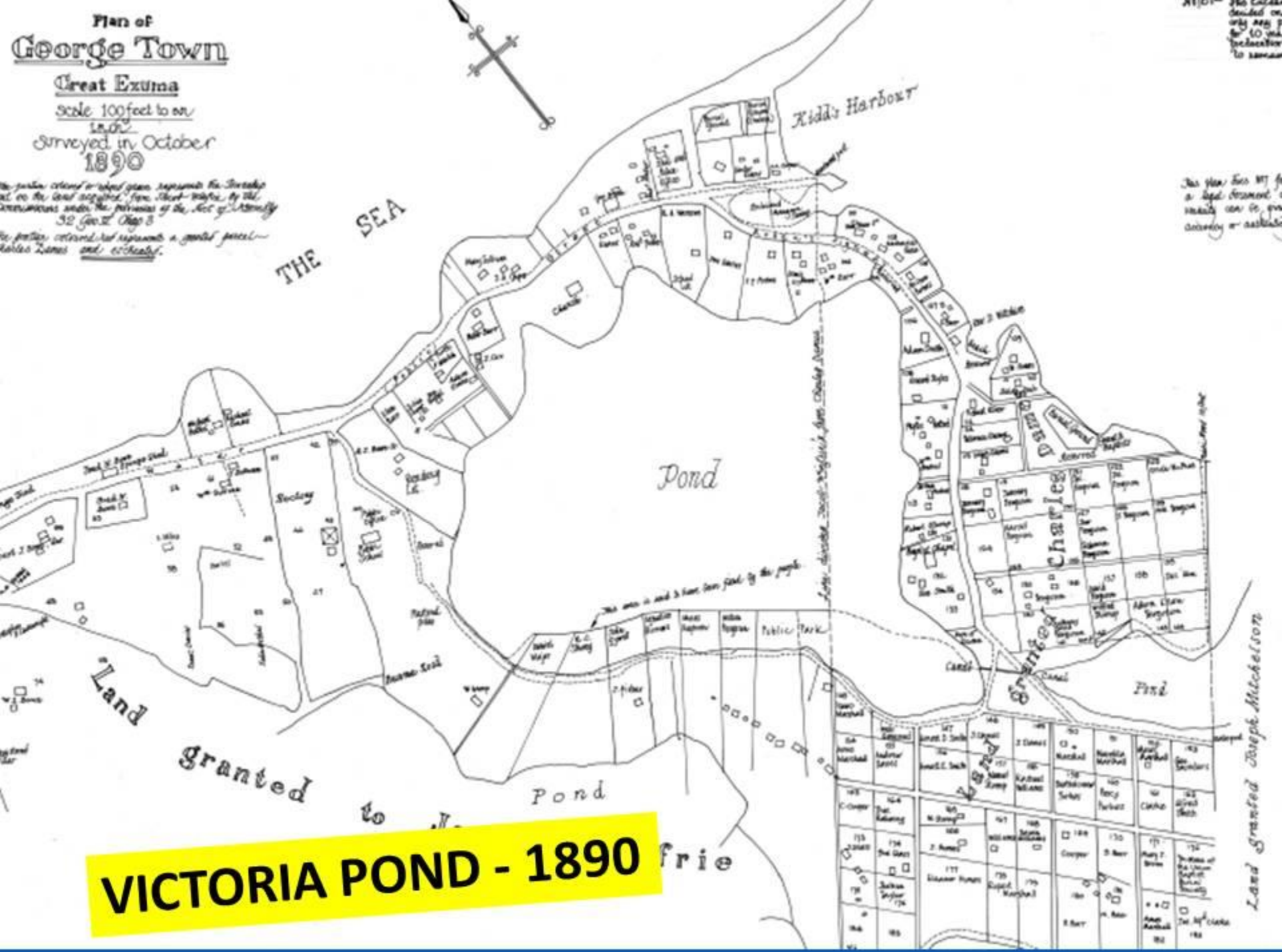

N
Image © 2011 GeoEye
© 2011 Google
Google
Imagery Date: 6/26/2010
30'16.83" N 75°46'22.42" W elev 10 ft
Eye alt 627 ft

Yes, people like to pick up trash and tidy up coastal areas, but then what?

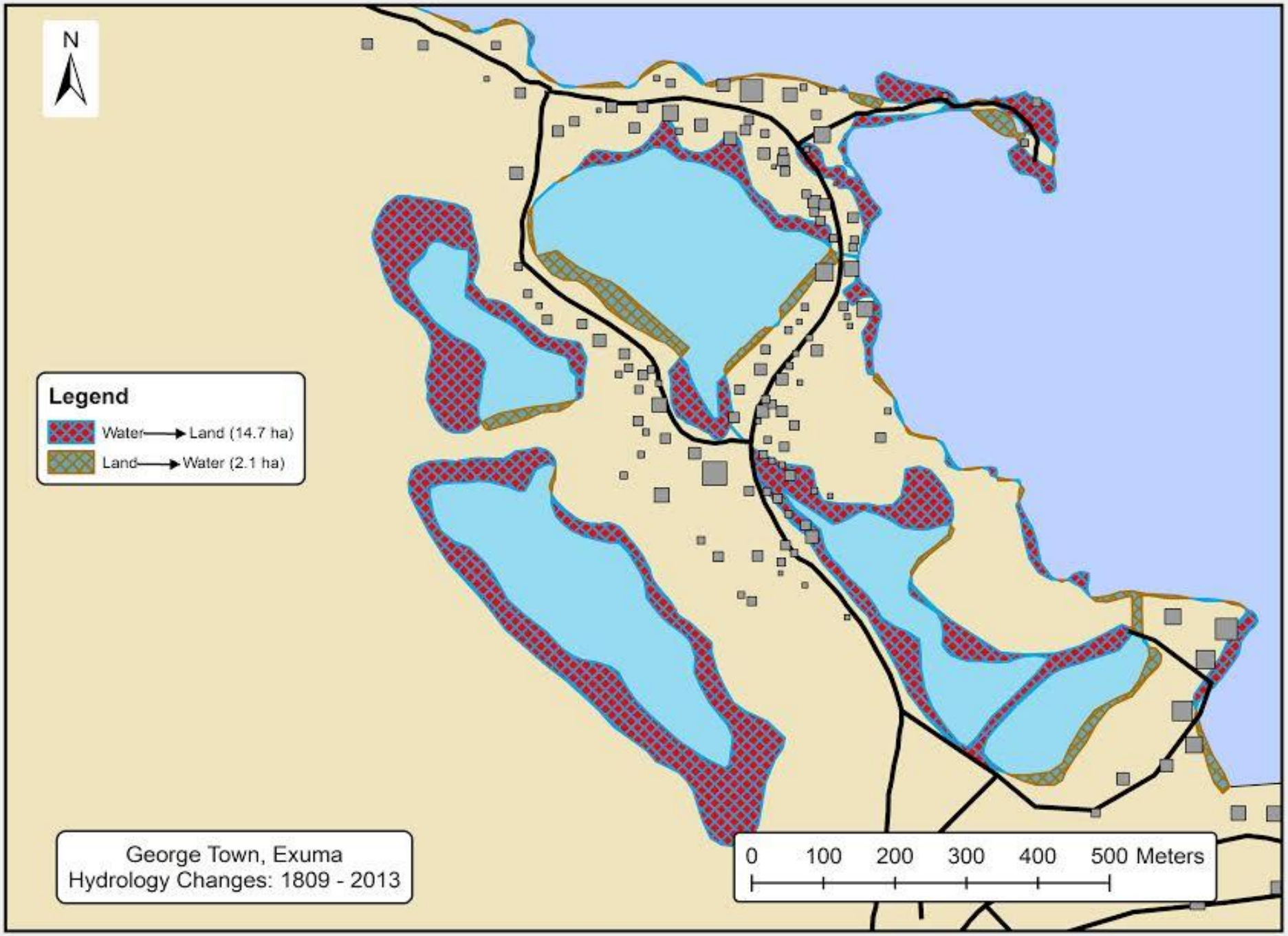
Part 2: Can mangroves help clean up the water?

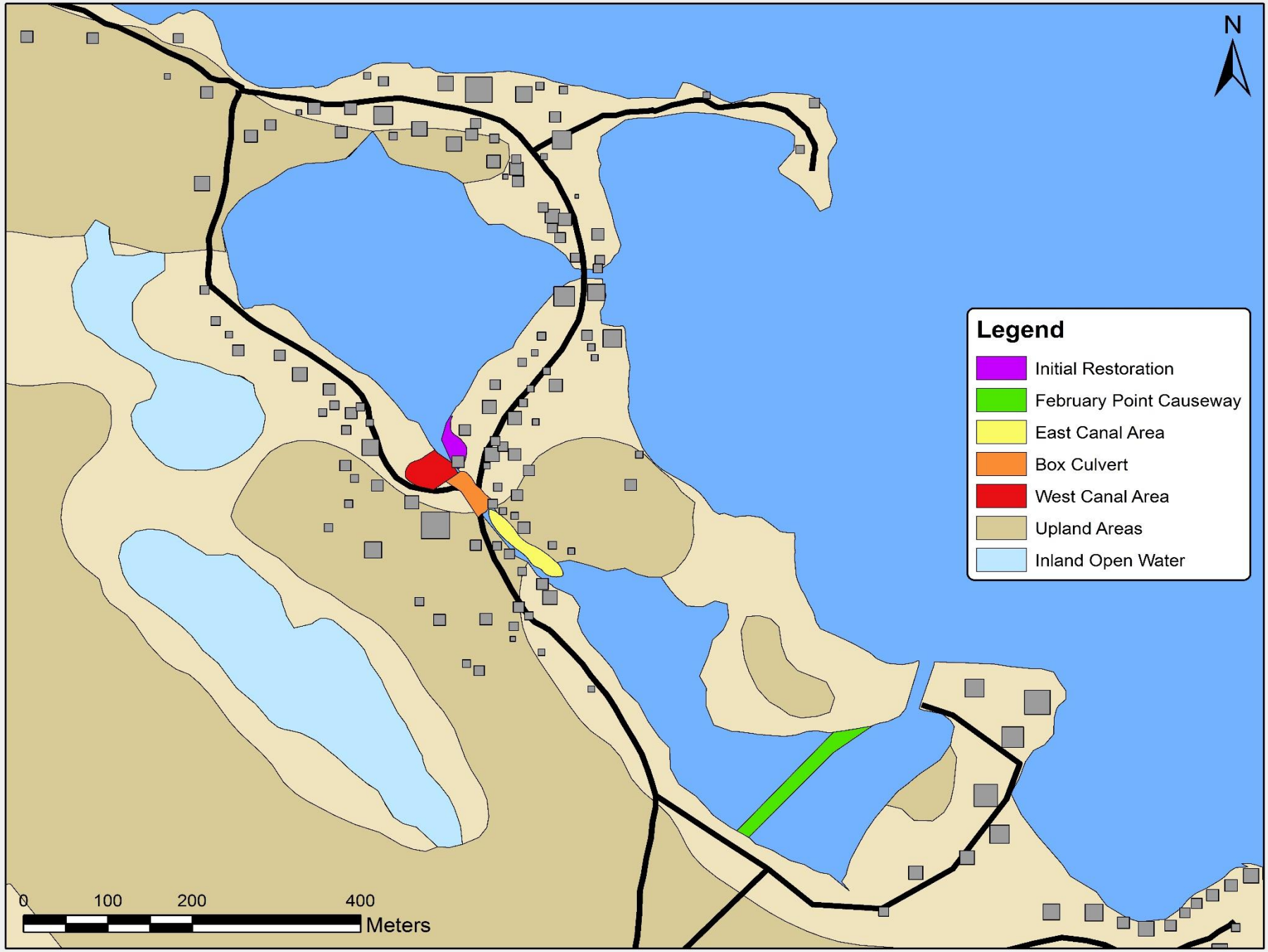



A. EXUMA EUTROPHICATION INDEX
Wet Season
Dry Season
Wet Season
Dry Season
Average Turbidity (NTU)
Dissolved Oxygen (%)
32.0
28.0
24.0
20.0
16.0
12.0
8.0
4.0
0.0
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
HYPOXIC CONDITIONS
Turbidity:
Victoria Pond N(wet) = 66 N(dry) = 116
George Town N(wet) = 123 N(dry) = 286
Elizabeth Harbour N(wet) = 45 N(dry) = 32
Hooper's Bay N(wet) = 27 N(dry) = 6
DO:
N(wet) = 155 N(dry) = 76
N(wet) = 152 N(dry) = 274
N(wet) = 58 N(dry) = 15
N(wet) = 22 N(dry) = 4



VICTORIA POND - 1890


N
Legend
Water → Land (14.7 ha)
Land → Water (2.1 ha)
George Town, Exuma
Hydrology Changes: 1809 - 2013
0 100 200 300 400 500 Meters

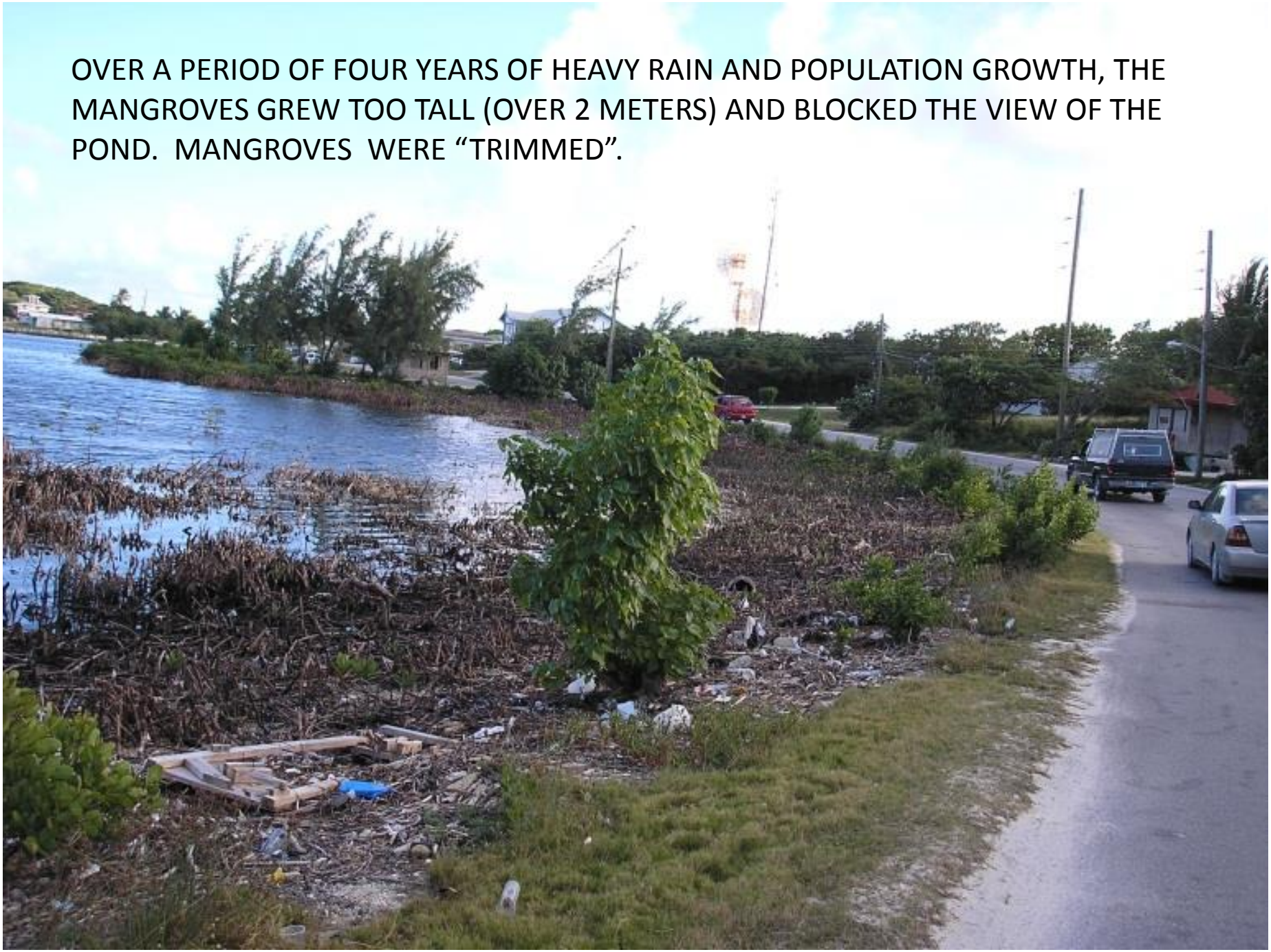

N
Legend
Initial Restoration
February Point Causeway
East Canal Area
Box Culvert
West Canal Area
Upland Areas
Inland Open Water
0
100
200
400
Meters


ANCHORAGE
PROJECT
HOMELESS
CONNECT

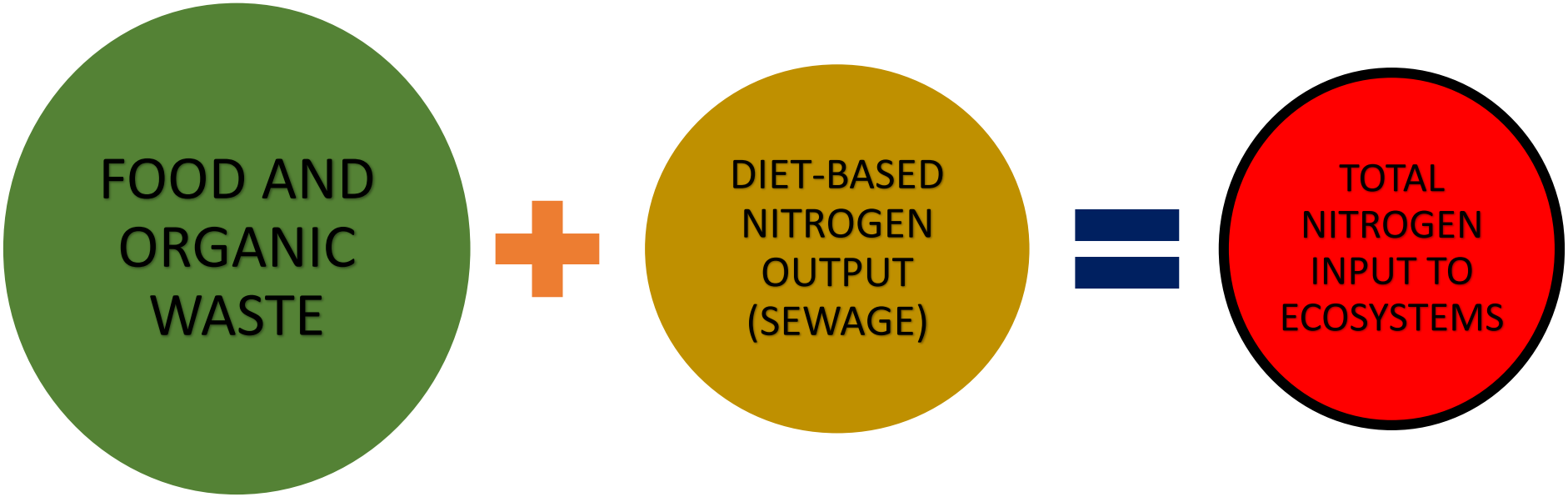
The mangroves grew too much ,and blocked the view across the pond, so

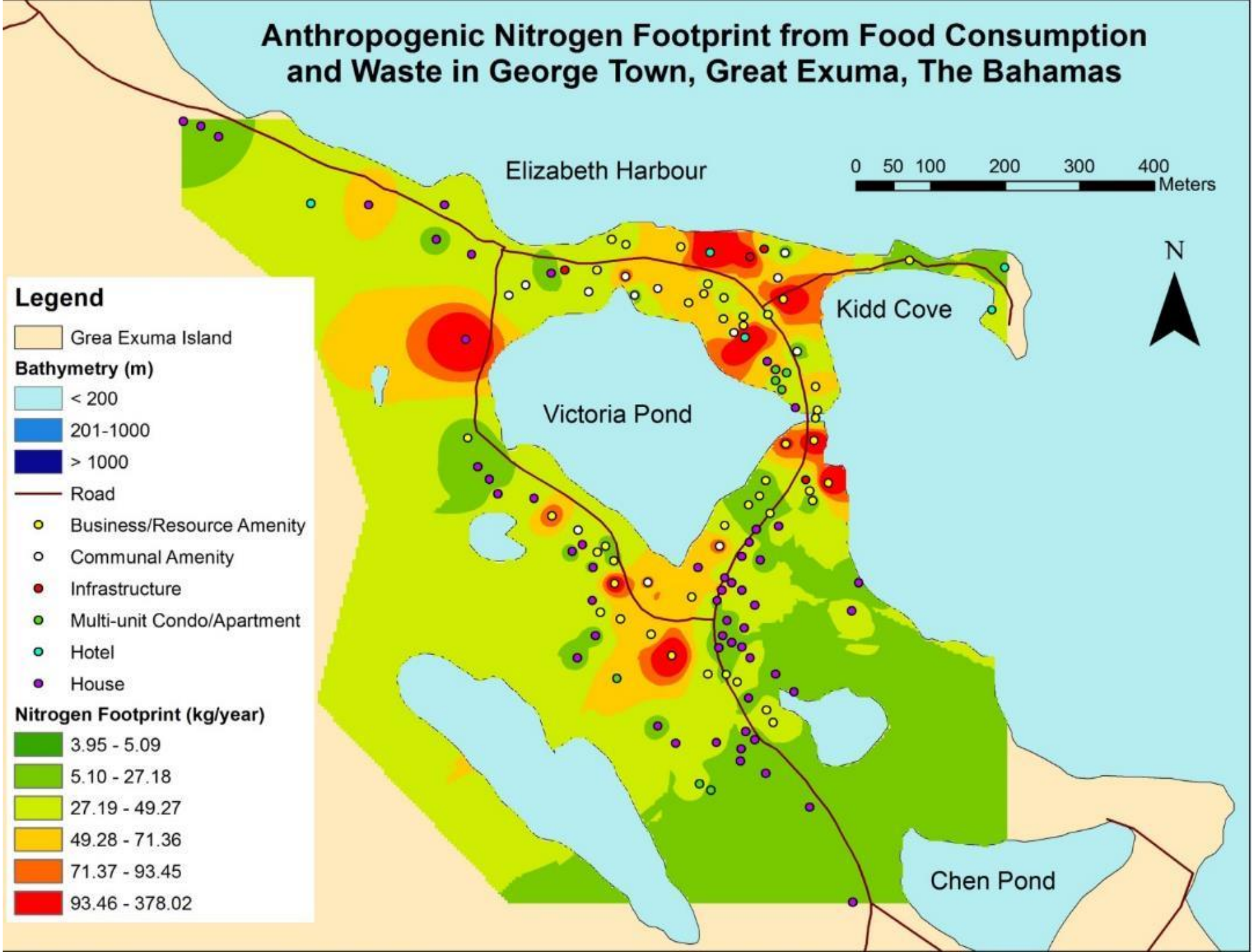
PART 3: Where were all the nutrients coming from? Can Cesspits be causing all this mess?

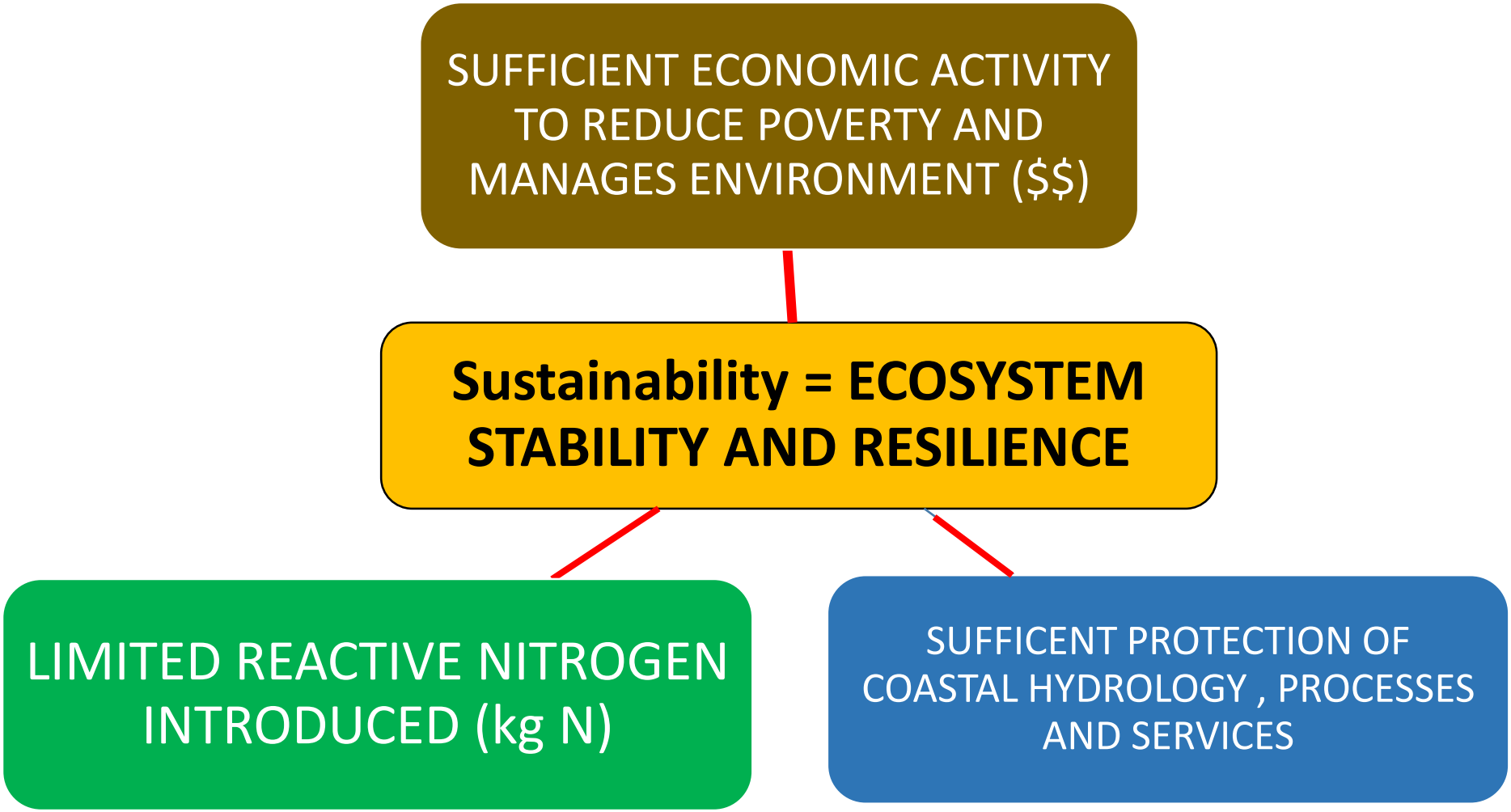
OVER A PERIOD OF FOUR YEARS OF HEAVY RAIN AND POPULATION GROWTH, THE MANGROVES GREW TOO TALL (OVER 2 METERS) AND BLOCKED THE VIEW OF THE POND. MANGROVES WERE “TRIMMED”.



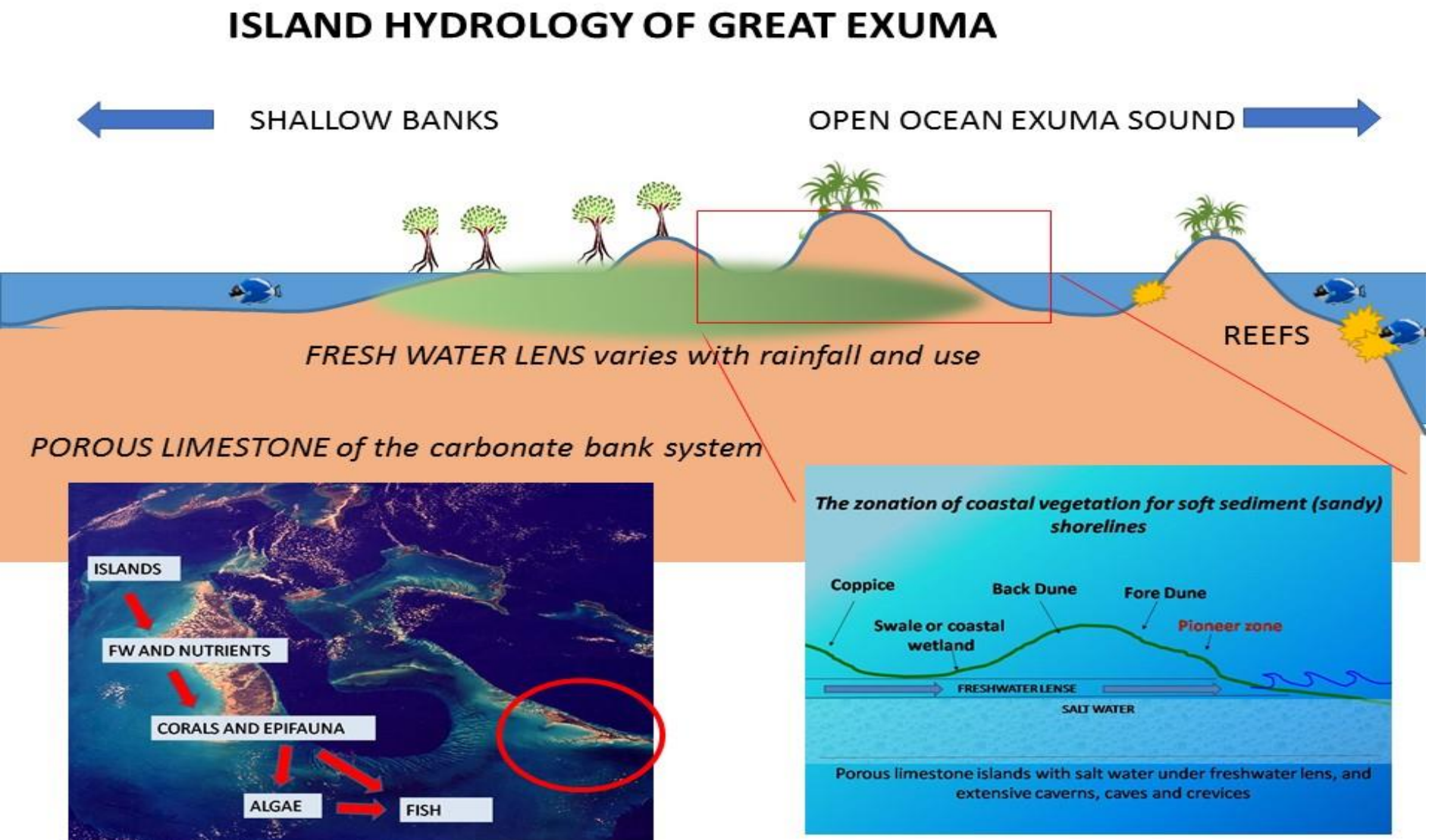
ISLAND NITROGEN FOOT PRINT




Anthropogenic Nitrogen Footprint from Food Consumption and Waste in George Town, Great Exuma, The Bahamas
Elizabeth Harbour
0 50 100 200 300 400
Meters
N
Kidd Cove
Victoria Pond
Chen Pond
Legend
Grea Exuma Island
Bathymetry (m)
< 200
201-1000
> 1000
Road
Business/Resource Amenity
Communal Amenity
Infrastructure
Multi-unit Condo/Apartment
Hotel
House
Nitrogen Footprint (kg/year)
3.95 - 5.09
5.10 - 27.18
27.19 - 49.27
49.28 - 71.36
71.37 - 93.45
93.46 - 378.02

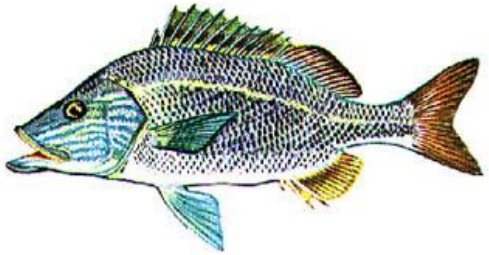

SUFFICIENT ECONOMIC ACTIVITY TO REDUCE POVERTY AND MANAGES ENVIRONMENT ($$)
Sustainability = ECOSYSTEM STABILITY AND RESILIENCE
LIMITED REACTIVE NITROGEN INTRODUCED (kg N)
SUFFICENT PROTECTION OF COASTAL HYDROLOGY , PROCESSES AND SERVICES

The southern Bahamas is hot and dry, with no surface water resources. The hydrology of Great Exuma is dominated by fresh water lenses, and ephemeral wetlands that form with high rainfall.



COST FOR ONE YEAR PER PERSON TO BUY CHICKEN (85 protein grams/ day) = $1,575 / year

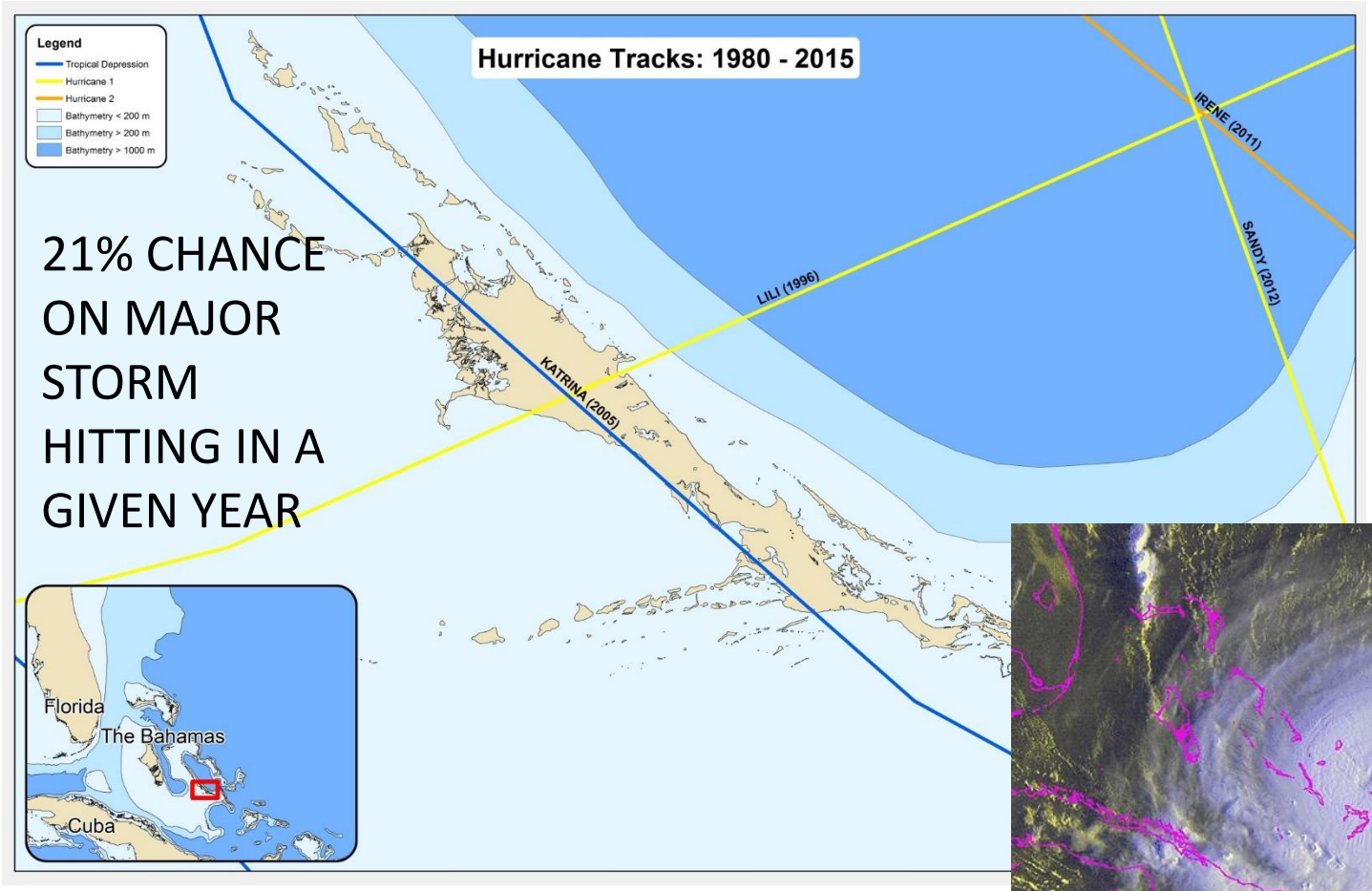
ECOSYSTEM SERVICES ARE QUANTIFIED BY REAL EXPENSES TO BUY FOOD, BUILD SEA-WALLS OR FUNDS RECEIVED FOR WILDLIFE PROTECTION



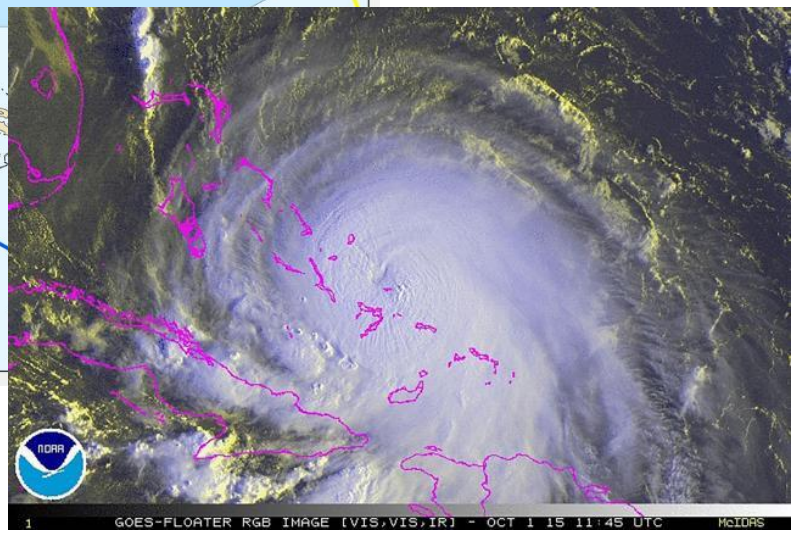
WHITE GRUNT

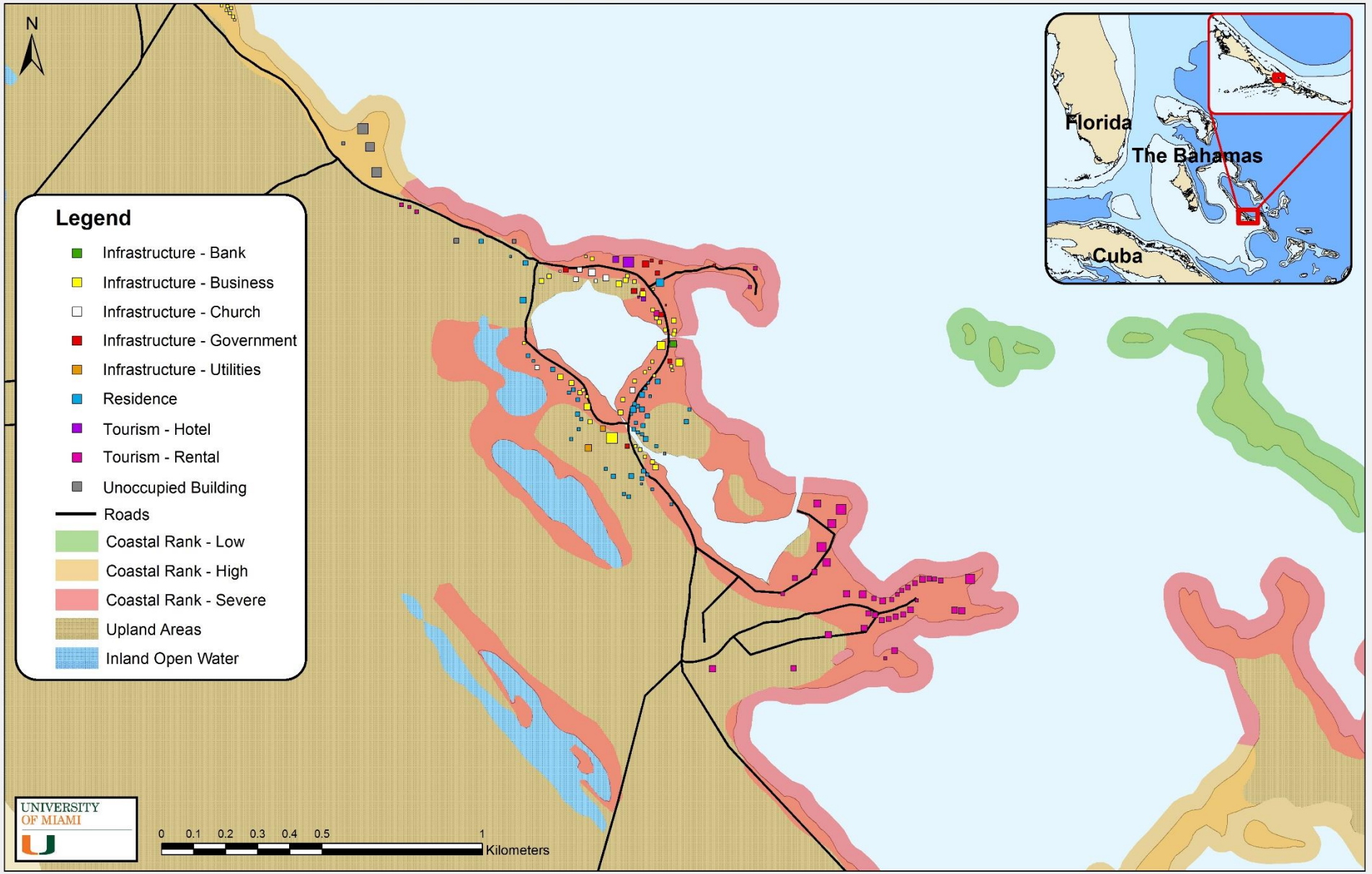
COST FOR ONE YEAR PER PERSON TO FISH GRUNTS, SHAD OR SNAPPER (85 protein grams/ day) = $178/ year

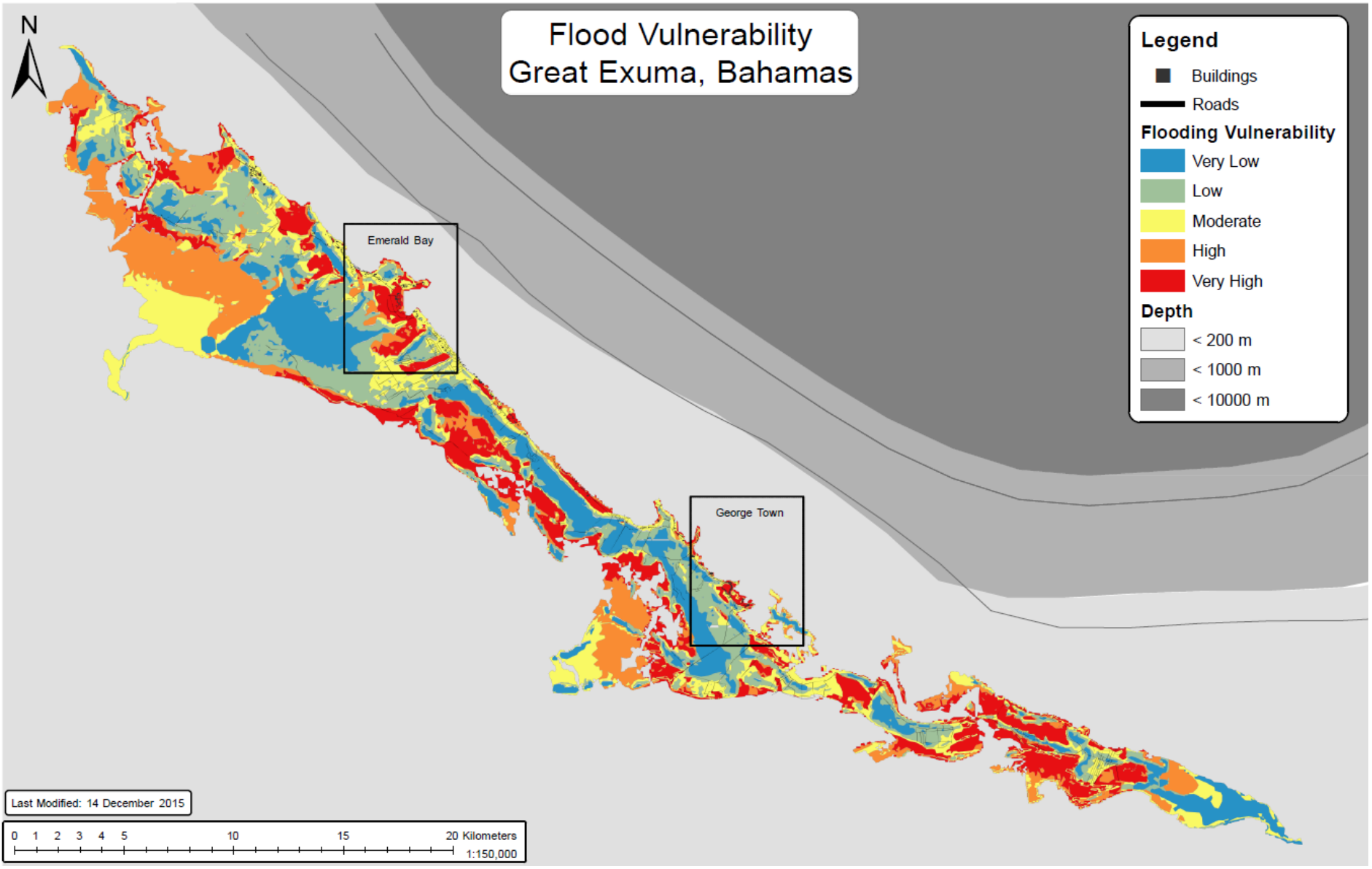
Part 4: Now, attention is really placed on flooding, and preventing flood damage…

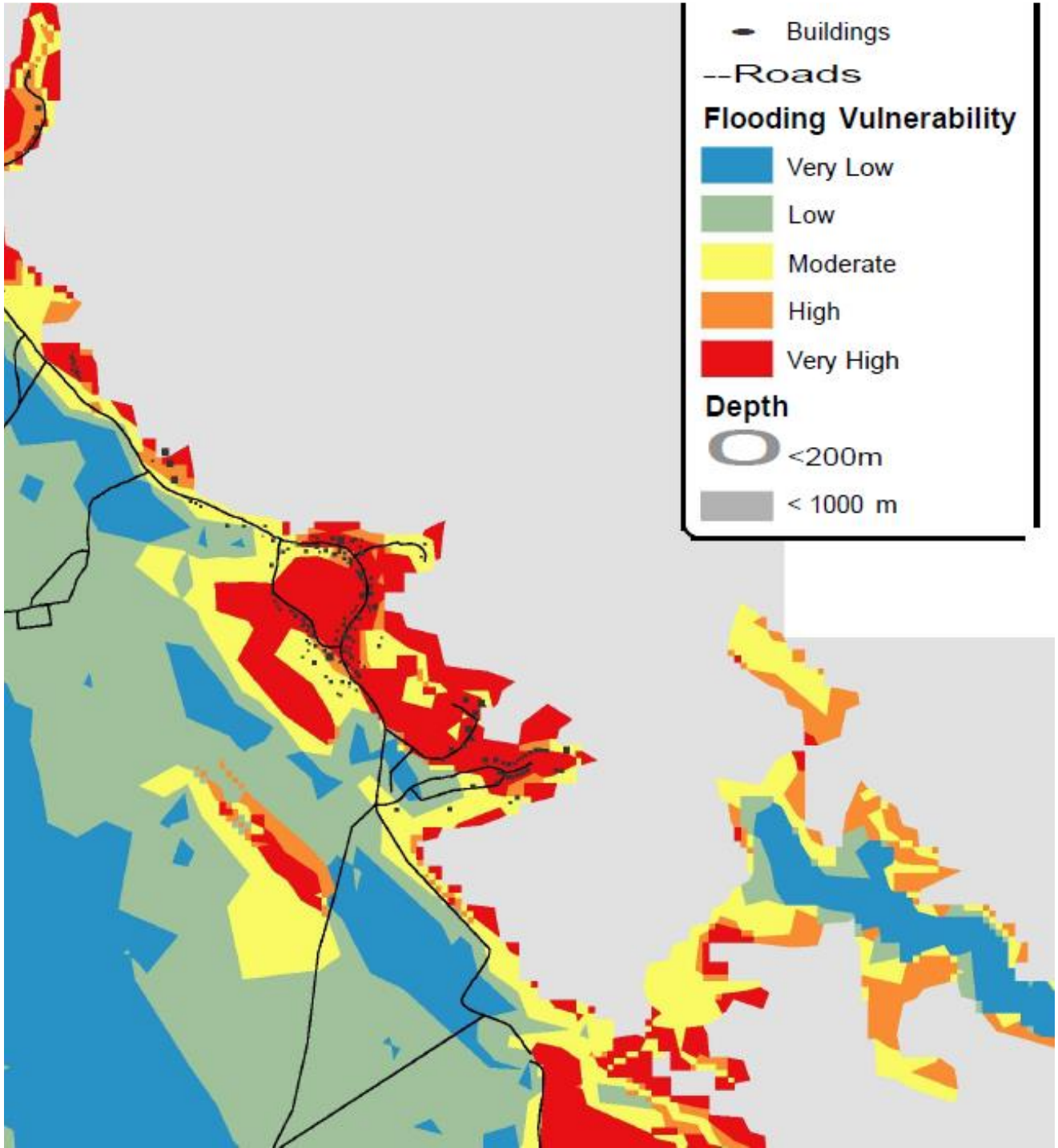


HURRICANE
JOAQUIN
1 October 2015




N
Legend
Infrastructure - Bank
Infrastructure - Business
Infrastructure - Church
Infrastructure - Government
Infrastructure - Utilities
Residence
Tourism - Hotel
Tourism - Rental
Unoccupied Building
Roads
Coastal Rank - Low
Coastal Rank - High
Coastal Rank - Severe
Upland Areas
Inland Open Water
Florida
The Bahamas
Cuba
UNIVERSITY OF MIAMI
0 0.1 0.2 0.3 0.4 0.5 1
Kilometers


Flood Vulnerability
Great Exuma, Bahamas
N
Legend
Buildings
Roads
Flooding Vulnerability
Very Low
Low
Moderate
High
Very High
Depth
< 200 m
< 1000 m
< 10000 m
Emerald Bay
George Town
Last Modified: 14 December 2015
0 1 2 3 4 5 10 15 20 Kilometers
1:150,000


Buildings
--Roads
Flooding Vulnerability
Very Low
Low
Moderate
High
Very High
Depth
<200m
< 1000 m

VICTORIA POND RESTORATION PROJECT

PROJECT GOALS INCLUDE SCIENCE, MANAGEMENT, COMMUNITY OUTREACH and FINANCE

1. **To establish a local mangrove preserve**.
2. **To restore natural drainage and tidal flow through the wetland preserve system**;
3. **To delineate the preserve area** and restore native plant **communities**
4. **To develop long-term community outreach and coastal stewardship programs** to help finance the management
5. **To document measurable improvements in coastal water quality and near-shore fish habitat**

VICTORIA POND RESTORATION PROJECT
UNITED NATIONS ECOHYDROLOGY DEMONSTATION SITE

WETLAND RESTORATION AND COASTAL ZONE MANAGEMENT IN EXUMA

- Protects biodiversity of Great Exuma, processes pollution, maintains a balance against insect and disease pests and adds to the beauty of our island;
- Stabilizes the coast line, reduces costs to local government and creates new jobs and local skills related to environmental management and stewardship; AND
- Wetland Protection is required by the laws, policies and treaty agreements already established in the Commonwealth of The Bahamas!
- LAKE VICTORIA IS A NATURAL AREA AND DEMONSTRATION PROJECT ON WETLAND PROTECTION.

BE PART OF THE RESTORATION EFFORT.
RECYCLE, REDUCE, RE-USE


THANKS TO
• Alohi Nakachi
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United Nations Educational, Scientific and Cultural Organization
International Hydrological Programme
50 years
ecohydrology programme
UNIVERSITY OF MIAMI