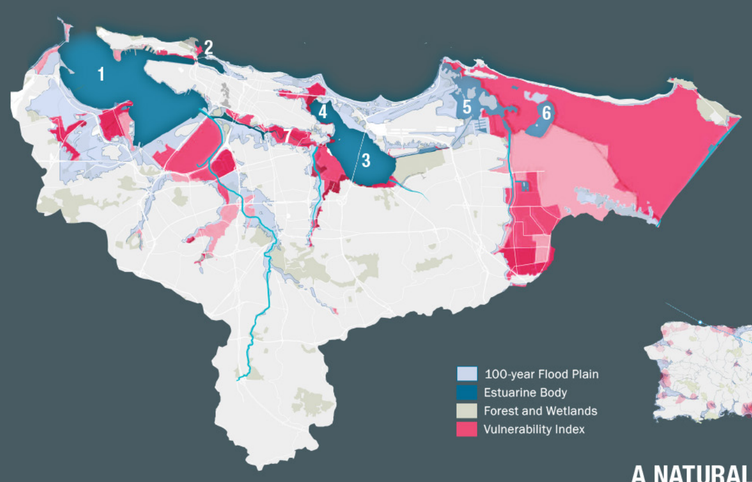
SAPPHIRE NECKLACE

RESILIENT SHORELINE COMMUNITIES ALONG THE SAN JUAN BAY ESTUARY

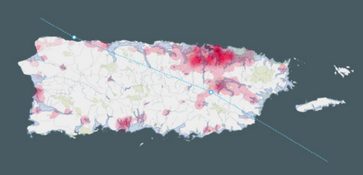
8th ICBR Lisbon | Nov 2018
Building 4Humanity
DESIGN COMPETITION
Category 2:
Resilient Projects (**Unbuilt**)

Team Project Coordinator(s): *J.Rodriguez*
Team Members: *A. Berrizbeitia, A. Colon, E. Llinas, J. Rodriguez*
Project Location: *San Juan, Puerto Rico*
Team Code: **B4H-DC2137**

INTRODUCTION + SITE DESCRIPTION



1. San Juan Bay
2. Condado Lagoon
3. San José Lagoon
4. Los Corozos Lagoon
5. Torrecilla Lagoon
6. Piñones Lagoon
7. Caño Martín Peña



Site: San Juan Bay Estuary, Puerto Rico

The San Juan Bay Estuary is a 3,400-acre multiple hazard-prone estuary system in San Juan, the capital city of the Commonwealth of Puerto Rico. The estuary encompasses more than 15 miles of shoreline and waterways, including the San Juan Bay, five lagoons (Condado, San José, Los Corozos, Torrecilla and the Piñones Lagoon) several rivers and creeks, and a network of channels interconnecting these bodies of water. The Estuary is the most populated estuary of Puerto Rico with more than 1.5 million inhabitants distributed through eight municipalities: San Juan, Bayamón, Cataño, Toa Baja, Guaynabo, Carolina, Loíza, and Trujillo Alto. The communities living along the estuary have some of the highest densities in Puerto Rico, with more than 8,000 inhabitants per square mile. Many of these communities have been the subject of long-standing neglect, lacking basic services and infrastructure.

DESCRIPTION OF RISKS

The estuary is surrounded by densely built formal and informal communities prone to multiple disaster hazards, including flooding, hurricanes and storm surge (currently in recovery from the impact of a category 4 hurricane), earthquakes, tsunamis, droughts, and coastal erosion. Many of these risks are currently being exacerbated by climate change, posing significant challenges in the estuary's systems and neighboring communities, particularly after the 2017 hurricane season.

A NATURAL EVENT; A MAN-MADE DISASTER

In September 2017, Puerto Rico endured the catastrophic impact of two category 5 hurricanes after Hurricanes Irma and Maria hit the island only two weeks apart. Hurricane Maria made a direct hit on the island, becoming the worst natural disaster in Puerto Rico's modern history and the deadliest natural disaster in modern US history, with approximately 2,975 casualties from direct and hurricane-related causes.

Damage to critical infrastructure resulted in cascading failures of the lifeline systems of energy, telecommunications, water, and transportation. Given the scale of the disaster, the limited response resources, and the failure of lifeline systems, emergency services were severely compromised and residents lacked electricity, food, and water for a prolonged period. Disinvestment in the electrical grid and lack of renewal energy sources became a central challenge of the immediate disaster response. Thousands of families had to survive nearly a year without electricity, in what became the largest blackout in US history and the second largest worldwide.

Decades of inadequate planning and unsustainable urbanization patterns in flood-prone areas only contributed to exacerbate the crisis. Nearly half-a-million people live in coastal zones, and 2.3 million in the 44 coastal municipalities of the island. As the most densely populated estuary in Puerto Rico, the home to the largest share of people living in vulnerable, flood-prone communities, San Juan Bay Estuary was severely impacted by these events.

Once A Wetland, Today home to Thousands of Working-class Families

During early 20th century, dramatic rural-to-urban migrations resulted in the rise of large informal settlements, particularly along one of the estuary's waterways: Caño Martín Peña. Today, these neighborhoods remain a centerpiece of the social fabric of the city, with strong local advocacy groups and thriving community-run businesses. Nonetheless, despite herculean community-driven revitalization efforts, approximately 65% of the households in the eight communities surrounding the Caño Martín Peña remain under the US poverty level, and 55% of the households reported an income equal or less than $10,000 per year.

Environmental Assets and Challenges

Today, the estuary makes up to more than 30% of the remaining mangrove forests in Puerto Rico, and is home more than 160 bird species, 125 fish species, and 300 plants species, including 17 plant and 8 animal endangered species. Nonetheless, more than 80% of the estuary watershed has been urbanized, posing significant pressures on the ecological balance of the system. Decades of incremental infill and informal land reclamation resulted in a substantial decline of the estuary's ecology. Point and non-point sources pollution have compromised the estuary's water quality, while multiple of its waterways remain too narrow or stagnant to support marine life due to accumulation of artificial and natural debris.

Flooding and Storm Surge Vulnerability

Communities along the estuary area are also prone to flood events and storm surge. Due to the environmental degradation of the estuary's waterways, water during flood events is highly polluted, severally compromising the health of these communities. In 2002, 39% of households reported at least one incident of flooding with contaminated water during the previous year. The number increased to 70% in 2012.

Climate Change Stressors:

Many of the challenges noted earlier are and will be further exacerbated by climate change. These include:

- *Sea Level Rise: will cause substantial flooding of shoreline communities. It will also result in freshwater wetlands becoming more salinized.*
- *More-intense rainfall: will cause more frequent and intense episodes of flooding and intense runoff. drains, which will already be saturated.*
- *Warmer water temperatures due to Global Warming: will result in more frequent and stronger storms, and low oxygen concentrations in the estuary.*
- *More-frequent droughts or greater rainfall amounts will lead to changes in the distribution of salinity in the estuary.*

PROPOSAL: A PROTECTED, ENVIRONMENTALLY IMPROVED BLUE SPINE FOR SAN JUAN:

Re-envision 2,975+ acres of the San Juan Bay Estuary watershed as a protected, environmentally sound estuarine necklace, combining both hard and soft infrastructure to protect low income communities from flooding, storm surge and sea level rise, while enabling an extensive network of open spaces.

The aftermath of Hurricane Maria provides Puerto Rico with one in a generation opportunity to build back better. To think big and holistically, integrating local, statewide and federal agencies to make our cities more resilient and reduce the impact of future disasters like Maria.

PROJECT GOALS

STRENGTHEN ECOSYSTEMS

- Improve and restore hydrological and ecological functions while protect ecosystems: a healthy and improved blue spine for San Juan
- Start from the beginning: reinforce riparian corridors contributing to the estuary

KNIT COMMUNITIES TOGETHER

- Re-define the San Juan's waterfront by establishing a network of open spaces and recreational connections along the city's estuary
- Introduce an aggressive water transportation system, anchored by multimodal hubs at key confluences

PROVIDE COASTAL RESILIENCY

- Protect shoreline communities from sea level rise and projected storm surges
- Re-define major North-South corridors in the city as major stormwater collectors.

FOSTER ECONOMIC DEVELOPMENT AND COMMUNITY STEWARDSHIP

- Build upon an ongoing community driven vision: Proyecto Enlace
- Stimulate economic development by promoting the visitor's economy and strengthening local micro-business

PRELIMINARY STRATEGIES

1. STRENGTHENING ECOSYSTEMS

1.A Reinforce and restore coastal barrier systems:
- 1.A.1 Incorporate artificial reefs for wave attenuation
- 1.A.2 Restore and enhance coastal dunes

1.B Support and expand current efforts to eliminate discharges and disposal of sewage, sediments, and debris, among other pollutants currently impacting water quality.

1.C Build upon ongoing projects to improve water circulation on estuarine bodies

1.D Identify additional water outlets, particularly on sea level rise prone areas.

1.E Establish aggressive reforestation efforts along riparian corridors and strengthen existing urban forests.

1.F Replace hard-armored channelization with environmentally sound restoration techniques.

2. PROVIDING COASTAL RESILIENCY

2.A Incorporate integrated flood protection systems that respect and preserve the integrity of existing ecosystems. These include:
- 2.A.1 Constructed Wetlands and Mangroves
- 2.A.2 Multipurpose levees and berms, incorporated with other landscape elements as waterfront parks
- 2.A.3 Reinforced bulkheads (for areas with existing bulkheads and low environmental impact)
- 2.A.4 Coastal Morphology Restoration
- 2.A.5 Deployable Flood Walls
- 2.A.6 For flooding and storm surge prone areas where density significantly low, establish long term re-localization strategies

2.B Transform north-south vehicular corridors into green streets, incorporating extensive rainwater runoff management and infiltration systems.

2.C Identify sites for renewable energy production, including wind and wave energy farms.

3. CONNECTING COMMUNITIES; LINKING OPEN SPACES

3.A Build ongoing governmental and community-driven efforts to create a extensive network of recreational trails and open spaces. These entail:
- 3.A.1 Boardwalks
- 3.A.2 Trails
- 3.A.3 Dedicated Bike Tracks

3.B Restart the water taxi system and establish water hubs at key intermodal connections, such as Hato Rey (connection to the Tren Urbano metro system), San Juan Port, LMM Airport, and Carolina (connection to AMA bus system)

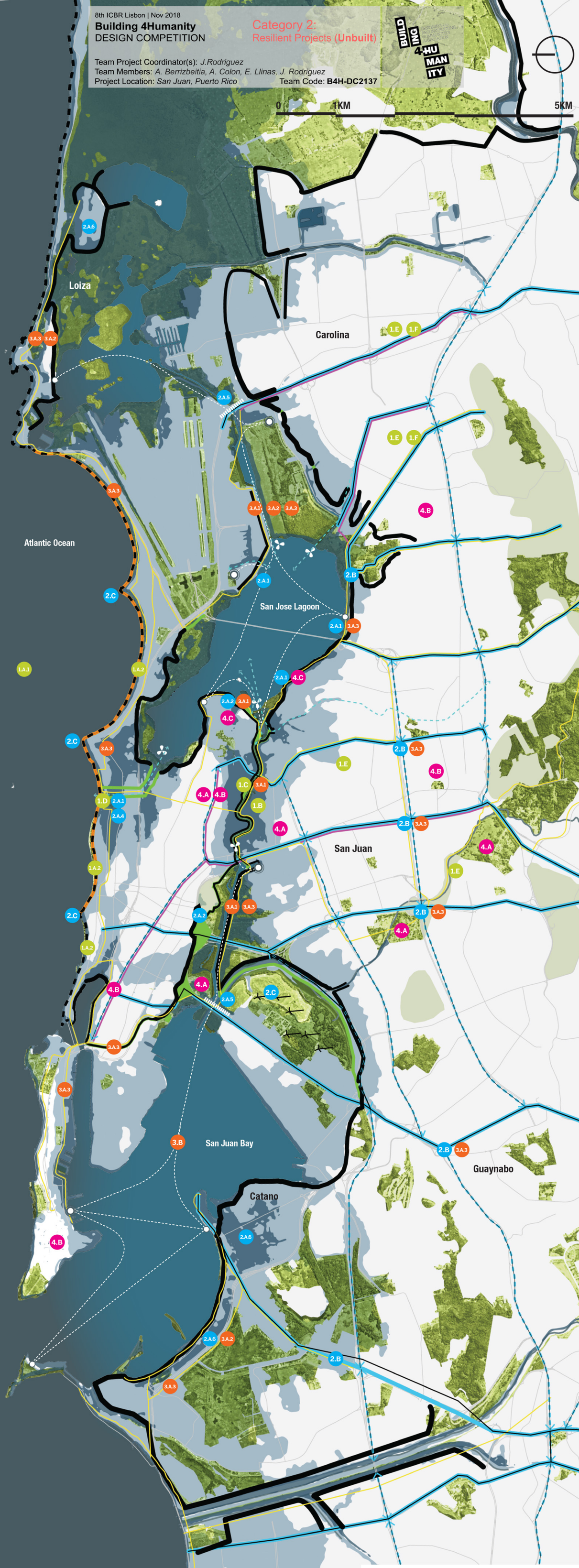
4. PROMOTING SOCIAL RESILIENCY AND COMMUNITY-DRIVEN ECONOMIC DEVELOPMENT

4.A Increase food security by promoting urban farming

4.B Establish micro-grids and solar energy hubs to provide critical services if power is interrupted

4.C Support and expand ongoing community-driven initiatives to promote the visitors economy

4.D Support community-run micro business, such as educational and natural adventure tours, local restaurants, aquaculture, among others



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SAPPHIRES + MULTIPURPOSE BERM

A necklace of waterbodies connecting and protecting people and ecosystems in the estuary.

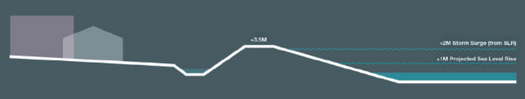
A berm created with fill from water quality-driven dredging processes and adapting morphology according to context.

+

A Multi-purpose resist barrier that: **Protects** vulnerable flood-prone communities along the estuary

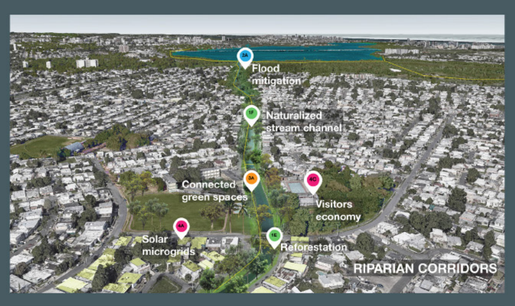
A Multi-purpose resist barrier that: **Enhances** community spaces and provides opportunities for economic growth

A Multi-purpose resist barrier that: **Connects** open spaces and ecosystems



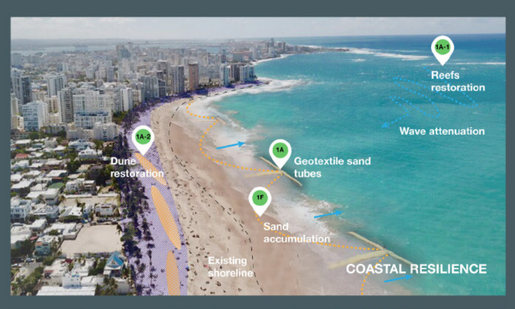
MANAGING WATER FLOWS + CONNECTING COMMUNITIES

Substantially reduce disaster damage to critical infrastructure and disruption of lifeline systems (water, electricity, communication, food).



PROVIDING COASTAL RESILIENCE + STRENGTHENING ECOSYSTEMS

Substantially reduce number of affected people by hurricanes, flooding, sea level rise, storm surge.



PROVIDING COASTAL + SOCIAL RESILIENCE

Helps reduce direct disaster economic loss and faster recovery process.

PROMOTING A BLUE ECONOMY + RESILIENCE

A blue economy is based on the health of its estuary and ocean. 1) Blue carbon; 2) Coastal Protection and habitat protection, restoration; 3) Waste management of nutrients, solid waste; 4) Biodiversity and habitats conservation.