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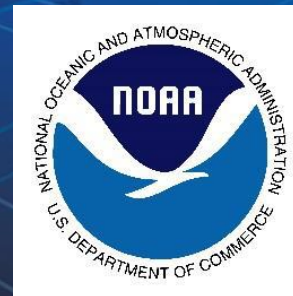
2016 Puerto Rico Climate Change Council Annual Meeting

Community Based Climate Adaptation Plan for Rincón Municipality, Puerto Rico

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April 7, 2016

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Introduction

Problem: Natural Hazards and Climate Change Risks to the Community

Project Objectives: Explore the questions of - How is Rincón vulnerable to climate variability and change? What actions could Rincón take to reduce that vulnerability?

Key Stakeholders and Collaborations:

- Rincón Municipality
- Puerto Rico's Coastal Zone Management Program, DNER
- Puerto Rico Climate Change Council
- National Oceanic and Atmospheric Administration
- UPR Sea Grant College Program
- Climate Change Council
- University of Puerto Rico – Mayagüez Campus
- Puerto Rico Water Resources and Environmental Research Institute
- EPA Caribbean Environmental protection Division
- Tourism Association of Rincón
- Surfrider Foundation Rincón
- Puerto Rico Aqueduct and Sewer Authority
- UPRM Seismic Network
- PR National Weather Services
- Professional Surfing of PR Association

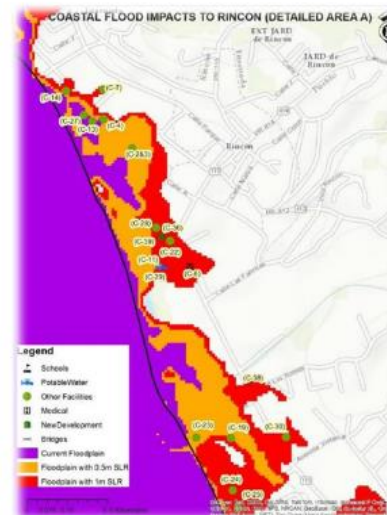


Community Based Climate Adaptation Plan for Rincón Municipality, Puerto Rico

Volume 1 – Site Description and Initial Stakeholder Outreach and Engagement Report

Volume 2 – Vulnerability Assessment Report

Volume 3 – Risk Profile and Climate Change Adaptation Plan



Submitted to:

Departamento de Recursos Naturales y Ambientales
 PO BOX 366147
 San Juan, PR 00936

Submitted by:

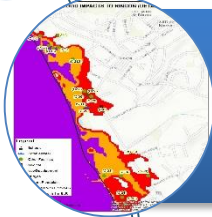
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Methodology



Step 1: Stakeholder Engagement and Outreach (Volume 1)

- Public workshops, technical site visits of at-risk areas/infrastructure



Step 2: Evaluate Projected Climate Change Impacts and Hazards (Volume 2)

- A detailed climate, vulnerability, and impact assessment conducted for the municipality



Step 3: Develop Vulnerability and Risk Management Profiles (Volume 3)

- Priority hazards summarized in a risk matrix



Step 4: Identify Adaptation Strategies (Volume 3)

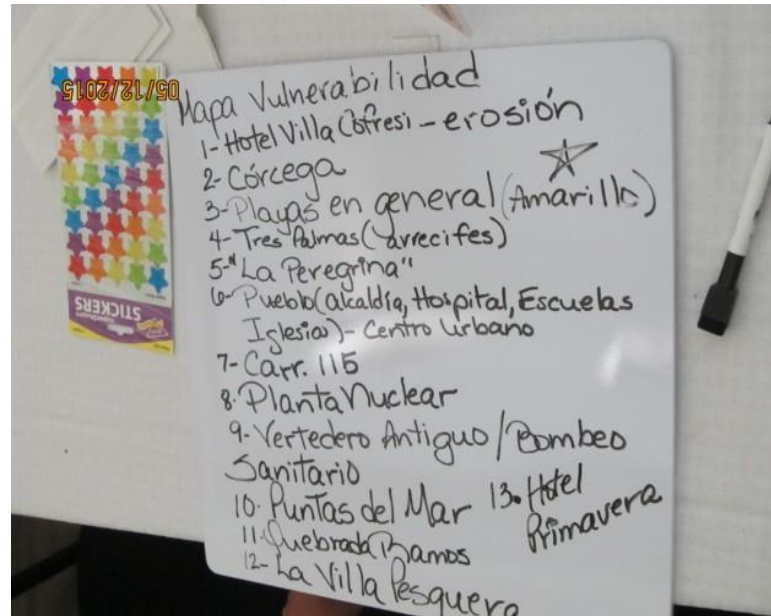
- Adaptation strategies identified for each vulnerability profile



Step 5: Refine Adaptation Strategies with Stakeholders and Launch Adaptation Plan (Volume 3)

- Survey used to refine strategies; Plan launched via social media

Stakeholder Workshop



Vulnerable Resource/Infrastructure	Type	Identified by Multiple Groups	Identified in Technical Site Visit
Los Ramos USACE Channel	Coastal Infrastructure	X	X
BONUS	Critical Infrastructure		X
Communication Antennas (Channel 12)	Critical Infrastructure		
Drinking Water (Pumping station and two reserve tanks (0.5 MG and 0 MG))	Critical Infrastructure	X	
Emergency Assembly Designated Place- Recreational Park	Critical Infrastructure		
Geriatric Center	Critical Infrastructure		
Hospital	Critical Infrastructure	X	
Hotels	Critical Infrastructure	X	
Police Station	Critical Infrastructure	X	
Religious Facilities- Juan Pedroza School and Manuel Gonzalez School	Critical Infrastructure		
Road 115	Critical Infrastructure		
Sanitary System (Pumping Station and Discharges)	Critical Infrastructure	X	
Schools	Critical Infrastructure		
Town Center Facilities (City Hall, Hospitals, Schools, Churches)	Critical Infrastructure		
Transportation Infrastructure	Critical Infrastructure		
Tourism Activity	Economy		
"La Peregrina"	Natural Resource		
Beaches	Natural Resource		
Córcega Beach	Natural Resource	X	X
Endangered Species Forest (near BONUS Facility)	Natural Resource		
Fisheries	Natural Resource		
Mangroves Critical Habitat	Natural Resource		
Marias Beach	Natural Resource		
Rincón Recreational Public Beach	Natural Resource		X
Sandy Beach	Natural Resource		
Tinglar Turtles Nesting Areas	Natural Resource		
Tres Palmas Marine Reserve	Natural Resource	X	X
Ventana al Mar	Natural Resource		
Córcega Housing Development	Public Infrastructure		
Estrella Community	Public Infrastructure		
Horn Dorset Primavera Resort	Public Infrastructure	X	
Hotel Villa Cofresi	Public Infrastructure		
La Cambija (Potential Historic Site)	Public Infrastructure		
La Villa Pesquera	Public Infrastructure		
Lighthouse (Historic)	Public Infrastructure		
Parcelas Stella	Public Infrastructure		
Puntas del Mar	Public Infrastructure		
Puntas Ward	Public Infrastructure		
Residential Areas	Public Infrastructure		
Rincón COOP and Banco Popular de PR	Public Infrastructure	X	X
Rincón Cultural Center	Public Infrastructure		
Spanish Wall (Potential Historic Site)	Public Infrastructure		
Vista Sur	Public Infrastructure		
Old Landfill	Solid/Hazardous Waste	X	X

Technical Site Visits



Domes Beach Site and
BONUS Reactor



Spanish Wall Site



Wastewater Pumping
Station



Historic Coastal Landfill



Public/Recreational
Beach and Rincón
COOP Facilities



Los Ramos Channel

Technical Site Visits



Córcega Beach Site

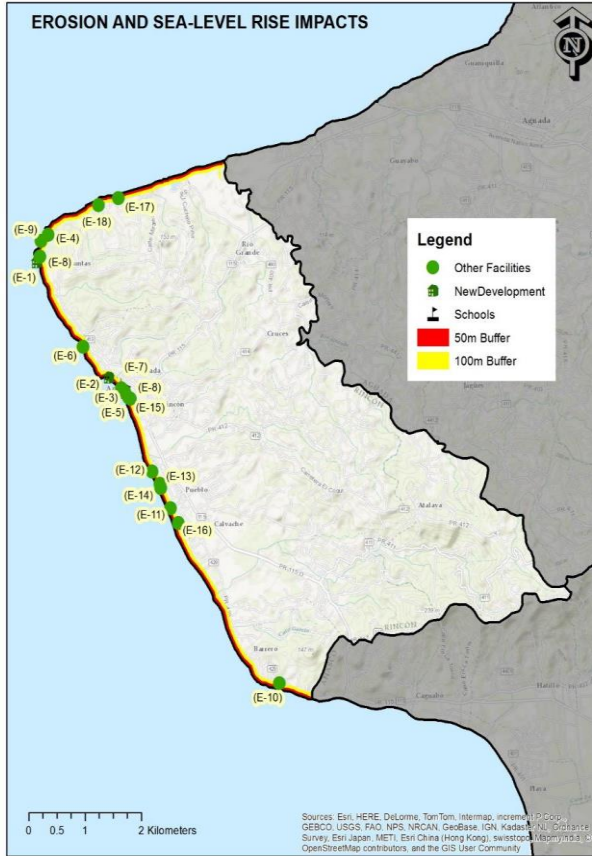
Climate Change Projections

- ***Sea Level Rise (SLR) and Coastal Erosion***
 - 0.5 m (1.65 ft) for mid-century
 - 1.0 meter (3.3 ft) for end of century
- ***Coastal Storm Surge***
 - 0.5 m SLR for mid-century
 - 100-year surge with 1.0 m SLR for end of century
- ***Increased Hurricane Intensity***
 - Hurricanes are a common hazard for Rincón
 - Climate change could cause more intense hurricanes

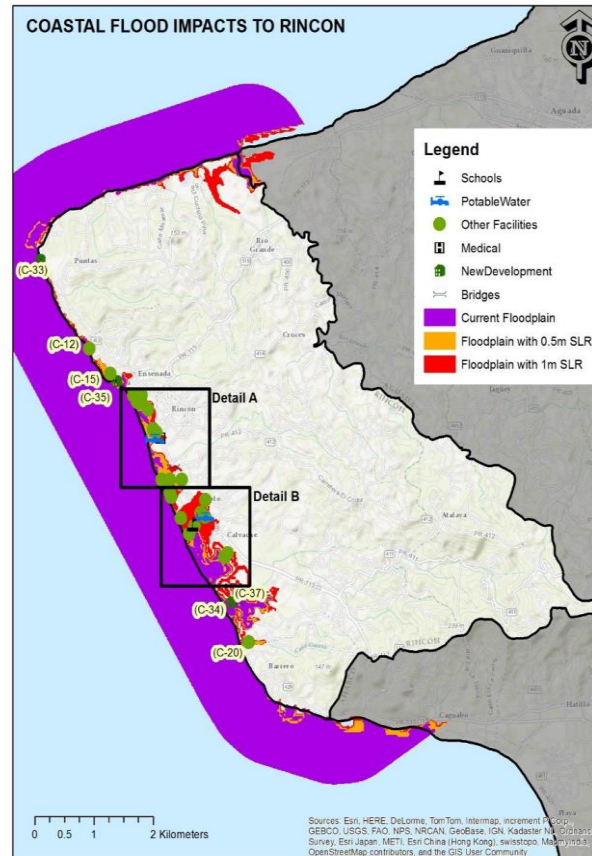
Climate Change Projections

- ***Increased Extreme Precipitation Events and Riverine Flooding***
 - Riverine flooding is fairly common in Rincón
 - Number of extreme precipitation events is projected to increase
- ***Decrease in Annual Precipitation***
 - Drought periods have been increasing
 - Projections show a median decrease of 12 % per year
- ***Increased Air and Sea Surface Temperature (SST)***
 - Clear trend of increased air and SST
 - SST above threshold for coral bleaching could be exceeded 1/3 of the year

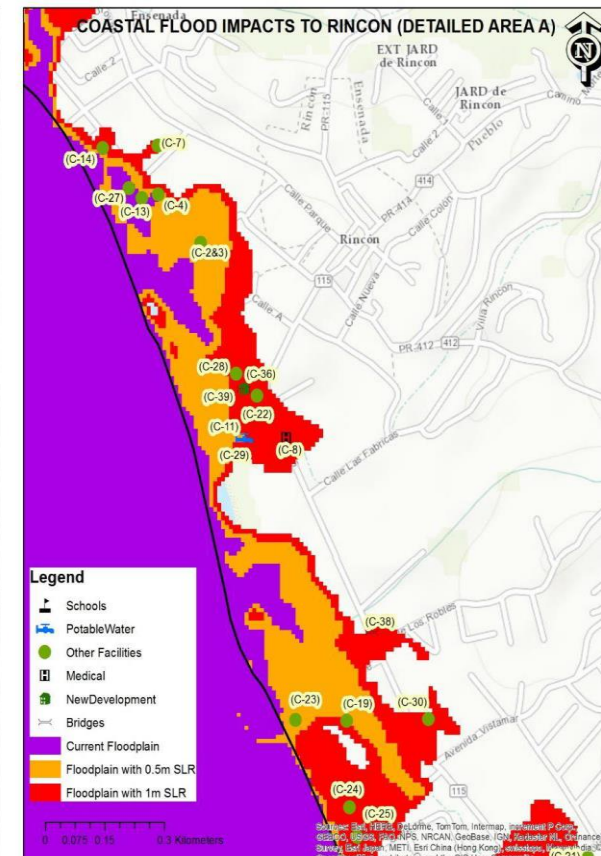
Vulnerability maps



Erosion and SLR Impacts



Coastal Flood Impacts



Coastal Flood Impacts – Detail A (0.5m and 1.0m)

Risk to the Municipality of Rincón

Economic (from coastal storm surge with 1 m SLR)

- Property loss and loss of livelihood
 - Loss/impacts to 14 businesses (hotels, restaurants)
Commercial losses of \$10,245,852 (1.7 % of total building stock)
- Critical Infrastructure or Essential Facilities
 - Healthcare pump systems, Rincón Medical Center, Head Start, Pump Station, Texaco Road, water wells, Grande Creek bridge and channel, gas station
- Operational Impacts
 - Loss/impacts to roads and bridges and other critical infrastructure

Risk to the Municipality of Rincón

Social Risk (from coastal storm surge)

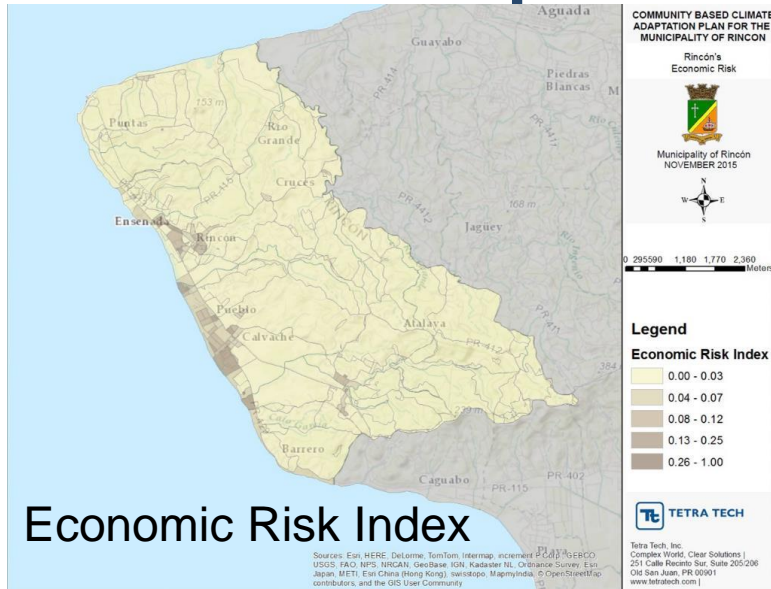
- Displacement
 - 1,200 households displaced
 - Residential losses of \$21,989,148 (1.89 %)
- Health and Safety
 - Need for evacuation and emergency response
 - Impacts to transportation networks, utilities, medical center, among others



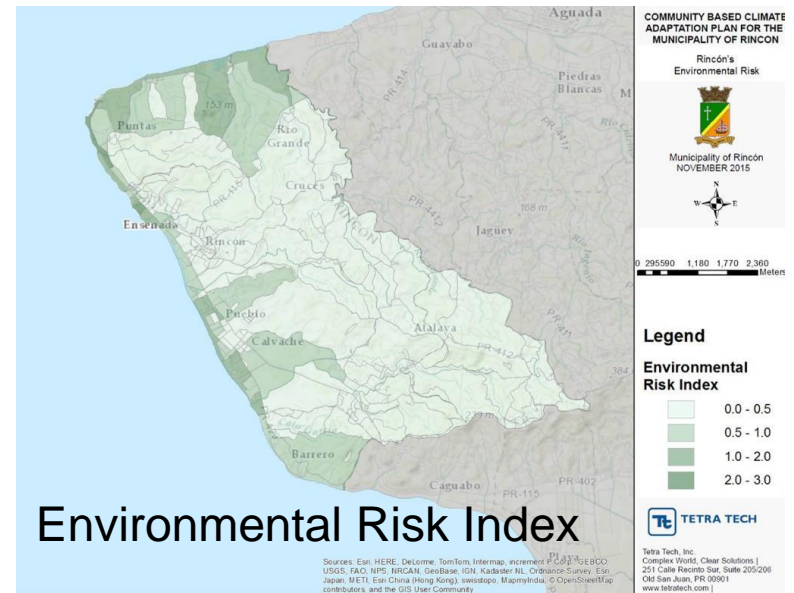
Environmental Risk

- Water quality
 - Potential bank scouring/erosion, water pollution from debris, waste, nutrients from flooding
- Marine resources
 - Beach scouring/erosion, impacts to reefs, sensitive habitat

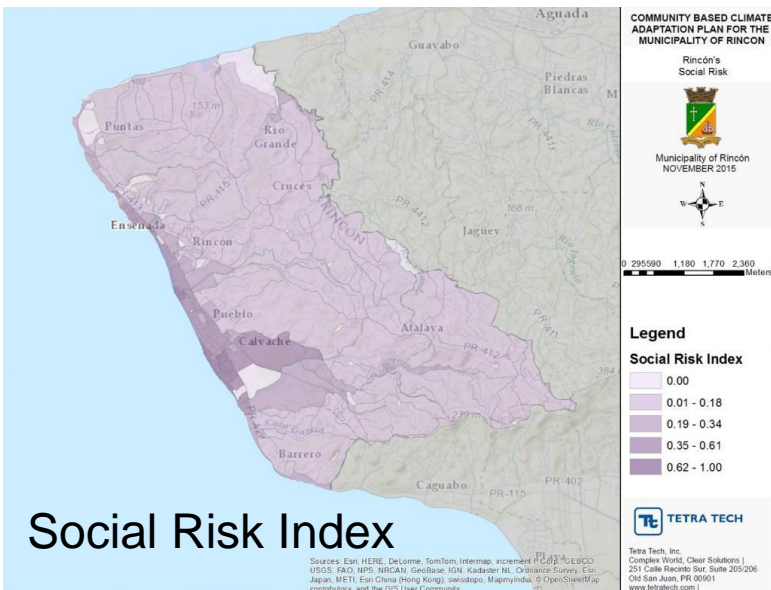
Risk Index Maps



Economic Risk Index



Environmental Risk Index



Social Risk Index

Adaptation Goals and Measures

Adaptation Goal 1: Increase Resiliency of Critical Infrastructure to Improve Community Reliability and Functions

- Training and awareness building for the business community (operators of critical infrastructure)
- Make repairs to drainage canals
- Increase storm drainage for transportation networks
- Develop a landslide program to identify, control, and monitor at-risk areas



Adaptation Goals and Measures

Adaptation Goal 2: Promote Community Health and Well-Being to Increase Resiliency of Social and Ecological Systems

- Incorporate Resilient Rincón and update Rincón's Comprehensive Master Plan
- Updated and Adopt Local Zoning Ordinances
- Use Rincón's Updated Coastal Erosion Study to Prioritize Implementation of Actions to Mitigate Coastal Erosion
- Clean-up/remediate Abandoned Solid Waste Coastal Landfill
- Implement the Tres Palmas Protection Plan

Adaptation Goals and Measures

Adaptation Goal 3: Advance Economic Development Opportunities

- Provide Emergency Preparedness and Hazard Mitigation Information to Business and Industry
- Promote Resiliency Actions for Business and Industry

Next Steps

“Formally Implement the Adaptation Plan, Goals and Strategies with the Community of Rincón and Incorporate the recommendations into the Updated Hazard Mitigation Plan, to meet the new FEMA requirements on Climate Change”



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Community Based Climate Adaptation Plan for Rincón Municipality, Puerto Rico

Questions?

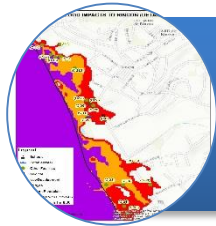
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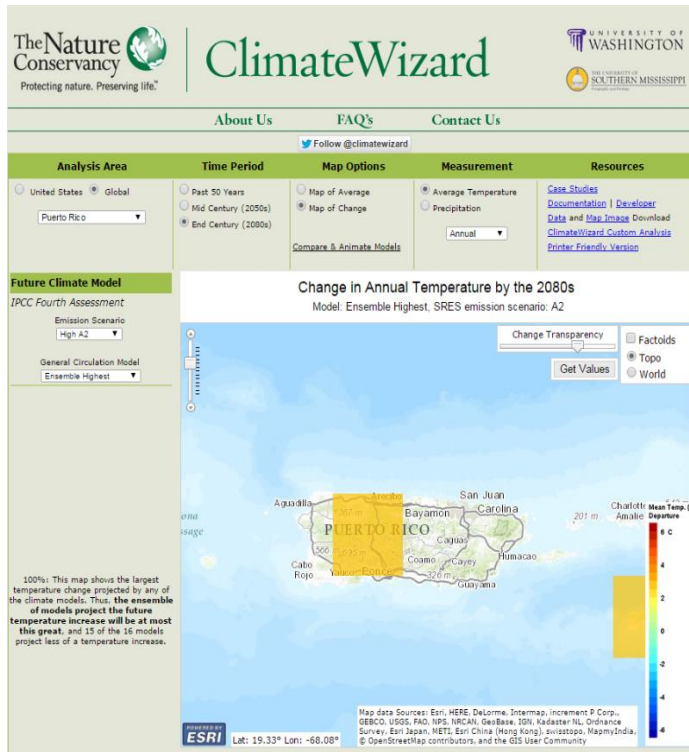


Volume 2 – Vulnerability Assessment

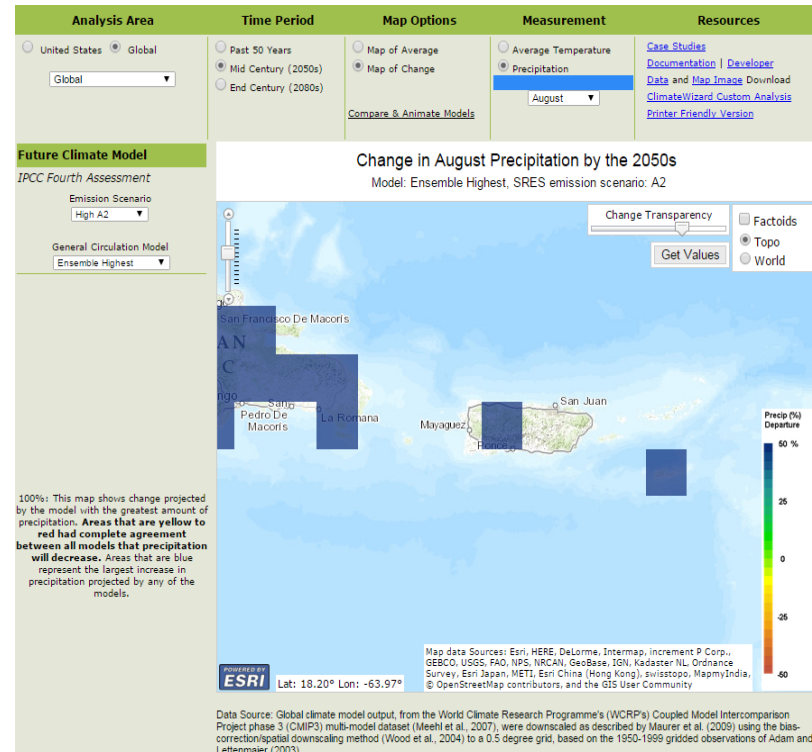


Step 2: Evaluate Projected Climate Change Impacts and Hazards (Volume 2)

- A detailed climate, vulnerability, and impact assessment conducted for the municipality

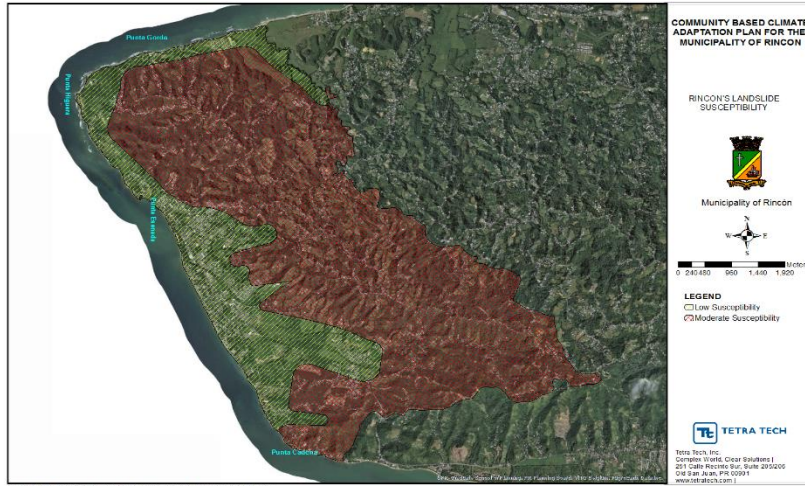


Temperature

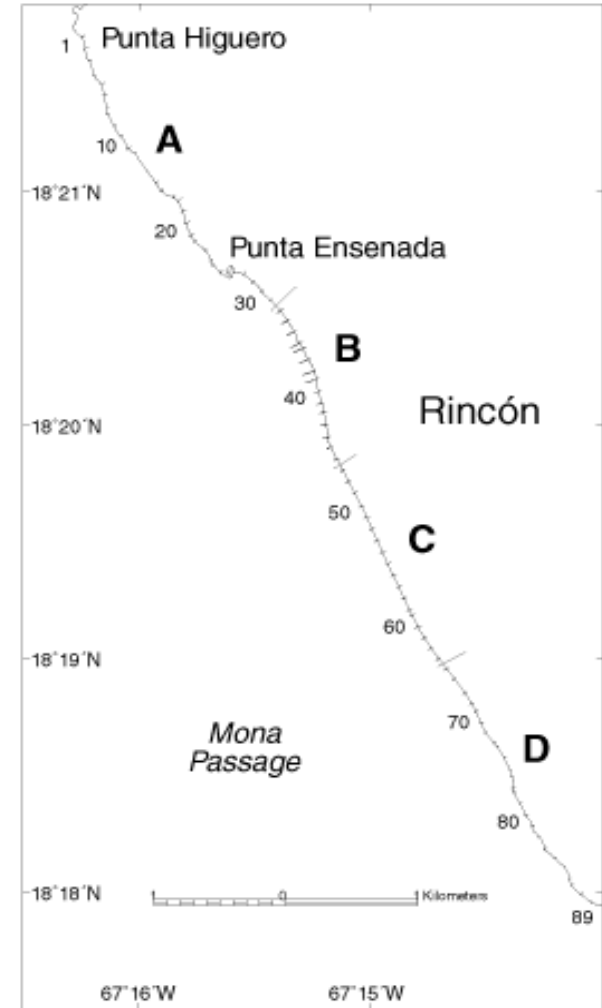


Precipitation

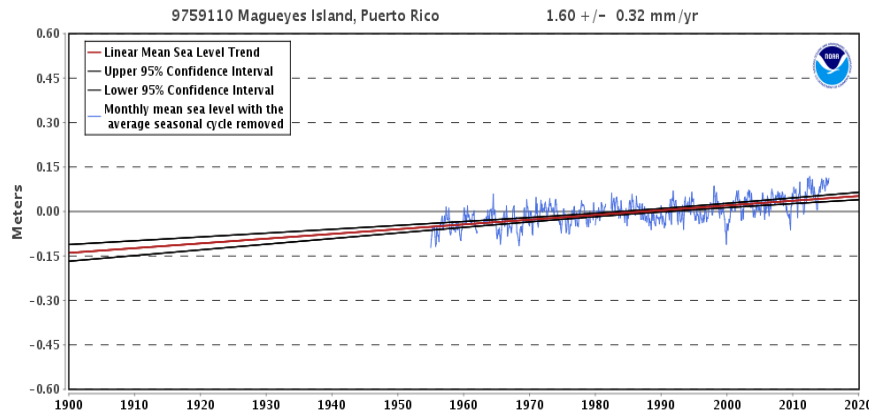
Climate Assessment



Landslide Susceptibility Map



Erosion Rates

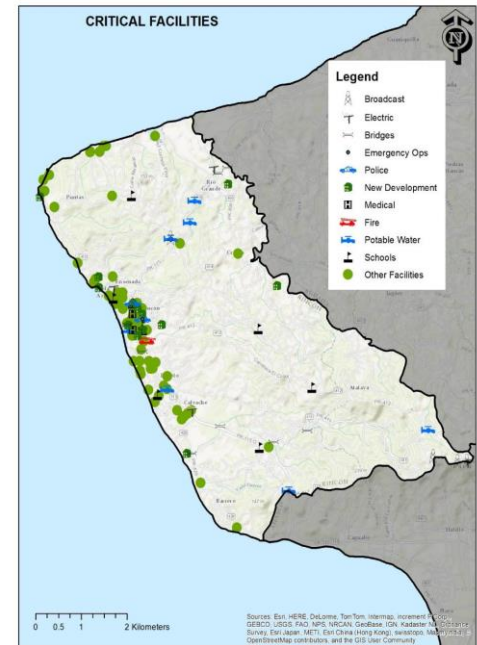


SLR Trends for Maguëyes Island

Exposure and Vulnerability

Aggregated Building Stock Values

Building Occupancy Class	Estimated Aggregate Replacement Cost (\$)	Estimated Aggregate Content Cost (\$)	Total Value (\$)
Residential	803,740,033	359,481,801	1,163,221,834
Commercial	374,502,967	229,856,199	604,359,166
Total	1,178,243,000	589,338,000	1,767,581,000



Critical Facilities

Name	Address	Facility Type*	Occupancy Type**	Replacement Cost (Structural value)	Building Type***	Backup Power
City Hall	Calle Muñoz Rivera #5	City Hall	Municipal Government	\$4.5 million	Concrete	Yes
Rincón Health Center	Calle Muñoz Rivera #58	Hospital	Medical	\$5.6 million	Concrete with fire proof gypsum board	Yes
State Police Station	Calle Nueva Final	Police	Government	\$800 thousand	Concrete	Yes
56 other facilities						

Volume 3 – Risk Profile and Climate Change Adaptation Plan



Step 3: Develop Vulnerability and Risk Management Profiles (Volume 3)

- Priority hazards summarized in a risk matrix



Step 4: Identify Adaptation Strategies (Volume 3)

- Adaptation strategies identified for each vulnerability profile



Step 5: Refine Adaptation Strategies with Stakeholders and Launch Adaptation Plan (Volume 3)

- Survey used to refine strategies; Plan launched via social media

Vulnerability and Risk Management Profile



Climate Change Scenario	Notes	Social Factors		Economic Factors			Environmental Factors		
		Displacement	Health and Safety	Property Loss/ Loss of Livelihood	Critical Infrastructure	Operational Impact	Air Quality	Water Resources	Marine Resources
Increased Sea Level Rise (SLR)/ Coastal Erosion [^]	Current erosion rates of 1 meter per year SLR estimates of 0.5 m (1.65 ft) and 1 meter (3.3 ft)	Potential for residences on coastline to be impacted (coastal erosion currently impacting residences)	Abandoned structures currently pose health and safety risk (pollution, debris)	Potential for businesses on coastline to be permanently impacted. Loss of surf beaches could impact tourism.	Potential for critical infrastructure damage and loss (roads, utilities, hospitals, etc.)	Loss of critical infrastructure and transportation routes could cause operation impacts	n/a	Salt-water intrusion could impact freshwater resources and sensitive ecosystems	Loss of beaches could decrease sea turtle nesting habitat. Erosion could increase sedimentation impacts to coral reefs.
Increased Coastal Storm Surge and Wind (Hurricane and Storm Events)*	Storm surge expected to be greater due to SLR/erosion; also potential for more intense hurricanes	Potential for temporary evacuation; residences to be impacted	Storm surge could pose risk to human life, create debris and cause pollution impacts. Impacts to critical infrastructure could challenge emergency response/relief	Potential for businesses on coastline to be permanently impacted by flood/wind impacts. Loss of surf beaches could impact tourism.	Potential for critical infrastructure damage and loss (roads, utilities, hospitals, etc.)	Loss/disruption of critical infrastructure and transportation routes could cause operation impacts, including temporary closure and loss of tourism	n/a	Short-term salt-water intrusion could temporarily impact freshwater resources and sensitive ecosystems. Potential water pollution from debris, waste, nutrients from flooding	Loss of beaches could decrease sea turtle nesting habitat; potential to damage coral reefs and other sensitive habitat (Tres Palmas Marine Reserve). Increased sedimentation impacts.

Guide Estimates of Likelihood of Risks

Probability Range by Type of Event	Very Low - 0	Low Risk - 1	Moderate Risk - 2	High Risk - 3	Very High Risk - 4
Significant Single Event*	Not likely to occur	Likely to occur once between 30 and 50 years	Likely to occur once between 10 and 30 years	Likely to occur at least once a decade	Likely to occur once or more annually
Ongoing/Cumulative Occurrence [^]	Not likely to become critical	Likely to become critical in 30-50 years	Likely to become critical in 10-30 years	Likely to become critical in a decade	Likely to become critical within several years

Vulnerability and Risk Management Profile

Climate Change Scenario	Social Factors		Economic Factors			Environmental Factors		
	Displacement	Health and Safety	Property Loss/ Loss of Livelihood	Critical Infrastructure	Operational Impact	Air Quality	Water Resources	Marine Resources
Increased Sea Level Rise (SLR)/ Coastal Erosion	7	7	6	6	6		2	5
Increased Coastal Storm Surge	6	6	6	6	6		4	5
Increased Hurricane Intensity	6	6	6	5	5		4	5
Increased Riverine Flooding	5	5	5	5	5		4	4
Drought	2	4	2	2	4	3	4	
Increased SST and Ocean Acidification			4					5
More Days over 95°F		3	4	3	3	2	3	3

Likelihood			Consequence		
			1	2	3
			Low	Medium	High
5	Very High	6	7	8	
4	High	5	6	7	
3	Moderate	4	5	6	
2	Low	3	4	5	
1	Very Low	2	3	4	

Strategy and Option	Hazards Addressed	Relative Costs	Feasibility	Ameliorate Risk	Time-frame	Acceptability	Opportunity	Total
Strategy 1: Prevent Service Interruptions								
Mutual Aid Agreements	Flooding, Hurricane, Drought	3	2	2	3	2	3	15
Structural and Operational Improvements	Flooding, Hurricane, Drought, Extreme Heat	2	3	2	3	3	3	16
Training	Flooding, Hurricane, Drought	3	3	1	3	3	3	16
Strategy 2: Assess and Repair Critical Networks								
Increase Storm Drainage for Transportation Networks	Flooding, Hurricane, SLR	2	2	2	3	3	3	15
Landslide Program	Flooding	2	2	2	3	3	3	15
Assess Bridges and Retrofit/Make Repairs	Flooding, Hurricane, SLR	1	2	3	2	3	3	14
Make Repairs to Canal Los Ramos	Flooding, Hurricane, SLR	2	2	2	3	3	3	15
Make Repairs to Drainage Canals	Flooding, Hurricane, SLR	2	3	2	3	3	3	16
Assess and Implement a Stream and Drainage Channel Cleaning Program	Flooding, Hurricane, SLR	3	3	2	3	3	3	17
Establish a Memorandum of Understanding (MOU) with DRNA	Flooding, Hurricane, SLR	3	2	2	3	3	3	16
Strategy 3: Retrofit, relocate, or abandon/dismantle at-risk infrastructure								
Retrofit	Flooding, SLR, Hurricane, Extreme Heat	2	2	2	3	2	3	14
Relocate	Flooding, SLR, Hurricane	1	1	3	2	1	1	9
Abandon	Flooding, SLR, Hurricane	1	1	3	1	1	1	8
Strategy 4: Use Resilient Rincón products for future development								
Use Resilient Rincón Products for future development siting	Flooding, Hurricane SLR	3	3	2	3	2	1	14
Training on Hazus use	Flooding, Hurricane SLR	3	3	1	3	2	1	13

Refine Adaptation Strategies with Stakeholders and Launch Adaptation Plan



Tiered Bulkhead



Oyster Reefballs



Clean-up and Removal of Abandoned Solid Waste Landfill

