Resilient Coastal Development in Belize

Resilient Reefs Urban Design Studio and Accelerator Workshop Report

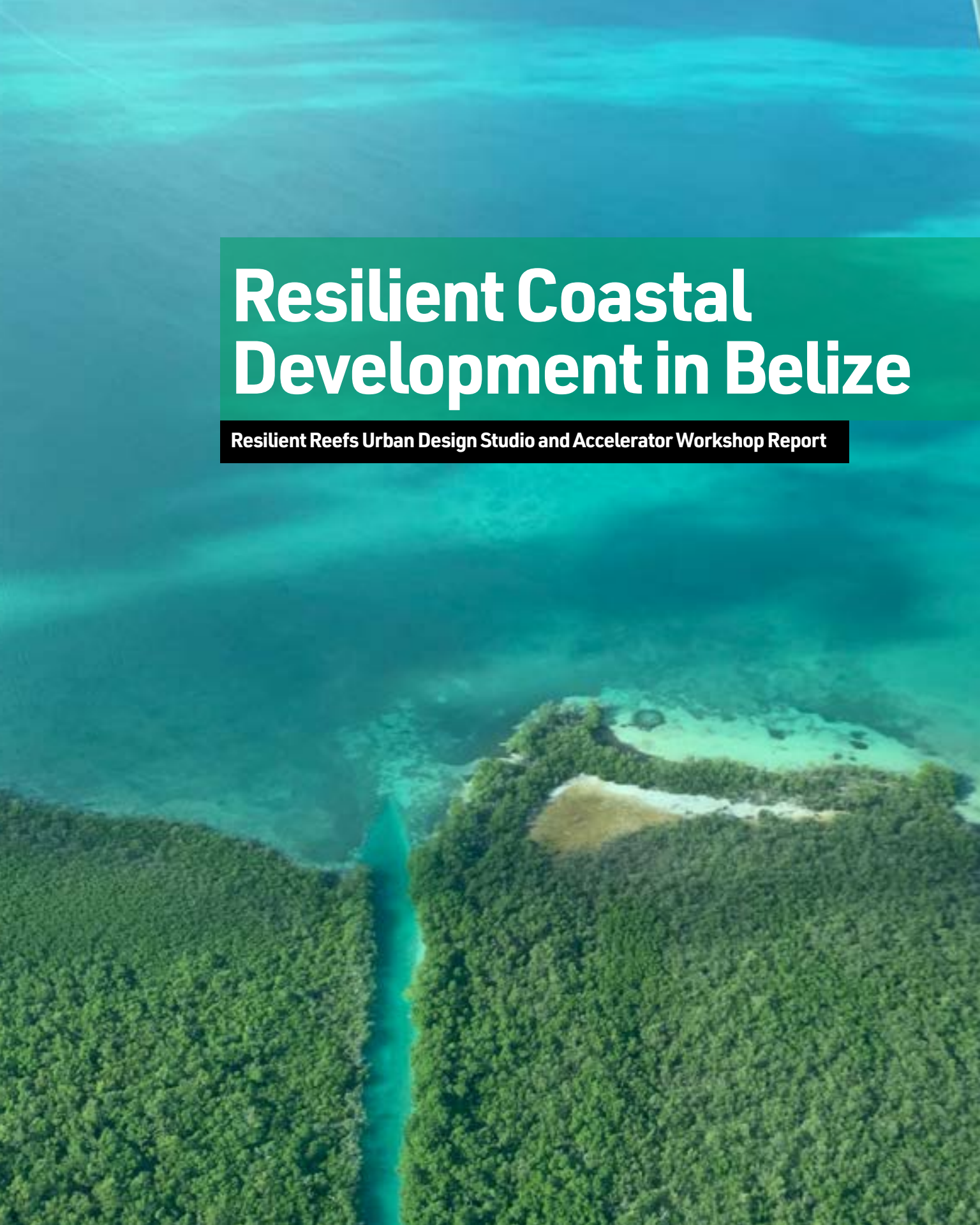

Image: Thad Pawlowski

RESILIENT COASTAL DEVELOPMENT IN BELIZE

RESILIENT REEFS URBAN DESIGN STUDIO AND ACCELERATOR WORKSHOP REPORT

VIRTUAL WORKSHOP | JAN 24 - 29, 2022

Ministry of Blue Economy & Civil Aviation

Education Empowers a Nation

COLUMBIA | Center for Resilient Cities and Landscapes

COLUMBIA GSAPP

Great Barrier Reef Foundation

Image: Thad Pawlowski

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Source: Allen Coral Atlas

BACKGROUND

With COP 26 failing to set international policy to significantly curb greenhouse gas emissions, and global landscapes in varying states of collapse, it is clear that urban design strategies need to scale to defend the living planet's massive critical ecosystems. The Mesoamerican Reef is the largest barrier reef in the Western hemisphere. A mosaic of mangroves, beaches, lagoons, coastal wetlands, limestone valleys and hills, and seagrass beds anchor an intensively productive ecosystem that has sustained human settlements over deep time. These "blue carbon" marine ecosystems store up to four times as much carbon as forests.

Lidar maps have revealed entire societies that thrived between forests and the Reef. In northern Yucatán, "in a region known as the Puuc (pronounced "Pook"), the Maya built remarkable structures, including artificial reservoirs, more than 1,200 ovens, a handful of terraces for farming and nearly 8,000 platforms where houses were built" (see article). Sprawling ancient hybrid wetland-fields among many other future oriented typologies of renewable energy, habitation, transportation, edge design and food production are examples of systems that could be part of a future strategy to interweave human habitation and the survival of the Reef in the climate emergency.

Today, the Mesoamerican Reef provides essential coastal and marine ecosystem services, sustains key economic sectors (especially fisheries and tourism), supports the livelihoods of millions of people, and contributes to protecting coastal communities against adverse effects of climate change.

At the same time, the Caribbean coastlines of Mesoamerica (e.g., Mexico, Belize, Guatemala ,and Honduras) are among the most vulnerable regions worldwide to climate impacts (Reynolds, 2019). As Columbia's Cynthia Rosenzewig of CCSR explains, "Coral reefs are already experiencing damage [from climate change], and they're projected to experience significantly more damage, even at temperature rises of 1.5 and 2 degrees Celsius" above pre-industrial levels. The Belize Barrier Reef system is a UNESCO world heritage site, and it is deeply tied to onshore urbanization, culture, and livelihoods.

"The Belize Barrier Reef spans seven sites and is the largest barrier reef in the northern hemisphere. Offshore atolls, several hundred sand cays, mangrove forests, coastal lagoons and estuaries house rich marine life including threatened species like marine turtles, manatees and the American marine crocodile. The reef is facing a number of local threats including coastal development, overfishing, invasive species, as well as the multiple impacts of climate change such as coral bleaching, more severe storms and rising sea levels. Belize has faced a range of shocks and stresses in recent years that have tested its resilience. On top of the humanitarian and economic crisis caused by the COVID-19 pandemic, the country was affected by three hurricanes — Nana, Eta and Iota — in quick succession in late 2020, causing major flooding and damage across the country. Belize has also recently seen the spread of Stony Coral Loss Tissue Disease, which has affected coral reef systems throughout the Caribbean. This water-borne disease destroys the soft tissue of some species of hard coral, killing them within weeks or months."

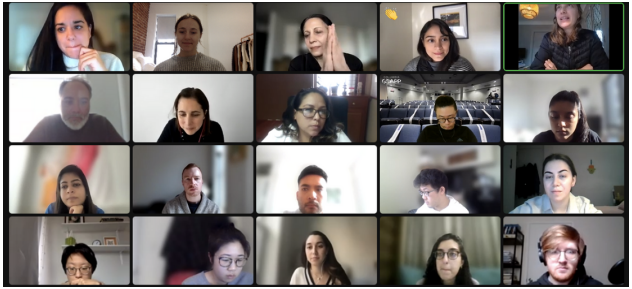
- Great Barrier Reef Foundation
Resilient Reefs Initiative

Further, rapid development in the Mexican context is being spurred by the Tren Maya project, which is designed to stretch along the Yucatan peninsula crossing Cancun's tourist mecca and archeological and touristic sites. While the project aspires to enact economic development, reduce poverty, mitigate carbon emissions and shift from private cars to public transportation, it has also spurred land speculation surrounding the stops on its path. The rapid urbanization pressures that the train will bring also pose a threat to the natural capital of the peninsula of Yucatán due to accelerated and unplanned urban growth along with touristic development in the coastal region.

A "business as usual" approach will accelerate reef loss, endanger the entire reef ecosystem, and increase the risk for shoreline communities.

The time to act is now - in anticipation of demographic pressures, urban expansion and climate change effects along the coast of Belize and Yucatan peninsula.

RESILIENT REEFS URBAN DESIGN STUDIO AND ACCELERATOR WORKSHOP



VIRTUAL WORKSHOP PARTICIPANTS

Rapid development along Belize's coast and climate change is reshaping the coastline, land- and sea-scapes, and communities. It presents both challenge and opportunity for local communities and livelihoods, the region, and for the Belize Barrier Reef System. To clarify these challenges with stakeholders, align on possible strategies for improving outcomes at multiple scales, and visualize possible future scenarios the Resilient Reefs Initiative, the **Coastal Zone Management Authority & Institute**, **Belize Fisheries Department**, and **Ministry for Blue Economy & Civil Aviation** are partnering with the **Center for Resilient Cities and Landscapes (CRCL)** and **Graduate School of Architecture, Planning, and Preservation (GSAPP) at Columbia University in the City of New York** (together, referred to as "the Team") to deliver a **Water Urbanisms Urban Design Studio** and **Accelerator Workshop**.

The effort was anchored by a week-long virtual workshop which convened local partners, stakeholders, and interdisciplinary academics in order to ground the partnership in mutual learning and understanding of local policy and action. The workshop and subsequent Studio will explore and co-design a set of design principles, place-specific research, and conceptual design sketches that test those principles with students and faculty from the **University of Belize**, local stakeholders, subject-matter experts, and public agencies. Research and visualized design development scenarios prepared in the Studio will inspire the ongoing planning and engagement work of the Resilience Strategy, Coastal Zone Management Plan Update, and Ministry for the Blue Economy Strategy.

CORE PROGRAM ELEMENTS AND PARTNERS

RESILIENT REEFS INITIATIVE AND BELIZE RESILIENCE STRATEGY

The Resilient Reefs Initiative is a global partnership to support World Heritage Reef sites and the communities that depend on them by strengthening their ability to prepare for and recover from disturbances, adapt to changing circumstances and plan for the future.

The Resilient Reefs Initiative is partnering with communities across five World Heritage Reef sites to respond to climate change and local threats. Established by the Great Barrier Reef Foundation, this six-year, $AUD14 million program is a collaboration with UNESCO World Heritage Marine Programme, The Nature Conservancy's Reef Resilience Network, Columbia University's Center for Resilient Cities and Landscapes, Resilient Cities Catalyst and AECOM. The program is enabled by the BHP Foundation.

With funding from the Foundation, the Coastal Zone Management Authority and Institute (CZMAI) has appointed a Chief Resilience Officer in Belize, Kalene Eck. Ms. Eck is leading the development and implementation of a Resilience Strategy that responds to local threats. This work is supported by the CZMAI, as well as key partners in the Ministry of the Blue Economy and Civil Aviation and Fisheries Department.

The efforts of the Urban Design Studio and Accelerator Workshop are intended to support and inform the ongoing efforts of the Resilience Strategy, Coastal Zone Management Plan Update, and the Strategy Plan of the Ministry of the Blue Economy.

RESILIENT REEF INITATIVE SITE MAP

RESILIENCE ACCELERATOR SITE MAP

RESILIENCE ACCELERATOR WORKSHOP

The Resilience Accelerator (the Accelerator) is a program of the Center for Resilient Cities and Landscapes (CRCL) at Columbia University that supports partners responsible for the implementation of priority resilience projects. The Accelerator works with an expanded network of partners to strengthen the biophysical, drive social and climate justice, build institutional capacity, and expand equitable economic outcomes of projects. The program aims to generate investment opportunities, deepen relationships between project teams, and advance implementation concepts. The research, planning, and design expertise at Columbia when matched with local knowledge and relationships of partners, advances pre-design work of high priority projects using three key methods:

- **Delivering synthetic research, analyses, visualization of issues, and design in support of project and concept development**
- **Facilitating immersive workshops that bring together multi-disciplinary teams to advance strategy, project design, and implementation**
- **Convening the perspective of international and place-based thought leaders, designers, and technical experts chosen for their ability to facilitate and advise on topical subject matter**

Since the launch of the program in Spring 2018, the Resilience Accelerator has identified 13 projects across eight cities worldwide, two of which are in partnership with the Great Barrier Reef Foundation's Resilient Reefs Initiative advancing action in UNESCO World Heritage Marine Sites.

The Accelerator Workshop was the anchor methodology to kick off the Urban Design Studio and convene local stakeholders with critical perspectives around Coastal Development in Belize and the Yucatan.

GSAPP WATER URBANISMS STUDIO PAST REPORT COVERS

GSAPP WATER URBANISMS STUDIO

The GSAPP Urban Design Studio investigates the process of urbanization in a global context, examining sites facing substantive structural and social change. The studio is organized with the intensive participation of local partners, from city governments and planning departments, to humanitarian groups, local universities and community groups. The Studio produces exhibitions and public events with project partners and, as the final studio in the Urban Design sequence, students organize a publication documenting process, partnership findings and design proposals.

This Resilient Coastal Development in Belize studio will explore positive, regenerative "ridge to roof to reef" visions for key towns, cities and farms along the coast by focusing on green-blue infrastructure, eco-tourism, ocean-based renewable energy including wind and tidal, new housing and urban typologies, coastal design & zoning and regenerative agriculture.

The goal of this urban design studio is to understand how marine & fisheries restoration, climate mitigation, and local jobs & prosperity can combine across the system in different sites and scales. In the Belize context, innovative coastal zoning, land-use standards, housing typologies, new management and resilience concepts have created ground for alternative forms of water driven development patterns.

By workshopping and testing the implementation of water sensitive coastal zoning proposed by the Belize Coastal Zone Management Plan in a range of sites and systems through iterative spatial design, coastal transects will explore upland tropical forest protection measures to new urban design imperatives, sustainable fisheries management to innovative green infrastructure finance models and reef restoration. Students and faculty will work together to devise alternative futures for eleven transects from forest to roof to reef that address pressures of housing, livelihoods, transportation, and social justice issues.

The Studio will help advance shared work driven by the Resilient Reefs Initiative and Belize Resilience Strategy through co-creation of design principles across academia, government, philanthropic, NGO, and local stakeholders. By spatializing and visualizing alternative urban design futures that are grounded in local perspective, climate adaptation strategies prepared in the Studio can be a platform for deeper and more integrated engagement, action planning, and buy-in from multi-sectoral stakeholders.

WORKSHOP APPROACH

To kick-off a semester-long Urban Design Studio, the Team delivered a 5-day virtual workshop with local stakeholders and partners, faculty and students from the University of Belize, and students and faculty from Columbia University. Each day was organized by thematic topic and included lectures by experts, scholars, and public servants; a set of stakeholder breakout sessions to surface key issues, opportunities, and local insights; and intensive student exchanges to advance research and design topics.

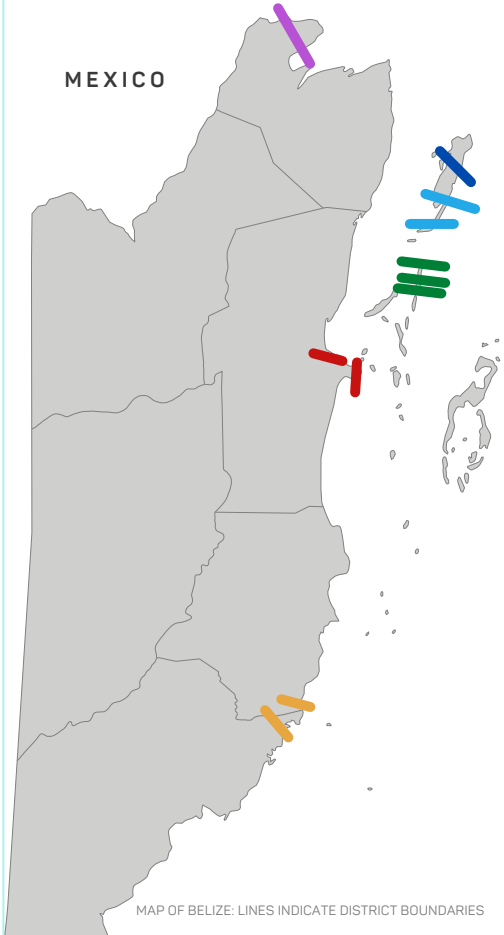
This learning culminated in final presentations developed collaboratively by GSAPP and UB students and delivered to stakeholders, invited guests, and faculty. **Students presented multi-scaler and multi-disiplinary perspectives as related to a set of 11 sites, "what if" statements that capture opportunities for adaptation futures, and design principles that advance the core objectives of the Resilience Strategy and ongoing planning efforts in Belize.** This workshop and resulting presentations are intended to be a starting point for the remainder of the Studio. The findings synthesized in this report are intended to both document these discussions for use by local partners as well as the Studio.

WORKSHOP OBJECTIVES

- **Develop problem statements that capture the relationships, pressures, and opportunities related to coastal development, the Belize Barrier Reef System, and community livelihoods at the scale of the coastal system and (11) identified transect areas**
- **Articulate a set of design and planning principles to guide future design and planning in the context of the CZMAI update, Resilience Strategy, and MBE strategy to ground student design concepts for each transect**
- **Convene local stakeholders, students, faculty, and scholars to uncover opportunities and ground problem statements and relationships across academic disciplines and institutions, public agencies, and local stakeholders**

WORKSHOP AGENDA

	AM		PM		
DAY 1 Introductions, Planning, Natural & Cultural Landscapes	OPENING	SPEAKER PANELS: PLANNING	STAKEHOLDER BREAKOUTS	SPEAKER PANELS: NATURAL & CULTURAL LANDSCAPE	STUDENT WORKING TIME
DAY 2 Water, Food & Climate	SPEAKER PANELS: WATER, FOOD & CLIMATE	STAKEHOLDER BREAKOUTS	STUDENT WORKING TIME	DESK CRITS	
DAY 3 Infrastrucutre, Energy & Land Use	SPEAKER PANELS: INFRASTRUCTURE, ENERGY & LAND USE	STAKEHOLDER BREAKOUTS	STUDENT WORKING TIME	GSAPP FACULTY LECTURES	
DAY 4 Livelihoods, Toursim & Economy	SPEAKER PANELS: FINANCE & INVESTING	STAKEHOLDER BREAKOUTS	STUDENT WORKING TIME	SPEAKER PANELS: TOURISM & LIVELIHOODS	
DAY 5 Final Presentations	STUDENT WORKING TIME			STUDENT PRESENTATIONS: PROBLEM DEFINITION & OPPORTUNITIES	



MAP OF BELIZE: LINES INDICATE DISTRICT BOUNDARIES

WORKSHOP SITE SELECTION

CHETUMAL

Chetumal-Corazol

- Natural border of Rio Hondo
- Influence of Tren Maya development and transboundary impacts
- Problematic waste disposal
- Interconnected relationships of watershed, lagoon, and bay

SAN PEDRO

Town Core
Mahogany Bay

- Adjacent natural ponds and lagoons that have passed a tipping point for filtering and naturally treating water
- Recent and recurring intensive resort developments
- Patterns of dredging, cut and pile, land reclamation for development
- Presence of solid waste dumping in San Pedro
- Discussion around transnational linkages to Tren Maya in Mexico and new San Pedro road

BELIZE CITY

Ladyville
Belize City

- Rapid unplanned developed between Ladyville and Belize
- Presence of international airport
- Presence of shrimp farms in north
- Planned bridge at the mouth of the Belize River
- Planned solid waste disposal site

AMBERGRIS CAYE

Ambergris Caye North

- Recent and recurring intensive resort development
- Patterns of dredging, cut and pile, land reclamation for development
- Discussion around transnational linkages to Tren Maya in Mexico and new San Pedro road
- Adjacent natural ponds and lagoons that have passed a tipping point for filtering and naturally treating water

CAYE CAULKER

Mangrove Reserve
Urban Center
Marine Protected Area

- Intensive solid waste dumping
- Existing IDB coastline stabilization study
- Recurring patterns of de-reserving protected mangroves for development
- Pursuit of wastewater storage funding by residents
- Dense, at capacity, development in Town Center, while less developed near the Marine Protected Area

PLACENCIA

Mango Creek
Seine Bight

- New plan for tourism port
- Prevalence of aquaculture
- 3-4 distinct communities on the peninsula
- Planned wastewater treatment plant
- Varied development between Placencia (dense development) and Seine Bight (less developed)

KEY THEMES AND PERSPECTIVES: WORKSHOP SPEAKER SESSIONS

At the start of each workshop day, presentations on key topics were given by **local stakeholders**, **subject matter experts**, and **public agencies**, with each day categorized into a thematic area.

These lectures provided students with the context and perspectives required to inform design and planning work as well as offered convening opportunities for local stakeholders.

PLANNING, NATURAL AND CULTURAL LANDSCAPE

RESILIENT REEFS INITIATIVE

Amy Armstrong, Program Director, Great Barrier Reef Foundation

Amy Armstrong presented an overview of the Resilient Reefs Initiative including its history, goals, partners and delivery approach. With the goal of dismantling barriers to managing for reef resilience, the initiative focuses on: 1) building capacity of reef managers, 2) empowering and equipping local communities to take action, 3) implementing solutions that have measurable impact on reefs and reef communities, and 4) fostering a global network of reef resilience leaders.

"Protecting and building more resilient coral reefs is of course an environmental issue. It's also very much a humanitarian and development issue."

RESOURCES

- Resilient Reefs Fact Sheet
- Reef Resilience Framework
- Protecting green turtles in New Caledonia
- Deloitte: Economic contribution of Ningaloo

BUILDING RESILIENCE IN BELIZE

Kalene Eck, Belize Chief Resilience Officer, CZMAI

Kalene Eck presented on the Resilient Reef's Resilience Strategy development process, advancing a bold vision for implementing local short- and long-term solutions that directly address the Belize Barrier Reef and reef community's vulnerabilities. A core part of this process is a Resilience Assessment, which includes direct engagement with eight Belizean NGOs and 11 local communities with a total of 150 participants. Key findings of the Resilience Assessment were categorized into three framework dimensions: Ecosystem, Community and Governance. Three future opportunities: 1) Waste management; 2) Harnessing community support of management; 3) Balancing MPAs and commercial use.

"Reef Resilience: Where we are, where we want to be, and how are we going to get there?"

SOCIAL, CULTURAL AND HERITAGE LANDSCAPES

Nigel Encalada, Sustainable Heritage Consulting

Nigel Encalada provided an overview of the policy and legal framework for the administration of Belize's culture sector and explains its link to Belize's potential for development. It also introduces a few macro-observations on issues concerning Belize's cultural communities and will explain why these should be considered when pursuing any development agenda.

"Culture is the sum total of ways in which a society preserves, identifies, organizes, sustains, and expresses itself."

COASTAL ZONE MANAGEMENT PLAN UPDATE

Samir Rosado, Coastal Planner, CZMAI

Samir Rosado joined on Monday to discuss the development of Belize's Integrated Coastal Zone Management Plan: a framework to facilitate improved management of coastal and marine ecosystems while ensuring the delivery of ecosystem service benefits. Coastal advisory committees and the general public were included in an iterative design process of nine planning regions and of three potential scenarios for coastal zone management: conservation based management, development based management and informed management which acts as a middle ground between the first two scenarios. Using the InVEST tool to inform the mapping of different use zones, the CZMAI then took results back to community stakeholders to determine whether these zones met the needs of those groups. Once an agreement was reached, the CZMAI finalized the coastal zone management plans for each distinct region as well as included frameworks for implementation.

"Not a blueprint for conservation but for sustainability"

RESOURCES

- A full list of all nine coastal zone management plans
- The plan development process: Integrated Management in Coastal Belize
- InVEST Scenarios Case Study: Coastal Belize

Valuing Natural Capital of a Future Climate: Landscape, The Reef, Economy, Society

Nadia Bood, Senior Program Officer, Marine Science & Climate Change at World Wildlife Fund Mesoamerica

Nadia Bood discussed the Smart Coasts Project, a climate adaptation project aimed to answer the following three questions: 1) What benefits were people receiving from nature throughout the region? 2) How might climate change affect these ecosystem services? 3) Where should there be investment in adaptation strategies? Utilizing InVEST modeling software and community stakeholder workshops, the project identified areas in Belize where certain climate change adaptation strategies such as mangrove restoration or coral reef protection would generate the greatest return to communities in terms of ecosystem services.

"We are economically dependent on our coastal ecosystems and the services they provide: magnifying the impending vulnerabilities they face due to climate change"

RESOURCES

- Natural Heritage, Natural Wealth
- InVEST Scenarios Case Study: Coastal Belize

WATER, FOOD AND CLIMATE SYSTEMS

CLIMATE CHANGE PROJECTIONS OF THE BBRS

Manishka De Mel, Center for Climate Systems Research, Columbia University

Manishka De Mel discussed her work at the Center for Climate Systems Research (CCSR) at Columbia University, a collaborative entity for the working relationship between NASA and Columbia University. She leads the CCSR Climate Impacts Group portfolio of Conservation and Development sector projects, collaborating with a range of partners including World Wildlife Fund, United Nations Development Programme and Wildlife Conservation Society. Her work centers on using climate risk information to inform adaptation planning and implementation. With this expertise she contributed to WWF's Smart Coasts Project to generate climate risk information and guide the application of such information in the Mesoamerican Reef region.

"...mitigation is critical, because if you mitigate, then you can prevent."

RESOURCES

- DRAFT: Assessing Climate Risk in Mesoamerica

WATERSHED ECOLOGY AND QUALITY

Professor Josué Ake, University of Belizé

Professor Josué Aké gave an overview of water quality management in Belize. He highlighted the importance of water quality in watersheds for rural water governance. He introduced the concept of utilizing watersheds as a management unit, reinforcing the need for a ridge to reef approach. Envisioning the way forward, professor Ake voiced a need for improved water quality, communication and data sharing, and capacity building efforts.

"...There is only this river that separates our two countries...my suggestion is that we establish a technical working group so that any projects regarding the Rio Hondo watershed can be accomplished..."

FISHERIES AND MARICULTURE

Felicia Cruz, Belize Department of Fisheries

Belize's fishing sector contributes significantly to the nation's socio-economic well being as an employer of over 2,500 and supporter of food security. The industry has traditionally included fisheries such as lobster, conch, sharks and sea cucumbers. Ms Cruz provided background information on mariculture developments in Belize, including policy and regulatory considerations, best management practices for seaweed cultivation and mariculture planning and design. Seaweed was largely focused on as it improves local water quality, absorbs carbon dioxide, and provides additional economic opportunities for Belizeans.

"(The) fishing industry contributed to socio-economic wellbeing in terms of employment, foreign exchange earnings, nutrition, and food security."

RESOURCES

- Healthy Reefs Map

MARINE MANAGEMENT AND REEF HEALTH

Kirah Forman, Hol Chan Marine Reserve

Established in 1987 as Belize's first marine receive, Hol Chan Marine Reserve protects diverse ecosystems within the Ambergris Caye and Caye Caulker region. The protected area is defined as multi-use, meaning that fishing and tourism activities are permitted in the area, but are regulated by zones to balance ecosystem health and economic livelihoods. As the most visited Marine Protected Area in Belize, the reserve faces multiple challenges including the loss of ranger staff, revenue loss due to COVID-19, coastal development, population growth and illegal fishing.

"It wasn't management going and saying 'we have to protect this area', it was the local community coming to the management and saying 'we need assistance to address certain issues."

INFRASTRUCTURE, ENERGY AND LAND USE

TREN MAYA INFRASTRUCTURE PLAN AND IMPACTS

Mónica Ortiz, Academic and research coordinator at Tren Maya - FONATUR - Mexico's National Tourism Fund

Monica Ortiz discussed Mexico's plan for a new train system in the southeast of the country, Tren Maya. 1,554km in distance and equipped with 21 stations and 42 trains, Tren Maya will act as both a passenger and cargo train to connect areas of the region that previously were isolated in which people found it very difficult to commute to nearby urban centers. The train will be both electric and diesel powered depending on the location of the tracks, and is estimated to increase the population of the area from 15.1 million to 17.3 million. In the context of Belize, Tren Maya's stops in Bacalar and the Chetumal Airport will likely bring more people and tourists to the border region of Mexico and Belize.

"Regions become richer and more prosperous with good connectivity infrastructure"

RESOURCES

- All Tren Maya Official Documents (Spanish)

ENERGY TRANSITION AND OFFSHORE EXTRACTION

Ryan Cobb, Belize Energy Unit

Ryan Cobb presented an overview of Belize's current energy sector alongside a look into what energy may look like in future Belize. With a 92% accessibility rate, the majority of Belizeans have access to Belize's electricity share which can be broken down into the following categories: 51% renewable energy share, 43% imported electricity share from Mexico (largely oil and gas), and 6% fossil fuel. Looking to the future, Belize is invested in energy security, not energy independence, as they don't want to impose price increases on the public or compromise development. With this in mind, Belize has a current renewable energy goal of 75% and is exploring the following to reach this goal: rooftop solar, increasing efficiency in the public transit sector through electrifying the bus system, fuel quality standards, used vehicle regulation and alternative fuel blends.

"Energy has so many permeating effects, being that it creates jobs, it does economic transformation, (and) improves lives specifically within rural communities."

RESOURCES

- Belize Ministry of Energy & Public Utilities Sustainable Energy Roadmap 2021-2040

WASTEWATER AND DEVELOPMENT IMPACTS

Jose 'Pepe' Garcia, Environmental Engineer Consultant

'Pepe' Garcia's presentation illuminated the water quality issues still plaguing Belize today. Although Belize has appropriate legislation aimed to tackle wastewater and pollution management, the enforcement of these laws, according to Mr. Garcia, is very lacking. He documented this through photos that showed the impact of improper waste disposal on local environments that stemmed from a variety of activities including the burning of plastic pollution and other garbage, the release of effluent from large scale developments into waterways, sedimentation and chemical pollution from agriculture and mariculture, and adverse downstream impacts from hydroelectric dams. While sophisticated wastewater treatment centers do exist in Belize, Mr. Garcia advocates for potable water providers to also provide sewage and wastewater treatment. He also called for increased monitoring of local waters, as data regarding marine and water pollution is lacking.

"I refuse to swim in Placencia, I refuse to swim in Caye Caulker, and I refuse to swim in San Pedro"

"...let me tell you...we do not enforce our laws!"

LIVELIHOODS, TOURISM AND ECONOMY

TPLANNING FOR THE BLUE ECONOMY
Shantel Espades, MBECA

The Ministry of Blue Economy and Civil Aviation has a strong vision: by the year 2030 Belize has a productive, resilient and vibrant blue economy that contributes to sustainability and to the socioeconomic well being of the country and its people. Established in 2020, the ministry has already developed many projects and programs aimed to increase GDP while protecting local environments. Importantly, the Ministry of Blue Economy played a key role in Belize's Blue Bond, a debt restructuring aimed to dedicate funds towards marine protection and conservation. The creation of a Blue Economy Strategy and Plan is in its final phase of development, and will be a blueprint for continuous work.

""We have a lot of other projects in the pipeline...and we have interest from several other organizations such as the World Bank"

BELIZE BLUE BOND FOR CONSERVATION
Emilie Gomez, Coordinator and Liaison Officer, MBECA

The Belize Conservation Fund was born out of the Blue Bond debt restructuring deal. This fund is split into three distinct uses: 1) Grants, 2) Government spending on conservation, 3) Overhead costs. Stakeholder engagement has been an important step in ensuring grant funding will go to projects that best represent the needs and wants of Belizean people. The $8 million dedicated towards the Conservation Fund will be managed by a board of nine representatives, four of which are tied to the government, five of which are not - all voted for by local stakeholders. Current progress indicates that the first round of funding will be available for applications in the fourth quarter of 2022.

"The mission is to increase GDP through a thriving blue economy development pathway that is harmonized, innovative and socially just, supported by a robust science based management regime."

RESOURCES

- Belize Blue Bond Press Release

FUNDING AND FINANCING FOR REEF HEALTH AND COMMUNITIES
Angeline Valentine, MarFund

Established in 2004, MarFund drives regional funding and partnerships for the conservation, restoration and sustainable use of the Mesoamerican Reef. MarFund has five distinct programs: 1) Saving our protected areas, 2) Fishing for the future, 3) Climate change, 4) Clean water for the reef, and 5) Belize marine fund. Ms. Valentine highlighted the economic importance of the Mesoamerican Reef system, stating that the current value of the reef is estimated to be $4.5 billion per year. In hopes of contributing to a healthier reef environment, MarFund has begun looking into private investment and blended finance models to bring more substantial funding into a historically underfunded environment.

"If the MAR continues to decline, by 2030 the per annum value of the system could fall by $3.1 billion. Conversely, a shift towards healthy reefs by 2030 could unlock an additional $2.5 billion annually across the three sectors."

RESOURCES

- Belize Marine Fund Investment Strategy

FROM THE WATERSHED TO THE REEF
Liliana Garcia, Amigos de Sian Ka'an

Amigos de Sian Ka'an is a non-profit organization dedicated to conservation and sustainable development in the Yucatan Peninsula in the Mexican Caribbean region. The work carried out by the organization is grounded in scientific research and is practiced in collaboration with local communities and experts, all in the aim of promoting public policies that support people and the planet. When it comes to reef health, Amigos de Sian Ka'an takes a ridge to reef approach, acknowledging the water cycle as complex and holistic: what impacts water in high mountain areas will impact reef environments eventually. With this in mind they have promoted community governance for water management to reduce pollution at the watershed level and diversify economic activities.

"...the participation of different stakeholders along the watershed, especially local actors, is fundamental in all phases of the project..."

LIVELIHOODS, TOURISM AND ECONOMY

TOURISM IN THE CARIBBEAN
Felix Madrazo, International Design

Supersudaca has closely followed the developments and impacts of mass tourism in the Caribbean, taking into account historical and political trends, market mechanism, branding, geography, urban planning, and typology. Research is conducted through several scales, from the food tourists eat to the way the Caribbean region has been used as a testing ground for cruise tourism and all inclusive resorts. Case studies for both modes of mass tourism explore the implications and paradoxes of the so-called industry without chimneys.

"Resorts create an illusion of diversity. They are exclusive closed economies that keep locals out"

LIVELIHOODS AND TOURSIM IMPACTS
Caroline Oliver, TIDE EcoTours

Caroline Oliver provided an overview of tourism in Belize, highlighting the importance the industry has on sustaining local livelihoods, a benefit that drastically decreased in the wake of the COVID-19 pandemic. She discussed the importance of reducing leakages in the tourism industry chain, often present in foreign owned businesses such as cruise lines. She encouraged striking a balance between resource protection, ecosystem service health and promotion of livelihoods through tourism. Importantly, increasing local benefits through direct bookings, locally sourced supplies, and the hiring of women.

"Tourism in Belize is based on natural resources and protected areas and by managing those resources, the ecosystem and tourism will benefit"

"There is loss of income to outside economies...especially common in Foreign owned enterprises. There is also a loss in authenticity, causing commodification"

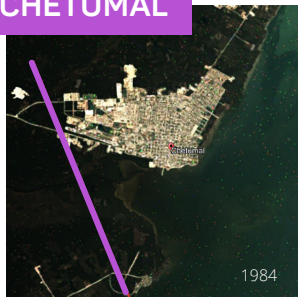
STAKEHOLDER SESSIONS: WORKSHOP DISCOVERIES AND DESIGN THINKING

During the weeklong workshop, students from **Columbia University** and **University of Belize** were grouped into teams, each exploring major themes in Belize as they relate to six specific locations: The Chetumal/Corozal border region, Ambergris Caye, San Pedro, Caye Caulker, Belize City and Placencia.

After local expert presentations in the morning, student teams and local stakeholders broke out into their respective groups, engaging in facilitated discussion activities to promote place specific learning. **Below are key takeaways from each group as it relates to these discussion sessions, intended to surface key issues and develop "What if" statements to guide the subsequent work of the student teams and inspire future planning in Belize.**

CHETUMAL

CHANGE MAPS (1984 VS 2020)



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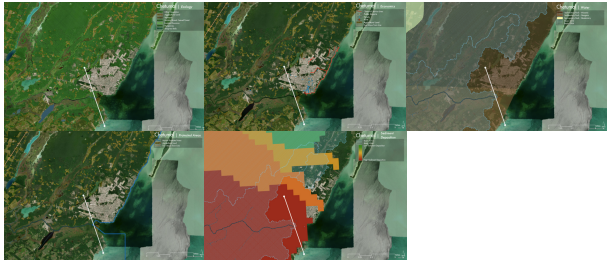
Kimberly Ramirez		
Daniela Deu		

CHETUMAL WORKSHOP BASE MAPS

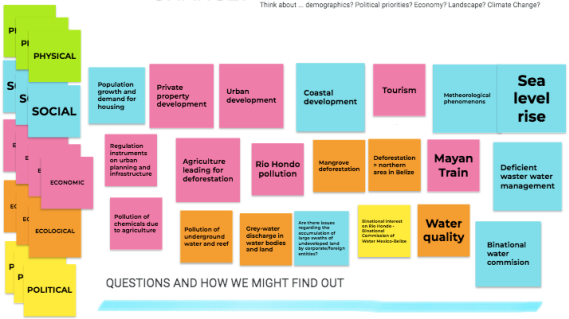


BASE MAPS (from top left to bottom right): ECOLOGY, ECONOMICS, WATER, PROTECTED AREAS, SEDIMENT DEPOSITION

CHETUMAL
30 mins

WHAT ARE THE DRIVERS OF THREATS AND CHANGE?

Consider the changes you observed, and what we know about whats driving impacts. Here is WRI's take on development impacts, but only as a conversation starter. OK if there are more questions than answers! Think about ... demographics? Political priorities? Economy? Landscape? Climate Change?



STAKEHOLDER BREAKOUT
Workshop Day #1

WORKSHOP LEARNINGS

CHALLENGES

- Power structures in Chetumal determine who has agency and who doesn't
- The Tren Maya project could impact local communities
- Lack of investment in resource monitoring to determine the state of coastal and marine ecosystems
- Lack of transparency regarding available financial mechanisms for projects

OPPORTUNITIES

- Densifying urban zones or increase efficiency in urban areas that exist
- Diversifying economic reliance on tourism could mitigate negative impacts on ecosystems and livelihoods
- Involving local communities is paramount in decision making
- A proposed solution to address management of the Mexico-Belize border is a binational protected area between Mexico and Belize

EMERGING QUESTIONS

- What degree of responsibility do local municipalities have in mitigating the impacts of a project like Tren Maya?
- What finance is available for conservation and adaptation projects in the region?

CHETUMAL

WHAT IF ...

the Rio Hondo watershed became a tool to unify, protect and uplift ecosystems and Indigenous communities by creating a transnational cooperation and resiliency zone that implements a unified plan to curb the impacts of mass tourism, development, and agriculture?

Belize and Mexico are divided politically by the Rio Hondo, an ineffective approach to conservation as it requires bilateral cooperation that has traditionally lacked. Additionally, the development of Tren Maya could impact the area in a negative way if protections aren't implemented.

To address these concerns, students proposed the Yucatec Maya Ejido, a transnational conservation and resiliency zone held in communal ownership, to ensure health of the watershed from ridge to reef and connect Indigenous communities across borders.

DEISGN AND PLANNING PRINCIPLES

- **Restoration of mangroves along the coast to promote resilient coastal infrastructure**
- **Mangrove protection to minimize destruction of existing ecosystems**
- **Promotion of sustainable agriculture and fishing practices through a knowledge center**
- **Introduction of small scale tourism in local communities**
- **Vertical densification of urban areas to limit land use in natural areas**
- **Improved water treatment and monitoring**
- **Removal of the Bacalar Tren Maya stop**
- **Establishment of a bilateral committee of Indigenous peoples to manage the watershed**
- **Preservation of archeological sites**

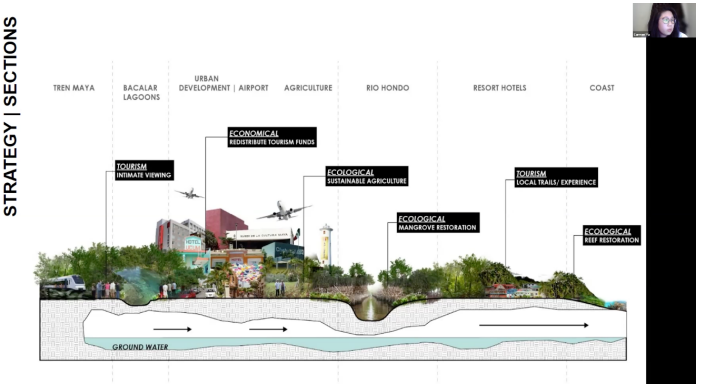
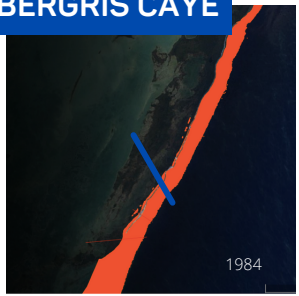
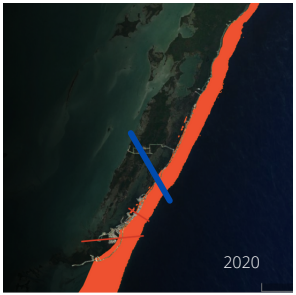


IMAGE. ZOOM SCREENSHOTS OF STUDENT WORKSHOP PRESENTATIONS (FOR EDUCATIONAL PURPOSES ONLY)

AMBERGRIS CAYE

CHANGE MAPS (1984 VS 2020)





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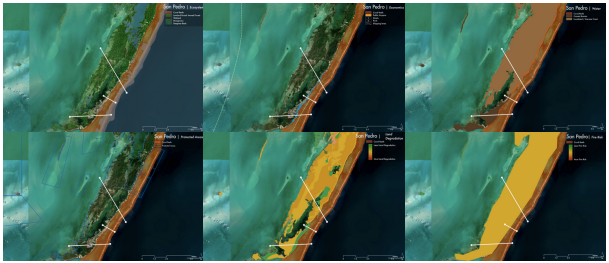
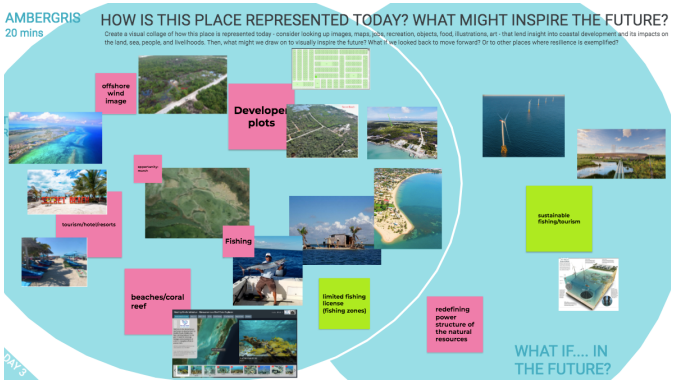
AMBERGRIS CAYE WORKSHOP BASE MAPS



BASE MAPS (from top left to bottom right): ECOSYSTEMS, ECONOMICS, WATER, PROTECTED AREAS, LAND DEGRADATION, FIRE RISK
NOTE: Base maps for Ambergris Caye are the same as San Pedro



STAKEHOLDER BREAKOUT
Workshop Day #3

WORKSHOP LEARNINGS

CHALLENGES

- There isn't a formal system for solid waste management in Ambergris Caye
- Refined climate projections are not available to relate to key species or key ecologies that have a greater sensitivity to climate change in order to inform policy
- Development of coastal piers has both a formal and informal development process: The formal permitting process goes through the planning department with a letter of support required from the local council. The piers must be publically accessible and have certain design standards. In reality, these standards aren't always met and often payouts occur to skirt around regulations

OPPORTUNITIES

- Soft and hard development and design interventions are needed
- Depending on climate impacts, designing for the short term and long term should be considered

AMBERGRIS CAYE

WHAT IF ...

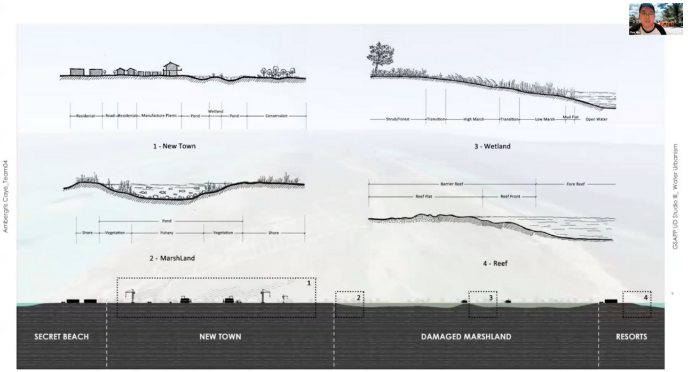
Ambergris Caye developed according to water logic instead of real estate logic?

Much of Ambergris Caye, with the exception of San Pedro Town, is undeveloped land. With risk of unchecked development looming, students proposed a water driven zoning mechanism to prioritize conservation and minimize urban footprint on Ambergris Caye.

The establishment of "New Town" on the west of the island paired with conservation zones on the east side of the island aim to accomplish this.

DEISGN AND PLANNING PRINCIPLES

- **Flood proofing of structures designed with hard infrastructure**
- **Promotion of aquaculture to diversify income for locals**
- **Utilization of timber construction, especially in elevated structures, for easy construction and low carbon footprint**
- **Restoration of mangroves to enhance storm protection and mitigate flooding**
- **Use of existing wetlands as a natural waste management tool to filter water**
- **Preservation of wetland through water driven zoning**
- **Establishment of offshore wind as a source of renewable energy**



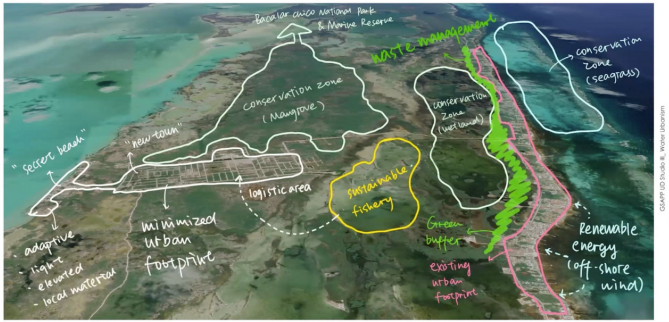
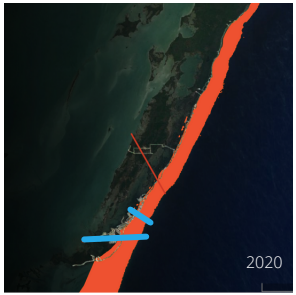


IMAGE. ZOOM SCREENSHOTS OF STUDENT WORKSHOP PRESENTATIONS (FOR EDUCATIONAL PURPOSES ONLY)

SAN PEDRO

CHANGE MAPS (1984 VS 2020)



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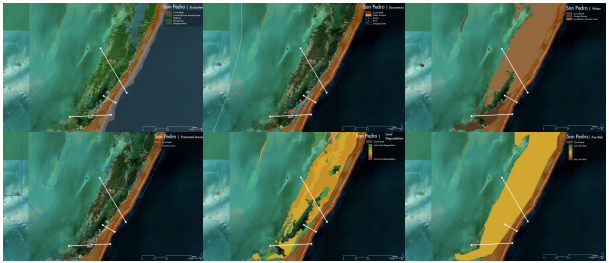
SAN PEDRO WORKSHOP BASE MAPS



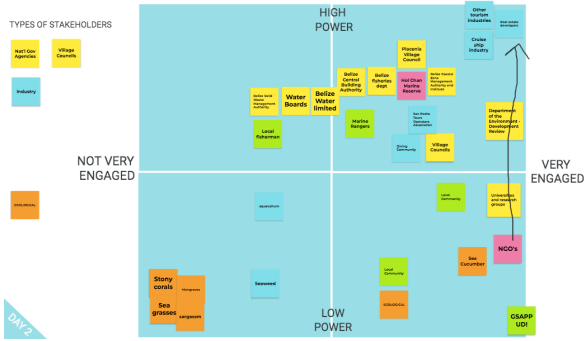
BASE MAPS (from top left to bottom right): ECOSYSTEMS, ECONOMICS, WATER, PROTECTED AREAS, LAND DEGRADATION, FIRE RISK

NOTE: Base maps for San Pedro are the same as Ambergris Caye

SAN PEDRO
20 mins

WHO IS INVOLVED IN COASTAL DEVELOPMENT AND HOW IT'S DONE TODAY?

Consider of coastal development is planned, managed, and implemented today (status quo)... Who are the actors? How engaged are they? How much power or influence do they have over the process or impacts? Discuss if/how stakeholders or agents of change might move from the bottom left quadrant to the top right!



STAKEHOLDER BREAKOUT
Workshop Day #2

WORKSHOP LEARNINGS

CHALLENGES

- A large amount of dredging takes plan on and around San Pedro
- San Pedro will be impacted by Tren Maya, potentially attracting more tourists to the caye
- Green infrastructure related to energy and its distribution is lacking
- Water quality information isn't reported and needs to be more available and transparent

OPPORTUNITIES

- A credit system for carbon was explored as a potential solution
- Seaweed farming is a possible tourism attraction and economic tool
- The personal experiences of University of Belize students working with NGOs/Department of the Environment/Larger institutions were key perspectives in informing student work

EMERGING QUESTIONS

- Does sustainable tourism exist?
- How can San Pedro generate social and economical capital locally?
- How can Belizeans add value to local resources and products before exporting them to other countries?

SAN PEDRO

WHAT IF ...

San Pedro diversifies its economy beyond tourism to generate social and economic capital locally - thus supporting long term growth?

As Belize's most visited tourist destination, San Pedro has undergone rapid development to support foreign visitors. Yet, the COVID-19 pandemic impacted tourism across the globe, including in San Pedro, highlighting a need for economic diversity to support local livelihoods. Additionally, ecological challenges like sea level rise and coastal erosion are amplified due to poor infrastructure planning and lacking water and waste treatment.

To address these issues, students framed their work within the context of water urbanism, an innovative approach to design practice that joins natural and built environments, water and cities, to promote resilient communities especially in the wake of climate change. Students considered San Pedro's impact beyond its local border, on Belize and the rest of the world. The design and planning principles generated by students reflected this holistic view.

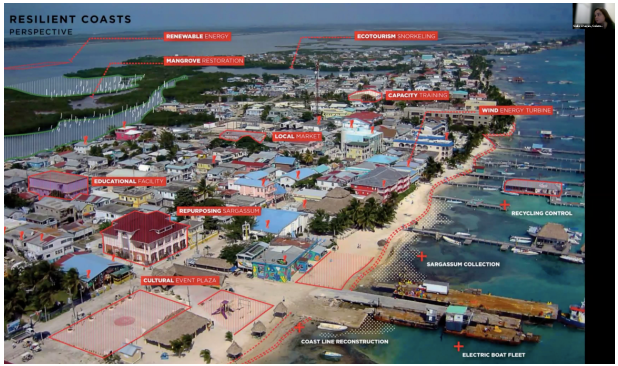


IMAGE. ZOOM SCREENSHOT OF STUDENT WORKSHOP PRESENTATIONS (FOR EDUCATIONAL PURPOSES ONLY)

DEISGN AND PLANNING PRINCIPLES

MAHOGANY BAY

- Seaweed farming near Mahogany Bay Lagoons
- Mangrove restoration along erosion-prone areas
- Coral reef rehabilitation
- Development of fish farming ponds and mangrove dike systems
- Promotion of a more robust seafood industry
- Modification of the wastewater treatment
- Establishment a seafood production education center
- Placement wave elimination blocks on the east side of the island

SAN PEDRO TOWN

- Implementation of coral reef restoration and coral nurseries
- Replanting mangroves and seagrass
- Investment in alternative forms of energy such as solar, wind, and hydropower plants
- Repurposing of sargassum and utilize local building materials
- Promotion of efficient water treatment, anaerobic digestion, and waste to energy
- Encouragement ecotourism practices as well as the development of eco-friendly parks and hotels
- Enforcement of the use of smart vehicles such are electric cars and boats
- Design of elevated lands barriers and incorporate wave breakers
- Building ofcommunity spaces such as a cultural event plaza, educational facility, local market, and a space for capacity training

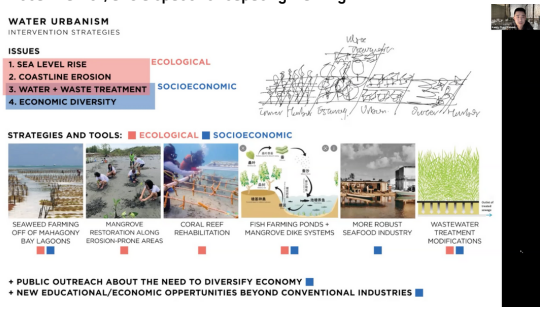
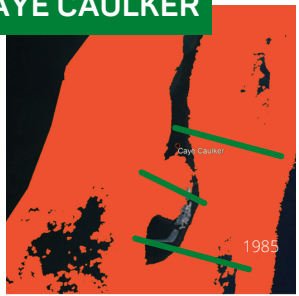
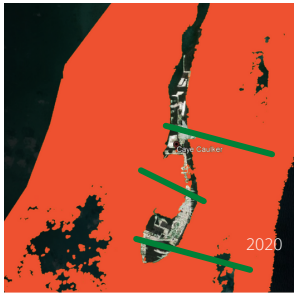


IMAGE. ZOOM SCREENSHOT OF STUDENT WORKSHOP PRESENTATIONS (FOR EDUCATIONAL PURPOSES ONLY)

CAYE CAULKER

CHANGE MAPS (1985 VS 2020)





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Giannie Vasquez
Jaydy Vargas

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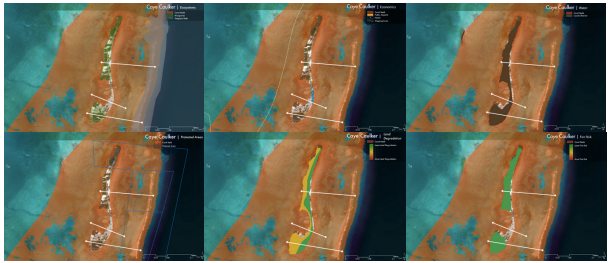
Felicia Cruz

CAYE CAULKER WORKSHOP BASE MAPS

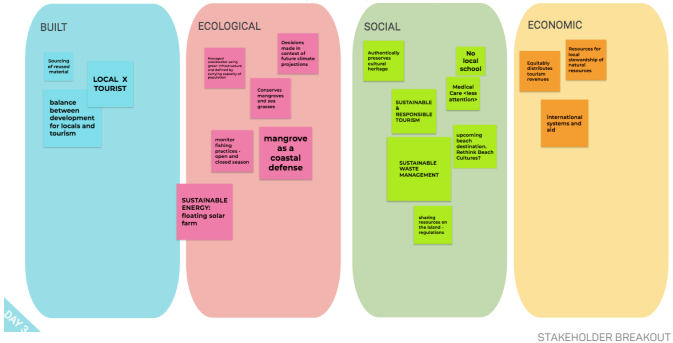


BASE MAPS (from top left to bottom right): ECOSYSTEMS, ECONOMICS, WATER, PROTECTED AREAS, LAND DEGRADATION, FIRE RISK

CAYE CAULKER 20 mins

WHAT ARE THE ELEMENTS OF FUTURE COASTAL DEVELOPMENT? WHAT SHOULD FUTURE DEVELOPMENT ASPIRE TO ACHIEVE

What are the principles, ideas, values, or aspirations that future coastal development might embodied? What do they respond to? For whom are they intended to benefit?



STAKEHOLDER BREAKOUT
Workshop Day #3

WORKSHOP LEARNINGS

CHALLENGES

- Excess nitrogen, waste water pollution and navigating small boats makes fishing hard in Caye Caulker
- The segregation of locals and tourists is harmful because it hides issues of poverty from people who are visiting
- The gap between law and enforcement of laws persists
- There are no schools or hospitals on the island, and people have to travel to Belize City or San Pedro to access these services

OPPORTUNITIES

- Mangrove replanting can be used as a coastal defense
- More conscious tourism is needed, where it does not extract but work hand in hand with conservation
- Balancing ecology and economy requires national and international intervention
- Improved accessibility to healthcare and education
- Hearing the local experts and stakeholders speak generated optimism that there are people out there who have dedicated their time to sustainability and conservation

EMERGING QUESTIONS

- Given the dichotomy between economy and conservation, is there a path forward for development on the island?

CAYE CAULKER

WHAT IF ...

Caye Caulker became a leader in defining resilient ecotourism?

A popular tourist destination, Caye Caulker faces challenges including coastal development, waste and water pollution, unsustainable fishing, and unregulated in-water construction. However, the student team imagined the future of tourism on Caye Caulker instead as an agent of ecological restoration, centering local industry and ownership.

Using a landscape first approach to zoning, ecology can be preserved and prioritized, supporting economic activities such as eco-tourism and fishing that sustain Caye Caulker.

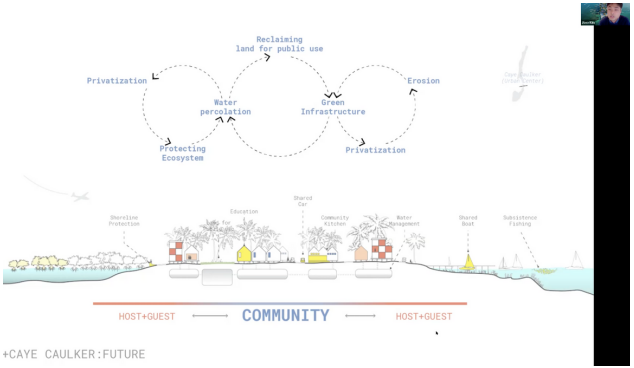


IMAGE. ZOOM SCREENSHOT OF STUDENT WORKSHOP PRESENTATIONS (FOR EDUCATIONAL PURPOSES ONLY)

DEISGN AND PLANNING PRINCIPLES

MANGROVE RESERVE

- Elevation of buildings and trails to adapt to sea level rise
- Protection and replanting of mangroves
- Restoration of coral reef and turtle rescue programs
- New and innovative farming methods towards the center of the island

CAYE CAULKER CENTER

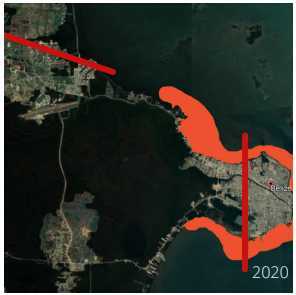
- Reclamation of land for public use
- Sharing of community resources such as docks, boats, and vehicles
- Creation of a community kitchen space
- Improvement of access to education on the island
- Promotion of subsistence fishing
- Investment in better water management infrastructure
- Implementation of shoreline protection measures through hard infrastructure

MARINE PROTECTED AREA

- Mangrove restoration that includes and "adopt a mangrove" initiative
- Implementation of a carbon credit program to encourage sequestration and storage
- Creation of a community owned eco-village and research center
- Transformation of land use policy to transfer ownership to the local community
- Regulatation of cruise line and shipping routes to promote responsible and conscious tourism
- Utilization of Indigenous fishing techniques
- Establishment a green corridor through the center of the caye

BELIZE CITY

CHANGE MAPS (1985 VS 2020)



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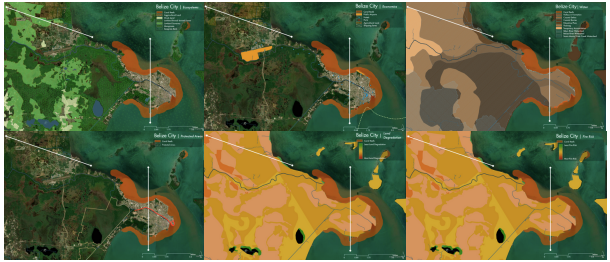
BELIZE CITY WORKSHOP BASE MAPS

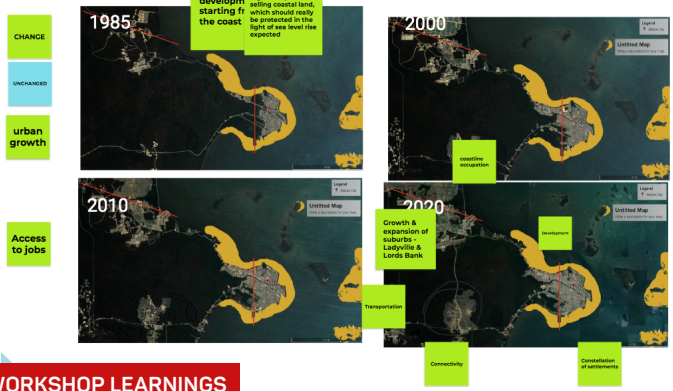


BASE MAPS (from top left to bottom right): ECOSYSTEMS, ECONOMICS, WATER, PROTECTED AREAS, LAND DEGRADATION, FIRE RISK

BELIZE CITY WHAT DO YOU SEE?

20 mins

Coastal development is ... What observations can we make about these changes over time? Feel free to reference additional Map in the MIRO board, google maps.



WORKSHOP LEARNINGS

STAKEHOLDER BREAKOUT
Workshop Day #1

CHALLENGES

- There is rapid development in Belize City, with the population doubling every 3 years
- COVID-19 had a substantial impact on the fishing sector in Belize, as many fishers transitioned back to subsistence fishing
- Laws are made without thought of enforcement
- Impervious surface coverage is greater than surface coverage from trees
- Belize city is highly impacted by climate change

OPPORTUNITIES

- The potential impact of mariculture on national GDP is substantial
- Coral reefs are important sequesters of carbon
- Local people want to see more recreational opportunities, especially towards the west side of Belize city, as well as other infrastructure like electric buses
- Proactive disaster management planning is needed

EMERGING QUESTIONS

- What role do NGOs play in regards to coastal development? What relationship do they have with real estate developers and the cruise ship industry?
- With population growth, how are water resources being allocated to prepare for the future?
- What is the role of the local government in protecting natural resources?
- How and when is restoration funded?
- Should intervention be proactive or reactive?

BELIZE CITY

WHAT IF ...

Belize City invested in its rivers, reefs and mangrove as drivers of its economy? How can we marshall its density for climate resiliency and maximum water quality benefit?

In Belize City population growth and climate change impacts are two key considerations in planning and designing the future of coastal development. Ladyville, a village eight miles northwest of Belize City, hosts the country's only international airport.

With this in mind, students envisioned development in this region of the country to center ecology, water quality and sustainable land consumption, prioritizing dense urban centers compatible with the nation's energy transition goals, a diverse economy that centers community, and implementing comprehensive climate adaptation interventions that build resilience to events like storms, flooding, and sea level rise.

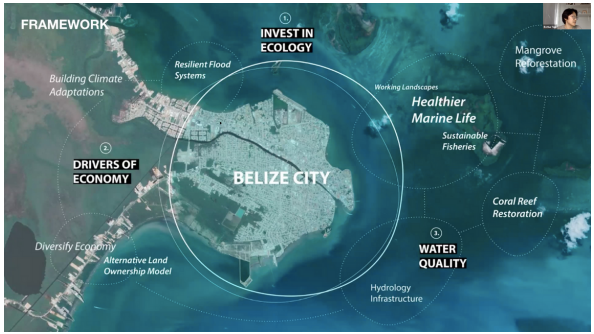


IMAGE. ZOOM SCREENSHOT OF STUDENT WORKSHOP PRESENTATIONS (FOR EDUCATIONAL PURPOSES ONLY)

DEISGN AND PLANNING PRINCIPLES

BELIZE CITY

- **Retrofitting of buildings to adapt to sea level rise, flooding and storms in the short term**
- **Restoration of mangroves to adapt to sea level rise, flooding and storms in the long term**
- **Improvement of wastewater management facilities**
- **Restoration of riverbank at Haulover Creek**
- **Investigation of alternative forms of land ownership in the region**

LADYVILLE

- **Densification of development with climate adaptive housing**
- **Restoration and construction of wetlands to treat wastewater**
- **Implementation of sustainable agriculture and fishing practices in and surrounding built wetlands to promote economic well being and local livelihoods**
- **Coastal mangrove restoration**
- **Establishment of an eco park on either side of the Belize river**

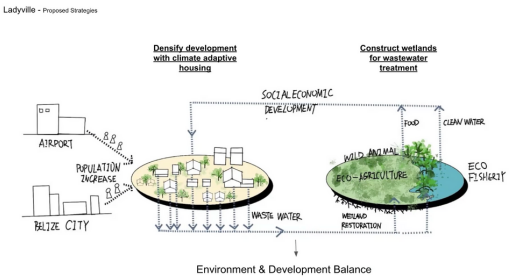
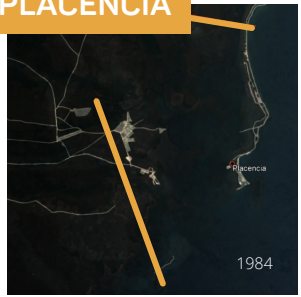


IMAGE. ZOOM SCREENSHOT OF STUDENT WORKSHOP PRESENTATIONS (FOR EDUCATIONAL PURPOSES ONLY)

PLACENCIA

CHANGE MAPS (1984 VS 2020)



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Shirley Chen
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Jake Tiernan
Cesar Delgado

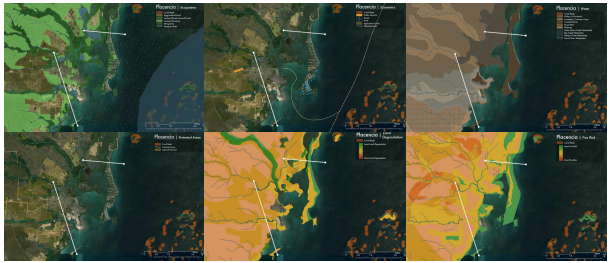
UNIVERSITY OF BELIZE STUDENTS

Alissa Roches
Anthony Mai
Cassandra Lewis

STAKEHOLDERS

Nigel Encalada
Ryan Cobb

PLACENCIA WORKSHOP BASE MAPS



BASE MAPS (from top left to bottom right): ECOSYSTEMS, ECONOMICS, WATER, PROTECTED AREAS, LAND DEGRADATION, FIRE RISK

PLACENCIA BREAKOUT INTROS __ DAY 3

10 mins

STAKEHOLDER BREAKOUT
Workshop Day #3

WORKSHOP LEARNINGS

CHALLENGES

- Urbanization is still rapidly occurring in Placencia
- Because of how renewable energy is distributed, if power outages occur it's hard to restore and use alternative paths of energy
- There is lacking enforcement of rules and regulations as it related to marine park management
- Ecosystem health is not monitored sufficiently

OPPORTUNITIES

- Sargassum can be utilized as a beneficial resource, for example as fertilizer
- The government must intervene to enforce laws
- Identifying industries responsible for pollution and waste contamination is needed

EMERGING QUESTIONS

- Because the government owns a portion of Belize's energy infrastructure, is it as cost effective as it could be?
- There is no difference between the categorization of international and local developers. Can incentivizing local development promote sustainable practices?

PLACENCIA

WHAT IF ...

Placencia could model the blue economy and become an example of integrated natural and social capital across sectors?

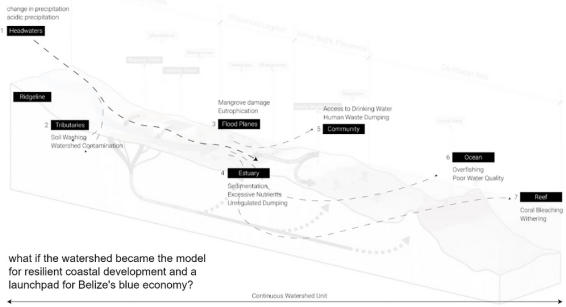
Placencia is heavily reliant on the end stream of its water system to support tourism, shipping, shrimp aquaculture and agriculture. Taking a ridge to reef approach, students envisioned the local watershed as a unified unit of management itself, rooting ecological and technological design and planning interventions in the overall health of the watershed.

DEISGN AND PLANNING IDEAS

- Mangrove and seagrass restoration
- Prioritization of precision agriculture and crop rotation
- Restoration and protection of key ecological features such as big creek and preserved areas
- Transition of cruise ship industry towards biofuel
- Transferance of ownership of Big Creek Group to the local community
- Promotion of agrivoltaic mangroves
- Improvement to wastewater treatment and monitoring
- Creation of locally owned shipping lines

STUDENT VISION

Watershed As A Unit



Unified Solution

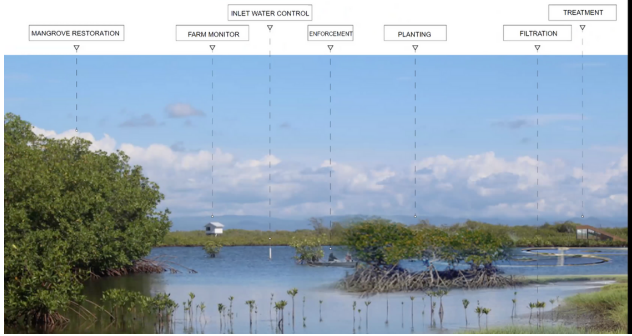


IMAGE. ZOOM SCREENSHOTS OF STUDENT WORKSHOP PRESENTATIONS (FOR EDUCATIONAL PURPOSES ONLY)

WORKSHOP FINDINGS : DESIGN PRINCIPLES AND NEXT STEPS

In keeping with the objectives of the workshop to both guide the subsequent work of the Urban Design Studio as well as the refinement of strategic planning and policy efforts in Belize, the workshop concluded with a **discussion and synthesis of key planning and design principles for future coastal development in Belize**.

These principles, organized by the emerging pillars of the Belize Resilience Strategy and the dimensions of the Reef Resilience Framework, represent a **University of Belize and Columbia GSAPP faculty-led aggregation of the presentations, design sessions, and stakeholder breakout sessions and were validated and discussed by the full group of invited guests during the final review and presentation session.**

KEY PLANNING AND DESIGN PRINCIPLES

ECOSYSTEM

- Improve watershed management with a focus on improving waste water treatment at source and upstream
- Restore and enhance mangrove and seagrass areas
- Protect biodiversity
- Prioritize nature based, decentralized infrastructure that can adapt to climate change and informality, over concrete infrastructure
- Reduce plastic usage and eliminate dumping

Image: Thad Pawlowski

Image: Thad Pawlowski

- Consider relocation strategies in areas expected to be severely impacted by sea level rise and increased storm surges
- Promote urban fabric and developments with the smallest possible footprints and discourage suburban sprawl
- Avoid sale of coastal public land, but allow for leased uses that are not detrimental to the environment and stay accessible to the public, with periodic reviews before renewal

GOVERNANCE

Image: The Nature Conservancy

- Ensure balance of conservation of marine protected areas with commercial and local use
- Follow the Triple Bottom Line accounting in all projects, ensuring that ecological, social and financial reporting is done before project approval as well as annually. Social impact statements to be a part of the requirements
- Strengthen enforcement of regulations and transparency
- Create a stakeholder plan based on natural and social capital as well as corporate responsibility

- Cooperate with neighboring countries to set optimum flat pricing for Cruise-ships visits, international tour operators in order to protect habitat corridors
- Solidify the position of Belize as a leader in creative ways of funding ecological protection, such as Blue Bonds
- Strengthen relationship between academia and coastal management
- Consider local financial and political contexts when designing and implementing interventions

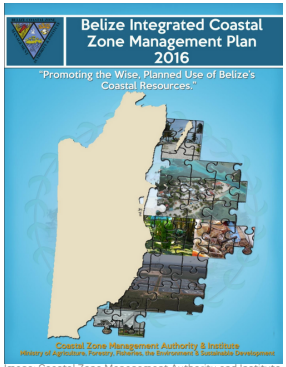


Image: Coastal Zone Management Authority and Institute

COMMUNITY

- Advance livelihood diversification within coastal communities and tourism dependent sectors
- Ensure decent living wages for fishers and farmers through value addition to produce as well as negotiations with international corporate agriculture operators
- Encourage incubators to launch employment generating knowledge businesses (information tech, fintech, others), possibly engaging the ex-pat community and leveraging remote work trends
- Create frameworks for responsible tourism, encouraging small operators, in order to control extractive multinational tour operators

- Ensure that all development plans and land rights are inclusive of and supporting native and indigenous populations, women and other marginalized populations
- Engage local communities and civil society organizations in the design and management of ecological protection plans and enforcement
- Forefront the cultural approach to coastal asset management
- Include indigenous communities in design development, governance of project design and implementation, benefit sharing, and collaborative work

NEXT STEPS

This workshop report represents a moment in time and point of departure for a number of subsequent activities and opportunities, that include:

1 RESILIENCE STRATEGY PROCESS

The principles and topics represented offer a point of departure for the **Belize Coastal Zone Management Authority**, **Ministry for the Blue Economy and Civil Aviation**, and **Department of Fisheries** for further refinement, coordination, and engagement of the Resilience Strategy process. A core component of the work ahead includes action identification and prioritization.

The principles outlined are intended to be supportive of this effort both as a framework for action and engagement tool with local stakeholders. Further, **the outputs of the Studio including research, design visualizations, maps, and narrative concepts can be used by the CZMAI and partners to advance engagement, advocacy, design, and policy as well as fundraising and development efforts with external partners.**

2 STUDENT AND STAKEHOLDER ENGAGEMENT

Additional speakers and local experts, including the **Planning and Lands Departments**, **local council**, and **local project proponents** will be engaged in lectures, panels, and deep dive discussions with student teams throughout the Spring semester.

The lectures will intend to fill gaps in local knowledge and perspective and offer deepened engagement on topics such as land issuances, coral reef restoration, and hyperlocal place-based trends and issues.

3 WATER URBANISMS URBAN DESIGN STUDIO

GSAPP students will continue to work on intensive research questions emerging from the workshop and development of 11 place-based design scenarios and project concepts.

Students will present for critical feedback from experts, stakeholders, and faculty during mid-semester and end-of-semester reviews. This work will culminate in a publicly available Storymap and report that includes visualizations of research and designs.

CLOSING THOUGHTS

The Resilient Coastal Development in Belize Studio Workshop represented an intensive exchange of faculty, students, stakeholders, program partners, and public agencies that uncovered the inherent relationships between culture, climate, natural resources, economy, and development. The Workshop format and intensive facilitated engagement offered a structured and methodical approach to viewing coastal development and its impacts free from singular silo of one stress or trend and therefore generated deeper and more complex questions and perspectives around multiple scales of pressures on the reef and vulnerable communities - from global corporate tourism activities to local water quality and legal context for wastewater treatment, for example. In so doing, the Team aspires to generate design and discussion that place local laws, projects, ecologies, built typologies, and perspectives in direct dialogue with global climate, social, economic, and financial systems.

Images: Thad Pawlowski

Pressures in Belize are accelerating from powerful development and tourism interests that are driving rapid urbanization, impacts on sensitive habitats, water quality and environmental stressors correlated with coral diseases, and displacement of local communities; climate change impacts from sea level rise and coastal storms to marine heatwaves; and economic disruption from global events like COVID-19.

Our hope is that conversations such as this can activate local agencies and power at the intersection of design, policy, planning, science, and community to shape a new paradigm for coastal development and political will to ensure that Belize, the Belize Barrier Reef System, and the region not only adapt to a changing climate, but support thriving local communities and economies.

I. PARTICIPANT LIST

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Felicia Cruz	Belize Fisheries Department
Felix Madrazo	International Design
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Gloria Mah	Columbia GSAPP
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Jisoo Kim	Columbia GSAPP
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Kimberly Ramirez	Columbia GSAPP
Kirah Forman-Castillo	Hol Chan Marine Reserve
Kris-An Hinds	USF Strong Coasts
Lamisa Haque	Columbia GSAPP
Lenardo Ash	University of Belize
Liana Santos	University of Belize
Lilia González	Previous Local director of the Mayan Train Part 6 - Chetumal & Bacalar
Liliana García	Friends of Sian Ka'an
Lipeng Zhu	Columbia GSAPP
Lorena Bello Gomez	Columbia GSAPP
Lucas Coelho Netto	Columbia GSAPP
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Marcia Itza	University of Belize
Maya A Trotz	University of South Florida
Melvin Myers	Belize City Council Planning Department
Meridel Phillips	SciSpace LLC (GISS Climate Impacts Group)
Minsung Kim	Columbia GSAPP
Monica Ortiz	FONATUR - Mexico's National Tourism Fund
Nadia Bood	World Wildlife Fund Mesoamerica
Nigel Encalada	Sustainable Heritage Consulting
Praditi Singh	Columbia GSAPP
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Rafael Robles de Benito	State of Quintana Roo
Rhea Pai	Columbia GSAPP
Riya Chadha	Columbia GSAPP
Rongxin Tang	Columbia GSAPP
Rotina Tian	Columbia GSAPP
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Sydnee Sampson	Columbia GSAPP
Tanuja Dhanasekaran	Columbia GSAPP
Thad Pawlowski	Columbia GSAPP
Tori Vuono	Columbia GSAPP
Vivian Ramnarace	Belize Fisheries Deparment
Wilbert Castillo	University of Belize
Yasmine Katkhuda	Columbia GSAPP
Zhifan Li	Columbia GSAPP

II. FULL WORKSHOP AGENDA

THURSDAY JANUARY 20TH

**Students only*

2:00 - 4:00 CST
3:00 - 5:00 EST

STUDENT FACULTY ORIENTATION

STUDENT INTROS: UB and GSAPP Student Orientation

Review workshop objectives, schedule, exercises and assignment; introduce UB faculty and students and set up Whatsapp groups; Happy Hour following on OhYAY

FRIDAY JANUARY 21ST

**Students only*

2:00 - 3:45 CST
3:00 - 4:45 EST

RESILIENT REEF INITIATIVE:INTRODUCTION

RESILIENT REEFS INITIATIVE

Amy Armstrong, Program Director, Resilient Reefs Initiative

Overview of the Resilient Reef Framework, initiative goals and partnerships; Theory of applying urban resilience lessons to reef sites; Discussion of evolution of conservation field towards resilience; Key trends, challenges, and opportunities seen in reef sites and management (case studies?); Defining and measuring success; Perspective on the role of designers in this space

Kalene Eck, Chief Resilience Officer CZMAI

Introduce the role as the Chief Resilience Officer; Career path and background; Perspective on the role of designers in this space and how the RRI intends to leverage outputs of this effort

Open Discussion and Q&A

MONDAY JANUARY 24TH

12:00 - 1:00 CST
1:00 - 2:00 EST

INTRODUCTIONS + PLANNING EFFORTS + NATURAL AND CULTURAL LANDSCAPES

INTRODUCTION: LAYING THE GROUNDWORK

12:00 - 12:10 CST
1:00 - 1:10 EST

Opening: Workshop Goals
Kate Orff, Director UD Program GSAPP

Water urbanisms studio and CRCL Accelerator process; Workshop goals and structure; Faculty introductions for UB and GSAPP

12:10 - 12:30 CST
1:10 - 1:30 EST

Building Resilience in Belize
Kalene Eck, Chief Resilience Officer CZMAI

Overview of resilience strategy process, initial challenges and opportunities and assessment findings; Key projects and plans; outreach and stakeholders overview; What's most needed from this Workshop and how will it be useful?

12:30 - 12:45 CST
1:30 - 1:45 EST

Coastal Zone Management Plan Update
Samir Rosado, Coastal Planner

Overview of CZM Plan update and process; Focus areas, key challenges and trends; Engagement process

12:45 - 1:00 CST
1:45 - 2:00 EST

Open Discussion and Q&A

1:00 - 1:15 CST
2:00 - 2:15 EST

BREAK

1:15 - 3:00 CST
2:15 - 4:00 EST

STAKEHOLDER ACCELERATOR BREAKOUT SESSIONS

1:15 - 1:25 CST
2:15 - 2:25 EST

Introduction and Transition to Breakout Teams
Johanna Lovecchio, Center for Resilient Cities and Landscapes

1:25 - 2:30 CST
2:25 - 3:30 EST

Breakout Sessions : Understanding Place
Change map and unpacking drivers of change

2:30 - 2:45 CST
3:30 - 3:45 EST

Report Out and Discussion

2:45 - 3:00 CST
3:45 - 4:00 EST

BREAK

3:00 - 4:00 CST
4:00 - 5:00 EST

PRESENTATIONS: NATURAL AND SOCIAL LANDSCAPES

Valuing Natural Capital of a Future Climate: Landscape, The Reef, Economy, Society
Nadia Bood, Senior Program Officer, Marine Science & Climate Change at World Wildlife Fund Mesoamerica

Social, Cultural, and Heritage Landscapes
Nigel Encalada, Sustainable Heritage Consulting

3:45 - 4:00 CST
4:45 - 5:00 EST

Open Discussion and Q&A

4:00 - 6:00 CST
5:00 - 7:00 EST

STUDENT RESEARCH AND WORKING TIME

TUESDAY JANUARY 25TH

9:30 - 10:30 CST
10:30 - 11:30 EST

WATER + FOOD + CLIMATE

WATER, FOOD AND CLIMATE SYSTEMS

Climate Change Projections of the BBRS
Manishka De Mel, Center for Climate Systems Research, Columbia University

Watershed Ecology and Quality
Professor Josue Ake, University of Belize

Fisheries and Mariculture
Felicia Cruz, Belize Department of Fisheries

Marine Management and Reef Health
Kirah Forman, Hol Chan Marine Reserve

10:30 - 10:50 CST
11:30 - 11:50 EST

Open Discussion and Q&A

10:50 - 11:00 CST
11:50 - 12:00 EST

BREAK

11:00 - 12:30 CST
12:00 - 1:30 EST

STAKEHOLDER ACCELERATOR BREAKOUT SESSIONS

11:00 - 11:10 CST
12:00 - 12:10 EST

Introduction and Transition to Breakout Teams
Johanna Lovecchio, Center for Resilient Cities and Landscapes

11:10 - 12:00 CST
12:10 - 1:00 EST

Breakout Sessions
Who is involved in coastal development and how is it done today?

12:00 - 12:30 CST
1:00 - 1:30 EST

Report Out and Discussion

12:30 - 1:00 CST
1:30 - 2:00 EST

BELIZE STAKEHOLDERS END / STUDENTS LUNCH

1:00 - 3:00 CST
2:00 - 4:00 EST

STUDENT RESEARCH AND WORKING TIME
Students self organize into virtual team rooms to research and work on final presentations in MIRO

3:00 - 5:00 CST
4:00 - 6:00 EST

GSAPP DESK CRITS WITH FACULTY

WEDNESDAY JANUARY 26TH

INFRASTRUCTURE + ENERGY + LAND USE

9:30 - 10:30 CST
10:30 - 11:30 EST

PRESENTATIONS: INFRASTRUCTURE, LAND USE, ENERGY

Tren Maya Infrastructure Plan and Impacts
Mónica Ortiz, Academic and research coordinator at Tren Maya - FONATUR - Mexico's National Tourism Fund

Energy Transition and Offshore Extraction
Ryan Cobb, Belize Energy Unit

Wastewater and Development Impacts
Jose 'Pepe' Garcia, Environmental Engineer Consultant

10:30 - 10:50 CST
11:30 - 11:50 EST

Open Discussion and Q&A

10:50 - 11:00 CST
11:50 - 12:00 EST

BREAK

11:00 - 12:30 CST
12:00 - 1:30 EST

STAKEHOLDER ACCELERATOR BREAKOUT SESSIONS

11:00 - 11:10 CST
12:00 - 12:10 EST

Introduction and Transition to Breakout Teams
Johanna Lovecchio, Center for Resilient Cities and Landscapes

11:10 - 12:00 CST
12:10 - 1:00 EST

Breakout Sessions
How is this place represented today? What could inspire the future given the challenges and opportunities we've heard about? What are the elements of future coastal development?

12:00 - 12:30 CST
1:00 - 1:30 EST

Report Out and Discussion

12:30 - 1:00 CST
1:30 - 2:00 EST

BELIZE STAKEHOLDERS END / STUDENTS LUNCH

1:00 - 3:00 CST
2:00 - 4:00 EST

STUDENT RESEARCH AND WORKING TIME

3:00 - 4:00 CST
4:00 - 6:00 EST

GSAPP FACULTY MINI LECTURES

Geeta Mehta, ***Social Capital Credits***
Thad Pawlowski, ***Natural Capital in Mozambique***
Kate Orff, ***Resilient Shorelines and Living Breakwaters***
Adriana Chavez, ***Coastal Resilience in Mexico***

THURSDAY JANUARY 27TH

LIVELIHOODS + TOURISM + ECONOMY

9:30 - 10:30 CST
10:30 - 11:30 EST

PRESENTATIONS: FINANCE AND INVESTING LANDSCAPES

Planning for the Blue Economy
Shantel Espades, Blue Economy Director, MBECA

Planning for the Blue Economy
Emilie Gomez, MBECA

Funding and Financing for Reef Health and Communities
Angeline Valentine, MarFund

From the Watershed to the Reef
Liliana Garcia, Amigos de Sian Ka'an

10:30 - 10:50 CST
11:30 - 11:50 EST

Open Discussion and Q&A

10:50 - 11:00 CST
11:50 - 12:00 EST

BREAK

11:00 - 12:30 CST
12:00 - 1:30 EST

STAKEHOLDER ACCELERATOR BREAKOUT SESSIONS

11:00 - 11:10 CST
12:00 - 12:10 EST

Introduction and Transition to Breakout Teams
Johanna Lovecchio, Center for Resilient Cities and Landscapes

11:10 - 12:00 CST
12:10 - 1:00 EST

Breakout Sessions
Planning with what tools to effect change? What is our resilience thesis statement?

12:00 - 12:30 CST
1:00 - 1:30 EST

Report Out and Discussion

12:30 - 1:00 CST 1:30 - 2:00 EST	**BELIZE STAKEHOLDERS END / STUDENTS LUNCH**
1:00 - 4:00 CST 2:00 - 5:00 EST	**STUDENT RESEARCH AND WORKING TIME**
5:00 - 6:00 CST 6:00 - 7:00 EST	**PRESENTATIONS: TOURISM IMPACTS AND LIVELIHOODS**
	Al Caribe: Tourism industry in the Caribbean, Research by Supersudaca *Felix Madrazo, International Design*
	Livelihoods and Tourism Impacts *Caroline 'Caz' Oliver, TIDE EcoTours*
5:45 - 6:00 CST 6:45 - 7:00 EST	**Open Discussion and Q&A**

FRIDAY JANUARY 28TH	**FINAL PRESENTATIONS**
8:00 - 2:00 CST 9:00 - 3:00 EST	**STUDENT RESEARCH AND WORKING TIME**
2:00 - 4:00 CST 3:00 - 5:00 EST	**PRESENTATIONS: PROBLEM DEFINITION AND OPPORTUNITIES**
2:00 - 3:30 CST 3:00 - 4:30 EST	**STUDENT PRESENTATIONS: 5-7 Minutes Each x11**
3:30 - 4:00 CST 4:30 - 5:00 EST	**Final Moderated Critique Panel and Design Principles** *Moderated by Professors Geeta Mehta and Cecy Castillo* *Student Certificates Ceremony*

III. SPEAKER BIOS

JOSUÉ AKÉ
Professor, University of Belize

Josué Aké is a Lecturer at the University of Belize, in the Faculty of Science and Technology, within the Natural Resource Management Program. He is a graduate with two master's degrees: M.Sc. in Environment and Resource Management focus in Water Resource Management, and M.Sc. in Environmental Science focus in Environmental Assessment.

He is a Belizean researcher in Water Quality Management in watersheds, rural water management, and Water Conservation Education. He participates with universities, environmental community organizations, national and international water entities, and researchers. He is also an academic national representative in regional and international conferences and seminars in water resources such as Global Water Partnership (GWP) Network, RISAF Network and DAAD Alumni Water Experts Seminars.

AMY ARMSTRONG
Program Director, Great Barrier Reef Foundation

Amy is an urbanist and conservationist with a 20 year track record of designing and leading ambitious programs that deliver environmental and social impact. She currently leads the Resilient Reefs Initiative--an AUD$14M global effort working at the intersection of community development and ecosystem restoration, partnering with UNESCO coral reef sites to build the resilience of their reefs and the communities that depend on them. This work draws on her previous experience helping to design and lead The Rockefeller Foundation's 100 Resilient Cities initiative—a USD$164M effort to transform how cities understand risk, engage their residents, and plan for the future. At 100RC, she partnered with cities around the world to design and implement holistic resilience strategies, and led the initiative's program design and monitoring & evaluation teams.

Prior to this work, she helped lead and grow two applied research centers at New York University, bridging research and policy to help cities make evidence-based decisions that deliver more equitable outcomes. Additionally, she has experience working for local governments and non-profits on program development, strategic planning, external affairs, and policy research and analysis.

She holds a B.A. in Political Science from Reed College and an MSc in Social Policy and Planning from the London School of Economics. She is an Edmund Hillary Fellow, and has been a Coro Leadership New York Fellow and a New York City Urban Fellow. A global citizen, she currently calls Bozeman Montana home where she is mom to a goofy and curious son who is also figuring out how to do well for the world.

NADIA BOOD
Senior Program Officer, Marine Science & Climate Change at World Wildlife Fund Mesoamerica

Nadia Bood discussed the Smart Coasts Project, a climate adaptation project aimed to answer the following three questions: 1) What benefits were people receiving from nature throughout the region? 2) How might climate change affect these ecosystem services? 3) Where should there be investment in adaptation strategies?

Utilizing InVEST modeling software and community stakeholder workshops, the project identified areas in Belize where certain climate change adaptation strategies such as mangrove restoration or coral reef protection would generate the greatest return to communities in terms of ecosystem services.

RYAN COBB
Energy Director, Belize Energy Unit

Ryan Cobb presented an overview of Belize's current energy sector alongside a look into what energy may look like in future Belize. With a 92% accessibility rate, the majority of Belizeans have access to Belize's electricity share which can be broken down into the following categories: 51% renewable energy share, 43% imported electricity share from Mexico (largely oil and gas), and 6% fossil fuel.

Looking to the future, Belize is invested in energy security, not energy independence, as they are not willing to impose price increases on the public or compromise development. With this in mind, Belize has a current renewable energy goal of 75% and is exploring the following opportunities to reach this goal: rooftop solar, increasing efficiency in the public transit sector through initiatives like electrifying the bus system, fuel quality standards, used vehicle regulation and alternative fuel blends.

FELICIA CRUZ
Fisheries Officer, Belize Department of Fisheries

Ms. Felicia Cruz is a Fisheries Officer within the Policy and Planning Unit of the Belize Fisheries Department with over 10 years' experience in fisheries management and conservation. Ms. Cruz is responsible for various functions which includes but is not limited to providing technical expertise in Fisheries policy and sectoral management (national, regional and international perspectives), developing sectoral plans and policies, synthesizing project proposals and resource mobilization strategies, permitting of research and mariculture developments, and coordinating the relationship between the Department and other public and private sectors in Belize. Inherently, Ms. Cruz is also involved in the alignment of the country's national frameworks which include Horizon 2030, and the GSDS to the fisheries sector. Furthermore, activities are also monitored and reported whereby these actions have contributed to Belize's implementation of Sustainable Development Goal 14, life below water.

MANISHKA DE MEL
Senior Staff Associate, Center for Climate Systems Research, Columbia University

Manishka has a background in climate change, biodiversity conservation and environmental management. She has 15 years of professional experience, gained across some 20 countries worldwide. She is a Senior Staff Associate at the Center for Climate Systems Research (CCSR) at Columbia University's Earth Institute, based at NASA GISS.

She leads the CCSR Climate Impacts Group portfolio of Conservation and Development sector projects, collaborating with a range of partners including World Wildlife Fund, United Nations Development Programme and Wildlife Conservation Society. Manishka has a MA in Climate and Society from Columbia University, a MS in Biodiversity, Conservation and Management from the University of Oxford and a Certificate in Business Excellence from the Columbia Business School.

KALENE ECK
Chief Resilience Officer, Coastal Zone Management Authority and Institute

She serves as the point person leading comprehensive efforts on resilience, working across the reef system locally, and developing the resilience strategy for Belize. She holds a Master of Marine Management degree with a focus in Marine Policy and Law from the Marine Affairs Program at Dalhousie University, Nova Scotia, Canada. Kalene possesses a wealth of knowledge and over ten years' experience in marine conservation, fisheries management, policy formulation, and of the legal framework governing marine affairs in Belize. Her goal is to work with a dedicated group of interdisciplinary personnel towards the implementation of sustainable environmental practices through research, and science communication with policy and decision makers.

NIGEL ENCALADA
Expert Culture Consultant, Sustainable Heritage Consulting

Nigel Encalada is an independent consultant on culture and heritage both in Belize and internationally. He is a senior UNESCO facilitator for the implementation of the 2003 Convention for the Safeguarding of Intangible Cultural Heritage and is currently a member of the 12-person Evaluation Body that reviews nominations at the international level for the inscription of cultural elements to the various Lists of Intangible Cultural Heritage of Humanity as well as requests for International Assistance. From 2009-2021, Nigel was the Director of Belize's Institute for Social and Cultural Research (ISCR) of the National Institute of Culture and History (NICH); was the editor of the Journal of Belizean Studies from 2007-2009, and was a teacher and lecturer of History, Economics and Research Methods at St. John's College from 1997-2009.

SHANTEL ESPADES
Community Blue Innovations Officer, Ministry of Blue Economy and Civil Aviation

Ms. Shantel Espadas is an Orange Walkeña with a passion for Belize's marine ecosystem. Her passion led her to pursue a bachelor's degree in Natural Resources Management from the University of Belize. While She has worked in various aspects in marine conservation and sustainable development for over 6 years.

Ms. Espadas is currently the Community Blue Innovations Officer for the Ministry of Blue Economy and Civil Aviation where her role is to build community resiliency to allow for economic and Livelihood recovery, through the use of Belize's Blue Space.

KIRAH FORMAN-CASTILLO
Technical Manager, Hol Chan Marine Reserve

Mrs. Castillo holds a Bachelor's Degree in Biology from the University of Belize, and a Master's Degree in Protected Areas Management and Eco-Regional Development from the University of International Cooperation, Costa Rica. She has been with the Hol Chan Marine Reserve for the past 16 years and has worked in conservation and marine protected areas management for close to 20 years.

Her duties include overseeing the research and monitoring program and providing technical support for all other management activities, grant funding and project management. She is also responsible for ensuring that the HCMR meet all its conservation objectives. Her mantra is "lead by example".

JOSE 'PEPE' GARCIA
Environmental Engineer Consultant, Tunich-Nah Consultants and Engingeering

Jose "Pepe" Garcia has served on many Boards such as The Belize Audubon Society, Belize Water Services, World Conservation Union/Central America Chapter, Ambergris Caye Planning Authority, Ladyville Village Council as well as many others. He is the founder of TNCE/Tunich-Nah Consultants & Engineering and has near 40 years of experience in the fields of civil/water/wastewater/solid waste and environmental engineering.

Due to this, he has amassed a massive amount of experience in a variety of fields. He has conducted studies for development of projects located across the entire country and on many islands including those located within the three atolls of Belize. These works/studies require in-depth studies as proper decision making is highly important in helping to protect our natural resources for coming generations.

LILIANA GARCÍA
Director of Programs, Amigos de Sian Ka'an

Liliana García has been an environmental lawyer for more than 20 years. For the past six years, she has worked with Friends of Sian Ka'an, an NGO dedicated to nature conservancy and sustainable development in Yucatan's Peninsula. As Director of Programs, she leads a team of professionals promoting the Maya Ka'an tourist destination. She led the environmental education program "You're water, be conscious" -or Eres agua, toma consciencia, in Spanish-; a set of manuals of good practices for the use and conservation of cenotes, sustainable planning, design, and construction in the Mexican Caribbean.

She led the MARTI Guide, aimed at real estate developers and investors and high-impact projects with a basin-to-reef approach, integrated water, and wastewater management, using innovative solutions in the Mesoamerican Barrier Reef System (MBRS).

Liliana was Deputy Director of Legal Support for Environmental Management at the Ministry of Environment and Natural Resources (SEMARNAT). She conducted research and legislative analysis to design legal frameworks in implementing sustainable projects in collaboration with the Commission for Environmental Cooperation.

EMILIE GOMEZ
Coordinator and Liaison Officer, Ministry of Blue Economy and Civil Aviation

Emilie is currently working as a consultant at the Blue Economy Unit for the Ministry of Blue Economy & Civil Aviation where she inputs her expertise in the development of this new innovative sector for Belize. A 27-year-old, Emilie majored in science at her local high school, San Pedro High School.

Her passion for the ocean and all nature's wonders guided her decision to pursue higher education in Environmental Engineering. Emilie successfully graduated with a bachelor's degree in Environmental Engineering in 2016 and later obtained her master's degree in the same field in 2020.

FELIX MADRAZO
Founding Partner, International Design

Felix Madrazo (Saltillo, Mexico 1972) is an architect, researcher and lecturer. He is a founding partner of the architecture studio IND [Inter.National.Design], co-founder of the research collective Supersudaca and lecturer in various universities. With Supersudaca he has carried several research projects related to the impacts of mass tourism in the Caribbean with special emphasis on cruise tourism and all inclusive resorts. He has published several articles with Supersudaca and is co-author of the books City Shocks and Copy Paste done at the Why Factory and published by Nai010 Press.

CAROLINE OLIVER
Sales and Marketing Manager, TIDE EcoTours

Caroline (Caz) knew from a young age that her passion lay in wildlife and its protection. She earned a Bachelor's degree in Environment, Economics and Ecology from the University of York (UK), and a Master's degree in Conservation and Tourism from the Durrell Institute for Conservation and Ecology at the University of Kent (UK). As part of her studies, she conducted coral reef research in a marine reserve in the Bahamas and completed a valuation of tourism strategies in a national park in Rwanda.

She returned to the Bahamas to work as a project scientist for 15 months, where she taught volunteers how to conduct coral reef surveys and was responsible for reporting research findings to the Bahamas National Trust. In 2013, Caz volunteered at TIDE as a Development Intern, and fell in love with Belize. She returned to TIDE after her internship, to help develop TIDE's Ridge to Reef Expeditions program in 2014. She focused on this program for two years, before taking on the role of Sales and Marketing Manager for TIDE Tours, where she was able to share her passion for Belize and education with travel planners from around the world. In 2019, she divided her time between TIDE's educational tour programs, developing and leading educational trips in the field, and project management, managing one of TIDE's large projects.

Following the decline in tourism in 2020, Caz transitioned to a full-time role in project management, and was appointed as TIDE's Program Director in 2021. In this role, she is responsible for overseeing project implementation, organizational and project budgets, meeting desired targets and objectives, and reporting to funders and TIDE' Board of Directors. Through her varied experiences at TIDE over the years, Caz has continued to be inspired by her dedicated team of colleagues and the rich diversity of southern Belize. At a time of unprecedented environmental change and challenges, she is humbled to be part of an organization that is leading the way in natural resource management and community participation in conservation.

MÓNICA ORTIZ ÁLVAREZ
Director of the Scientific, Environmental and Cultural Area at Tren Maya Project within FONATUR, the National Tourism Development Fund

Mónica Ortiz Álvarez holds a law degree from the Universidad Iberoamericana and a master's degree from the University of Texas, in Austin. She has also studied political campaigns at Yale University. She has worked as a public official in Mexico's Federal Government and in the Government of Mexico City. She has experience in the legal and public policy frameworks, specifically in the scientific, technological and educational sectors.

In addition, she has coordinated governmental entities and high-level professional affiliations and established and developed institutional and political links with the Federal and local Legislative Branches and liaison between the academic and governmental, national, and international sectors. She has also taught several courses and workshops on the national science and technology system. Currently, she is the Director of the Scientific Area of the Mayan Train.

SAMIR ROSADO
Coastal Planner, Coastal Zone Management Authority and Institute

Mr. Samir Rosado is the Coastal Planner at the Belize Coastal Zone Management Authority & Institute (CZMAI) and head of the Coastal Planning and Monitoring Unit. He has spent the last 11 years promoting the sustainable use and management of Belize's coastal resources through the development and implementation of the Belize ICZM Plan 2016.

Additionally, he has contributed to advancements in the research and monitoring of water quality and coastal sensitive habitats in the Belizean coastal zone. This includes Ocean Acidification, Blue Carbon, Reef Monitoring, Shoreline management among others.

ANGELINE VALENTINE
Project Officer, Mesoamerican Reef Rund

Angeline currently works as Project Officer for the Belize Marine Fund program of MAR Fund. She holds a Master's Degree in Environmental Management from Duke University, as well as a BSc. in Biology and Natural Resources Management from the University of Belize. She is the recipient of several awards and honors such as an OAS-Fulbright Fellowship to pursue graduate studies at Duke, a PEW Fellowship to participate in Duke University's Global Fellows Programme, and a Fellowship from Columbia University in New York to participate in their SEE-U (Summer Ecological Experience for Undergraduates) Programme. Additionally, she was also a member of the 2011 cohort of the MAR Leadership Programme. Angeline is based in Belize City, with her family.

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V. EXISTING PLANS REVIEW

WORKSHOP PRE-READ

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- Assessing Climate Risk: Mesoamerica — WWF and the Columbia University Center for Climate Systems Research — Page 7 — 2021

Note: All resources are hyperlinked in the titles

Cultural Heritage

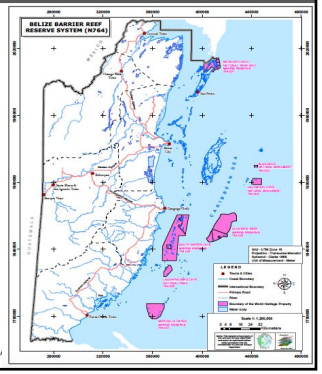
Belize Barrier Reef Reserve System

Contributors: UNESCO World Heritage Belize

2015

Purpose: To provide an overview of the Belize Barrier Reef and the reserve system in place

- The Belize Barrier Reef Reserve System, (made a UNESCO World Heritage Site in 1996), is comprised of seven protected areas; Bacalar Chico National Park and Marine Reserve, Blue Hole Natural Monument, Half Moon Caye Natural Monument, South Water Caye Marine Reserve, Glover's Reef Marine Reserve, Laughing Bird Caye National Park and Sapodilla Cayes Marine Reserve.
- Threats that impact the area; overharvesting of marine resources, coastal development, tourism, industrial development and proposed oil and gas exploration and exploitation
- The geographical spread of this area is a particular management challenge (oversight of protected areas is governed through various legislation, administered by various departments, and spread across ministries
- Revitalization of the Coastal Zone Management Authority and Institute (CZMAI), especially the coastal zone management plan, will strengthen coordination



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Climate Change, Adaptation and Natural Capital

Natural Heritage, Natural Wealth

Contributors: Belize Fisheries Department, WWF, Sea Belize, WCS Belize, Belize Audubon Society, Wildtracks

2017

Purpose: To determine the economic value of the BBRRS to the Belizean economy through the tourism industry, and use it to support & promote the management of the seven MPAs that make up the BBRRS World Heritage Site

- The BBRRS was added to the List of World Heritage in Danger in 2009 and to date remains on the UNESCO's in danger list based on threats related to the removal of mangrove cover, unsustainable coastal development, and, more recently, offshore oil prospecting
- The study assessed four of Belize's seven MPA's and determined that the total tourism economic value of these four areas is estimated to be up to US$18.8 million. There is potentially much greater additional value associated with the MPAs through other ecosystem services (see image)
- Based on the findings of the report, the authors call for the belizean government to 1) Enact the proposed legally binding indefinite moratorium on offshore oil exploration; 2) Implement a ban on further sale and lease of public lands within the BBRRS; 3) Enact the revised Mangrove Regulations; 4) Invest in the management of the BBRRS; 5) Enforce land-use and development regulations

ES CATEGORY	ES	INCLUDED IN STUDY? SECTION?
PROVISIONING SERVICES	FOOD	NO
	ORNAMENTAL RESOURCES	NO
	RAW MATERIALS	NO
	GENETIC RESOURCES	NO
	MEDICINAL RESOURCES	NO
REGULATING SERVICES	CARBON SEQUESTRATION AND CLIMATE REGULATION	NO
CULTURAL SERVICES	CULTURAL HERITAGE	NO
	SPIRITUAL & HISTORICAL HERITAGE	NO
	RECREATIONAL ACTIVITIES	TOURISM INCLUDED
	SCIENCE AND EDUCATION	NO
	PRIMARY PRODUCTION	NO
	COASTAL PROTECTION	NO
SUPPORTING SERVICES	PRIMARY PRODUCTION	NO
	COASTAL PROTECTION	NO

Nawaz, Sara, and Nadia Bood. "Natural Heritage, Natural Wealth: Highlighting the Economic Benefits of the Belize Barrier Reef Reserve System World Heritage Site." *WWF*, World Wildlife Fund, 18 Oct. 2017, https://www.worldwildlife.org/publications/natural-heritage-natural-wealth-highlighting-the-economic-benefits-of-the-belize-barrier-reef-reserve-system-world-heritage-site.

InVEST Scenarios Case Study: Coastal Belize

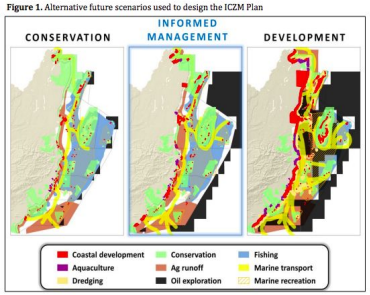
Contributors: Natural Capital Project, World Wildlife Fund, Stanford University

2015

Purpose: To develop and analyze management scenarios to inform Belize's Integrated Coastal Zone Management Plan (ICZMP)

- Utilized Integrated Valuation of Environmental Services and Tradeoffs (InVEST) - an evaluation software used for mapping, quantifying and valuing ecosystem services under different scenarios
- 3 scenarios considered: (1) conservation (preservation of existing ecosystems), (2) development (rapid economic development), and (3) informed management (blends environmental conservation goals with current needs for coastal development)
- It was determined that "informed management" scenario better better achieved the goals of the ICZM mandate than either "conservation" or "development."

Figure 1. Alternative future scenarios used to design the ICZM Plan



Rosenthal, Amy, et al. *Invest Scenarios Case Study: Coastal Belize*. https://naturalcapitalproject.stanford.edu/sites/g/files/sbiybj9321/f/publications/belize_invest_scenarios_case_study.pdf.

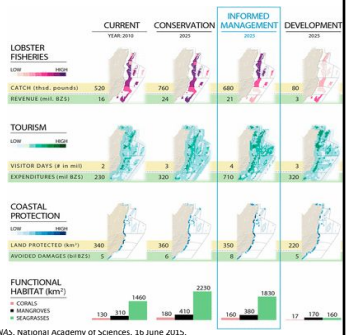
Embedding ecosystem services in coastal planning

Contributors: The Natural Capital Project, University of Washington, CZMAI, WWF–US

2015

Purpose: To integrate ecosystem services into marine and coastal spatial planning, to inform Belize's Integrated Coastal Zone Management Plan (ICZMP)

- Methodology: quantified ecosystem-service returns now and in the future under three management scenarios (development, conservation, informed management by assessing risk to habitats from a suite of human activities
- The process was designed to understand how the nine planning regions in Belize contribute in to a portfolio of national benefits from ocean ecosystems and to incorporate regional differences in stakeholder preferences for the future
- Higher value of coastal protection and tourism under the Informed Management scenario, compared with the Conservation scenario, serves as a reminder that ecosystem-service values depend on a combination of both biophysical and social variables



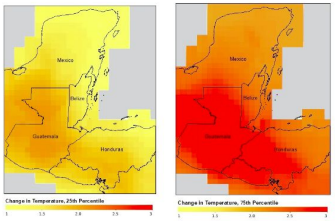
Arkema, Katie K., et al. "Embedding Ecosystem Services in Coastal Planning Leads to Better Outcomes for People and Nature." *PNAS*, National Academy of Sciences, 16 June 2015, https://www.pnas.org/content/112/24/7390.

Assessing Climate Risk in Mesoamerica (Draft)

Contributors: WWF and the Columbia University Center for Climate Systems Research (CCSR)

2021

Annual mean temperature change 2050s compared to the 1980-2005 baseline under RCP 8.5



Low estimate (25th percentile) High estimate (75th percentile)

Purpose: Integrate climate risk information into conservation, development, and disaster management policy and practice

- Methodology: use RCP scenario 8.5 to assess "low estimate" and "high estimate" scenarios (25th and 75th percentile, respectively) for climate change risk in 2050 in the Mesoamerican reef system region compared to the 1980-2005 baseline data
- Mean temperature, number of extreme heat days, sea level rise, sea surface temperature, all projected to increase across the region
- Precipitation and number of rainy days are projected to decrease, consistent with drought that is experienced across the region
- Key considerations: (1) using ranges of climate projections to discuss all possibilities, (2) integrating climate risk into ecosystem service modeling, (3) future technologies (e.g: NASA PACE program to advance the assessment of ocean health by measuring the distribution of phytoplankton

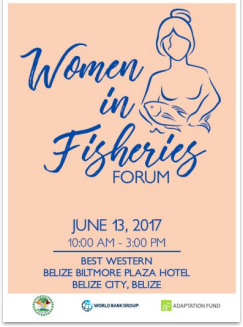
Belize Marine Conservation and Climate Adaptation Project

Contributors: Protected Areas Conservation Trust, World Bank Group

2018

Purpose: To implement priority ecosystem-based marine conservation and climate adaptation measures to strengthen the climate resilience of the Belize Barrier Reef System

- The MCCAP is currently in its third year of execution and has reached the mid-term of its implementation, and as such, a Mid-Term Evaluation is now required (this document)
- The geographic focus includes three Marine Protected Areas (MPAs): Corozal Bay Wildlife Sanctuary, Turneffe Atoll Marine Reserve, and South Water Caye Marine Reserve, and targets 12 fishing communities (Consejo Village, Corozal Town, Copper Bank Village, Chunox Village, Sarteneja Village, Belize City, Dangriga Town, Hopkins Village, Sittee River Village, Riversdale Village, Seine Bight Village, and Placencia Village) to act as champions for the management of these protected areas.
- The main components are: (1) Improving the Protection Regime of marine and coastal ecosystem, (2) Promotion of viable and sustainable alternative livelihoods for affected users of the reef, (3) Raising awareness, building local capacity, and disseminating information, and (4) Project Management/Administration
- An example of a project implemented under MCCAPP (see image)



Jacobs, Noel D. *Belize Marine Conservation and Climate ... - World Bank*. 5 Feb. 2018, https://pubdocs.worldbank.org/en/864511532335635037/S5-Final-MCCAP-MTE-Report-5th-February-2018-3.pdf.

Climate Change, Adaptation and Natural Capital

Integrated Vulnerability and Adaptation Assessment

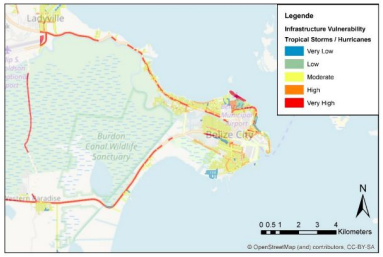
Contributors: EDB Global Optimum, Antea Group, UNDP Belize

2020

Purpose: To: (i) assess the scope of Belize's climatic vulnerability assessment; (ii) work with stakeholders towards developing robust impact scenarios with the available data; and (iii) understand the expectations concerning the adaptation measures that would be eventually proposed.

- This study focused specifically on vulnerability and capacity assessment in central and south-central Belize
- Four sectors were assessed: Coastal Zone, Water, Agriculture and Fisheries
- "Mainstreaming" adaptation means to systematically include climate risk and adaptation considerations in regular decision-making and planning processes instead of only implementing "stand-alone" adaptation measures
- The level of climate change adaptation mainstreaming into the:
  - Coastal Zone Sector is **medium**
  - Water Sector is **medium-low**
  - Agriculture Sector is **high**
  - Fisheries Sector is **medium**
- The plan also highlights the importance the equal participation and representation of women in the fight against climate change (gender mainstreaming)
- Sector specific adaptation recommendations are made (p96-110)
- Vulnerability mapping throughout the report (example image right)

Figure 43. Infrastructure sensitivity to tropical storms and hurricanes in Belize City



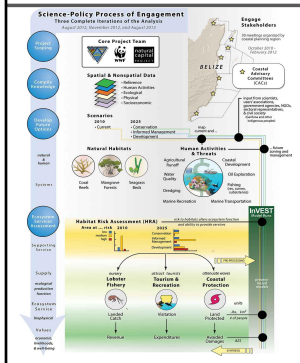
Issler, Fabiana, and Ivan Rocabado. "Integrated Vulnerability and Adaptation Assessment." 20 Jan. 2020.

Coastal Zone Management

Integrated planning in coastal Belize

Contributors: The Natural Capital Project, CZMAI, WWF, MacArthur Foundation

2017



Purpose: An overview of the processes that resulted in Belize's Integrated Coastal Zone Management Plans (ICZMP)

- Four key steps in the science-policy process applied in coastal Belize: (1) project scoping and stakeholder engagement, (2) compiling knowledge to quantify ecosystem services and map coastal and marine ecosystems and human activities, (3) developing future zoning and management options, and (4) conducting an ecosystem service assessment: learning through iteration.
- Three priority benefits that coastal and marine ecosystems in Belize provide to people: catch and revenue from fisheries, visitors and expenditures from tourism, and protection from storms
- The preferred zoning scenario, *Informed Management*, was refined through stakeholder feedback, and identified areas for preservation, restoration, and development uses
- Result: Successfully designed alternative coastal use plans that minimize ecological impacts and maximize economic prosperity

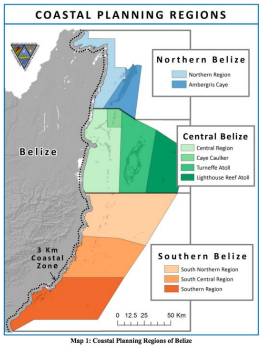
Gregory M. Verutes, Katie K. Arkema, Chantalle Clarke-Samuels, Spencer A. Wood, Amy Rosenthal, Samir Rosado, Maritza Canto, Nadia Bood & Mary Ruckelshaus (2017) Integrated planning that safeguards ecosystems and balances multiple objectives in coastal Belize, International Journal of Biodiversity Science, Ecosystem Services & Management, 13:3, 1-17, DOI: 10.1080/21513732.2017.1345979

Coastal Zone Management

Central Region Coastal Zone Management Plan

Contributors: CZMAI

2016



Map 1: Coastal Planning Regions of Belize

Purpose: To encourage and promote sustainable development, protect and preserve traditional way of life of stakeholders, and ensure sustainability of coastal resources in the Central Belize region

- The Central region is known as the historic gateway to modern Belize - believed to be situated on one of the ancient Maya trade routes
- It's the most populous and economically productive region, home to Belize City - the main hub for ground, water and air transportation, and point of entry and exit for the vast majority of cruise and overnight international visitors.
- Despite the central region representing one of the most important areas for lobster catch in Belize, many no longer fish in the region, possibly because of reducing fishing stock. But there is still much dependency on fish resources by local fishermen and potential displacement by rapid growth in the tourism sector
- Detailed recommendations are provided for the following 10 sectors: Fishing, Marine Tourism, Land-Use, Marine Dredging, Sensitive Habitats, Utilities, Pollution Control, Infrastructure & Social Amenities, Conservation, & Scientific Research & Education

Coastal Zone Management Authority and Institute (CZMAI). 2016. Central Region Coastal Zone Management Guidelines. Belize Integrated Coastal Zone Managem CZMAI, Belize City.

Coastal Zone Management

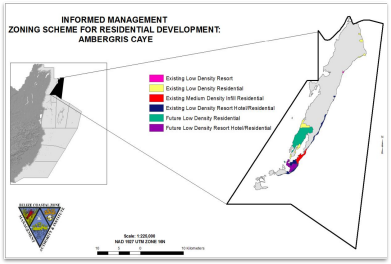
Coastal Zone Management Plan: Ambergris Caye

Contributors: CZMAI

2016

Purpose: To encourage and promote sustainable development, protect and preserve traditional way of life of stakeholders, and ensure sustainability of coastal resources in the Ambergris Caye Region

- Unique habitats exist in Ambergris Caye (mangroves, sea grass, coral reefs, etc) that support biodiversity, tourism and fishing (essential for the functioning of the people and place). Yet, tourism (the largest industry on the caye) is predicted to increase, placing increased pressure on local resources
- Recommendations are provided for the following 10 sectors: Fishing, Marine Tourism and Recreation, Land-Use, Marine Dredging, Sensitive Habitats, Utilities, Pollution Control, Social Amenities, Conservation, and Research & Education.
- Recommendation: Low-impact, environmentally-sensitive, nature-based tourism - avoiding practices that destroy habitats
- Recommendation for solid waste management: a new dump site location on north Ambergris Caye to relieve pressure on the existing dump site (a wetland area two miles south of San Pedro Town)



Coastal Zone Management Authority and Institute (CZMAI). 2016. Ambergris Caye Coastal Zone Management Guidelines. Belize Integrated Coastal Zone Management Plan. CZMAI, Belize City.

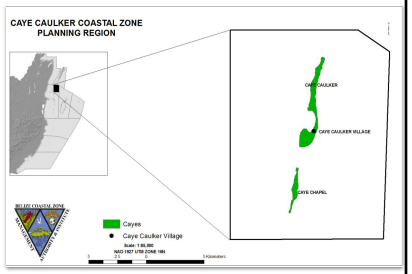
Coastal Zone Management Plan: Caye Caulker

Contributors: CZMAI

2016

Purpose: To encourage and promote sustainable development, protect and preserve traditional way of life of stakeholders, and ensure sustainability of coastal resources in the Caye Caulker Region

- Unlike Ambergris Caye, where tourism is the primary industry, most of those living on Caye Caulker support themselves through the fishing industry [Lobster]. However, tourism is increasing partly due to declining fishing stock in the region.
- Caye Caulker Village, unlike San Pedro on Ambergris Caye, is almost totally locally owned, and it is highly recommend to preserve it as such through informed management
- Detailed recommendations are identified and provided for the following 10 sectors: Fishing, Marine Tourism, Land-Use, Marine Dredging, Sensitive Habitats, Utilities, Pollution Control, Social Amenities, Conservation, and Research and Education
- Implementation of these coastal management guidelines will be undertaken through two mechanisms: (a) centralized statutory control through the various Government departments, and (b) localized community and stakeholder participation

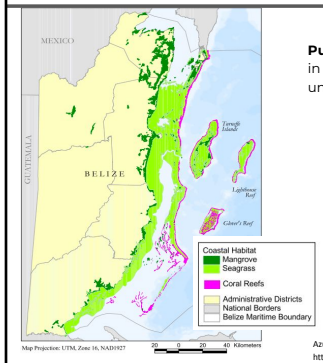


Coastal Zone Management Authority and Institute (CZMAI). 2016. Caye Caulker Coastal Zone Management Guidelines. Belize Integrated Coastal Zone Management Plan. CZMAI, Belize City.

State of the Belize Coastal Zone Report (2014-2018)

Contributors: MAFFESDE, CZMAI

2020



Purpose: To give a synoptic picture of the present and future development in the coastal zone, and a review of the coastal zone management actions under the ICZM Plan.

- Urban development, tourism development, sediment transport, beach erosion, nutrient pollution and poor waste management practices are causing high or very high impacts on Belizean ecosystems, especially coral reefs, seagrass, littoral forests, and mangroves
- There is a current moratorium on offshore oil exploration in Belize. However, transportation of oil is still a risk factor for oil spills in Belize
- In order to have sound Integrated Coastal Management Plan, the following are needed:
  - Better defined and centralized research data
  - An integrated approach at the national level to get the desired data for decision making
  - Intergovernmental cooperation
  - Multisectoral cooperation
  - Enforcement of development regulations (e.g: 1000ft spacing between piers)

Azueta, James, et al. "State of the Coast Report 2014-2018." *Belize Coastal Zone Management*, Mar. 2020, https://www.coastalzonebelize.org/state-of-the-coast-report-2014-2018/.

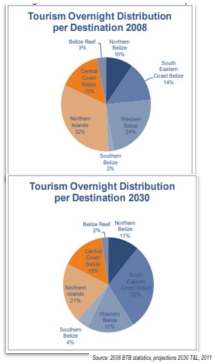
National Sustainable Tourism Master Plan (NSTMP)

Contributors: Belize Tourism Board, Ministry of Tourism, Civil Aviation and Culture, Tourism & Leisure Europraxis Consulting

2011

Purpose: To explain what Belize tourism industry is like today, the objective Belize tourism situation for 2030 and the strategies & actions to reach that goal

- Tourism contributes anywhere from 18% to 25% of the total GDP, and accounts for about 28%of total employment
- Main constraints on tourism identified are poor accessibility by land & air, lack of tourism services, scarce Belizean made handicrafts, inadequate (natural & heritage) asset management, deficient promotion of tourism assets, insufficient waste/sewage disposal, lack of urban planning & land use regulation, lack of public awareness programs, lack of integration of local communities
- Development strategies are to contain development and consolidate for Belize Reef, Ambergris Caye & Placencia Peninsula, promote tourism growth in San Ignacio, Northern Belize, & Southern Belize, add new development in Stann Creek, and facilitate urban renovation in Belize City
- The following macro plans were developed to focuses on the core components of the tourism sector: 1) Tourism Governance 2) Tourism Sustainability and Quality Assurance 3) Tourism Infrastructures 4) Tourism Marketing 5) Tourism Product development

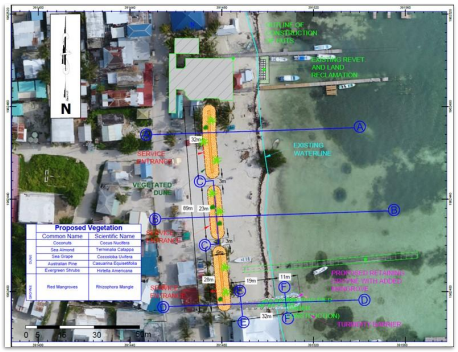


National Sustainable Tourism Masterplan for Belize 2030. (2011). Retrieved November 17, 2021, from http://www.turneffeatollmarinereserve.org/app/webroot/userfiles/214/File/Tourism/BLz%20Tourism%20Master%20Plan%20(Exec%20Sum).pdf.

Caye Caulker Shoreline Stabilization Study

Contributors: Smith Warners International

2017



Purpose: To design a shoreline stabilization system including nature-based solutions, stormwater drainage, and recreational sites

- Used satellite imagery to study the shoreline and designed vegetated sand dunes, breakwaters and groynes to stabilise newly-constructed beaches, a pedestrian walkway, and a novel hybrid rock revetment with a mangrove berm
- Part of a countrywide study mapping Belize's coastal hazard vulnerability
- A cost-benefit analysis was also conducted

"Belize Coastal Study." *Smith Warner International Ltd.*, 5 Aug. 2021, https://www.smithwarner.com/project/belize-coastal-study/.

Tourism Plans and Impacts

Caye Caulker Tourism Development Plan

Contributors: Inter-American Development Bank, Ministry of Tourism and Civil Aviation

2015

Purpose: In response to the National Sustainable Tourism Master Plan and through the establishment of Local Tourism Committees to identify priority needs and projects for Caye Caulker

- 2 major bottlenecks exist that hinder tourism growth: 1) The lack of a spacious and well maintained beach for general recreation purposes and light sports; 2) The split that divides the main island from the north island is impeding the development of new amenities such as a nature park, higher quality lodging and recreational or entertainment services
- The vision statement: a high-quality marine tourism destination with healthy ecosystems, friendly people, and a low-key island charm sustainably harnessed by a progressive, thriving and prosperous community
- This plan also details six major objectives and assigns specific responsibilities to each objective as well as provides a timeline for implementation

Goal Statements

1. Highly improved standards and quality of tourism products and services in Caye Caulker;

2. Expanded and responsible municipal & tourism infrastructural development at Caye Caulker;

3. Increased and sustained tourist arrivals and overnight stays in Caye Caulker.

Salas, Osmany. "Caye Caulker Tourism Destination Development Plan." *Ministry of Tourism*, Oct. 2015, https://tourism.gov.bz/mdocs-posts/caye-caulker-tourism-destination-development-plan/.

Economics, Financing and Investments

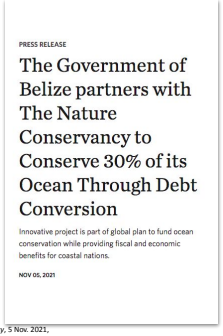
Belize Blue Bond

Contributors: The Nature Conservancy, Government of Belize, Credit Suisse, U.S. International Development Finance Corporation

2021

Purpose: To highlight an innovative financial mechanism that allows for greater ocean conservation and reduced national debt in Belize

- The Nature Conservancy worked with the Government of Belize, Credit Suisse, and the U.S. International Development Finance Corporation to fund a new US$364 million loan to Belize.
- The new loan enables Belize to repurchase and retire existing external commercial debt, create significant annual cash flows for conservation through 2040, and establish an endowment to fund conservation
- In exchange, Belize has pledged to protect approximately 30% of its ocean, including coral reefs, mangroves, and fish spawning sites
- Working with the Belizean government, The Nature Conservancy will facilitate a participatory, stakeholder-driven Marine Spatial Plan (MSP)
- The transaction restructures US$553 million of Belize's debt, leading to an overall debt reduction of approximately US$250 million, more than US$200 million in debt service savings, and an estimated US$180 million in funding for conservation over the next 20 years



PRESS RELEASE

The Government of Belize partners with The Nature Conservancy to Conserve 30% of its Ocean Through Debt Conversion

Innovative project is part of global plan to fund ocean conservation while providing fiscal and economic benefits for coastal nations.

NOV 05, 2021

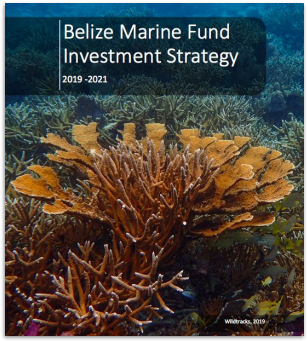
Winters, Rachel. "The Nature Conservancy Partners with the Government of Belize to Conserve 30% of Its Ocean through Debt Conversion." *The Nature Conservancy*, 5 Nov. 2021, https://www.nature.org/en-us/newsroom/blue-bonds-belize-conserve-thirty-percent-of-ocean-through-debt-conversion/.

Economics, Financing and Investments

Belize Marine Fund Investment Strategy

Contributors: Belize Marine Fund, Wildtracks Belize

2019



Purpose: to guide the Belize Marine Fund in making future investments into marine conservation in Belize, based on a theory of change model

- Belize Marine Fund will distribute $500,000 US per year to invest in organizations and projects that will provide impactful conservation returns
- 3 Themes of funding:
  - 1. Improved management effectiveness of marine protected areas across the national seascape
  - 2. Reduced pressures on the marine resources
  - 3. Effective marketing of Belize's reef at national and international levels
- BMF niches: consolidation (nurturing, growing & consolidating stable organizations & program areas), scaling (moving successful projects towards financial sustainability), and building supply chains (moving projects to functional, profitable industries). Less focus on funding grassroots organizations
- Other key funders in Belize: Protected Area Conservation Trust (PACT) & GEF Small Grants Programme

Belize Marine Fund Investment Strategy. (2019). Retrieved November 17, 2021, from https://marfund.org/es/wp-content/uploads/2019/05/BMF-Strategy-20_5_19-Final.pdf.

VI. CASE STUDY BOOKLET

WORKSHOP PRE-READ

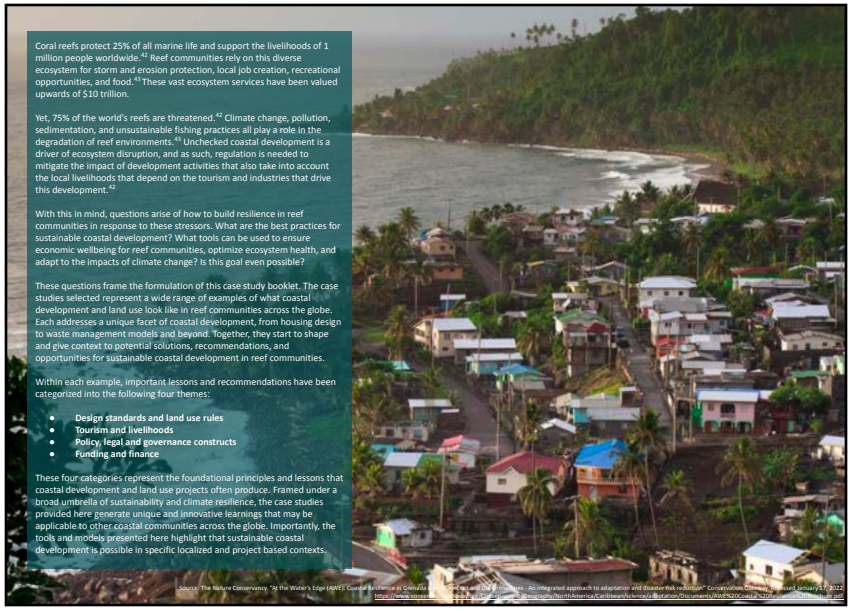
COLUMBIA | Center for Resilient Cities and Landscapes

PREPARED BY
Alexandra Grant-Hudd, Graduate Research Assistant
Johanna Lovecchio, Associate Director

COASTAL DEVELOPMENT AND LAND USE PRACTICES IN REEF COMMUNITIES

RESILIENT COASTAL DEVELOPMENT BELIZE BARRIER REEF UD STUDIO AND STAKEHOLDER ACCELERATOR

Image: Half Moon Bay, Roatan, Certification Ceremony. Photo © CORAL



Coral reefs protect 25% of all marine life and support the livelihoods of 1 million people worldwide.[42] Reef communities rely on this diverse ecosystem for storm and erosion protection, local job creation, recreational opportunities, and food.[43] These vast ecosystem services have been valued upwards of $10 trillion.

Yet, 75% of the world's reefs are threatened.[42] Climate change, pollution, sedimentation, and unsustainable fishing practices all play a role in the degradation of reef environments.[43] Unchecked coastal development is a driver of ecosystem disruption, and as such, regulation is needed to mitigate the impact of development activities that also take into account the local livelihoods that depend on the tourism and industries that drive this development.[42]

With this in mind, questions arise of how to build resilience in reef communities in response to these stressors. What are the best practices for sustainable coastal development? What tools can be used to ensure economic wellbeing for reef communities, optimize ecosystem health, and adapt to the impacts of climate change? Is this goal even possible?

These questions frame the formulation of this case study booklet. The case studies selected represent a wide range of examples of what coastal development and land use look like in reef communities across the globe. Each addresses a unique facet of coastal development, from housing design to waste management models and beyond. Together, they start to shape and give context to potential solutions, recommendations, and opportunities for sustainable coastal development in reef communities.

Within each example, important lessons and recommendations have been categorized into the following four themes:

- **Design standards and land use rules**
- **Tourism and livelihoods**
- **Policy, legal and governance constructs**
- **Funding and finance**

These four categories represent the foundational principles and lessons that coastal development and land use projects often produce. Framed under a broad umbrella of sustainability and climate resilience, the case studies provided here generate unique and innovative learnings that may be applicable to other coastal communities across the globe. Importantly, the tools and models presented here highlight that sustainable coastal development is possible in specific localized and project based contexts.

Source: The Nature Conservancy. "At the Water's Edge (AWE): Coastal Resilience in Grenada and the Grenadines - An integrated approach to adaptation and disaster risk reduction" Conservation Gateway. Accessed January 13, 2022. https://www.conservationgateway.org/ConservationPractices/Marine/policies/Documents/AWE%20Coastal%20Resilience.pdf

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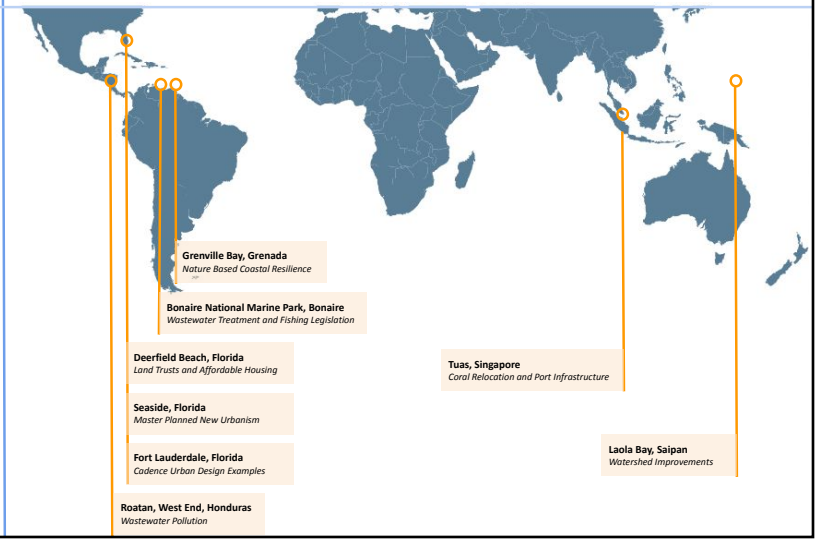


Comprehensive Watershed Improvements

Laolao Bay, Saipan

Contributors	Commonwealth of the Northern Mariana Islands (CNMI) Division of Environmental Quality (DEQ), Coastal Resource Management Office (CRM), CNMI Department of Land and Natural Resources, Division of Fish & Wildlife
Goals	• Improve water quality and coral reef health • Through ecological and infrastructural improvements, enhance tourism and the local economy
Timescale	Planning began in 2007, and infrastructural improvements began in 2012
Actions	• LaoLao Bay Drive Road Paving & Drainage • Stream Crossings • Revegetation • Marine Monitoring • Community Awareness Campaign
Funding	A total of $2,604,164 in funding was obtained through grants that fell under the American Recovery and Reinvestment Act, and an additional $65,926 through the EPA for stream crossing construction [2]

Source: "Laolao Bay Road & Coastal Management Improvement Plan". 2012. Reefresilience.Org. https://reefresilience.org/wp-content/uploads/Laolao-Bay-Road-Coastal-Management-Improvement-Plan.pdf.

ABOUT THE PROJECT

Laolao Bay is located on the south eastern side of Saipan, with three major watersheds feeding into the bay.[1] It is a popular location for local residents and tourists alike to take part in fishing and diving activities. However, rapid population growth and development on Saipan has resulting in increasingly degraded marine environments.[3] This is especially true for Laolao Bay, as varied pollution sources have contributed to decreased coral and fishery health as well as excess nutrients and microalgae. The bay is subject to erosion and runoff pollution from unpaved roads, unpermitted development, land clearing, and agricultural practices.[1]

In response, the Laolao Bay Conservation Action Plan was curated. Specifically addressing Laolao Bay's need for improved marine health, CNMI Division of Environmental Quality embarked on a huge project implementing the following:

- **LaoLao Bay Drive Road** was given major infrastructure updates that included storm water runoff controls, sediment chambers and regrading of unpaved sections of the road [2]
- **Stream Crossings** were added, hardening sections of road prone to heavy erosion
- **Revegetation** was conducted as a nature based solution to erosion control [2]
- **Marine Monitoring** was used to measure the health of benthic substrate, coral [3] communities, algal diversity, invertebrate densities and fish communities. Additional water quality measurements were taken throughout the project's implementation [3]
- **Community Outreach** campaigns utilized brochures, social media, posters, and volunteer outreach to educate the public of the project and the importance of ecological stewardship [3]

Stakeholder workshops took place to both educate the community and receive feedback on the project work, although community members were not directly involved with the initial planning of the project.[2] Local residents took part in volunteer efforts and training sessions to learn to revegetate lands with native plants.[3]

Source: "Laolao Bay Road & Coastal Management Improvement Plan". 2012. Reefresilience.Org.

Workshop participants discuss Stream Crossing #3

Comprehensive Watershed Improvements

Laolao Bay, Saipan

MAJOR LEARNINGS

Design standards and land use planning

- CAP Adaptive Management Cycle was used (an iterative process which helps conservation projects develop and implement strategies, and then evaluate and learn from their experiences) [4]
- Social considerations should be included in future long term planning [3]

Tourism and Livelihoods

- Low-volume Roads Engineering Training Workshops took place with local community members that informed road paving [3]

Policies, Legal and Governance Structures

- Laolao Bay is a Sea Cucumber Sanctuary where fishing of the species is prohibited, although enforcement is lacking [3]
- The goal to stop all "unsustainable" beach activities in the bay was not met because "unsustainable" and "beach activities" were not well defined in the action plan, and as such, governance constructs were difficult to implement [3]
- This was a government led, top down approach to land based restoration [2]

Funding and Finance

- Diversified funding sources that target infrastructure improvements can significantly improve the bay's water quality as well as the efficacy of conservation action planning [3]

Coral reef ecological monitoring – photo quadrant survey

Source: "Laolao Bay Road & Coastal Management Improvement Plan". 2012. *Reefresilience.Org.*

Source: "Laolao Bay Road & Coastal Management Improvement Plan". 2012. *Reefresilience.Org.*

OUTCOMES AND RESULTS

2,100 ft of road paved [1]
6 stream crossings upgraded with erosion control [1]
1.9 miles of road regraded [1]

1,600+ native plants across 12 species were planted by 55 community members, with a 68% overall survival rate [1]

32 schools received informational materials [3]

Turbidity levels were much less in 2015-2016 than in 2011-2012, indicating improved marine health [2]

ADDITIONAL SOURCES

- LaoLao Bay Road & Coastal Management Improvement Plan
- Comprehensive Watershed Improvements in Saipan (Reef Resilience)
- 2018 Dissertation: Enhancing Coral Reef Resilience And Restoration Success
- Laolao Bay Conservation Action Plan

OUTSTANDING QUESTIONS

- How are other sources of pollution such as agricultural runoff and land clearing being addressed in Saipan?
- What considerations were used to justify road infrastructure improvements as an action that could improve runoff and pollution in the area?

Wastewater Pollution

Roatan, West End, Honduras

Contributors: Coral Reef Alliance (CORAL), Polo's Water Association Waterboard, Bay Islands Conservation Association (BICA)-Roatan

Goals:
- Improve water quality in the West End, Honduras
- Ensure safe water based recreation and tourism can thrive in the area
- Promote the following Sanitation Best Management Practices (SBMP's)
  - Having a treatment facility to serve the community
  - Integrated management involving the community
  - Water quality monitoring of effluent discharged and surrounding marine sites
  - Ensuring sanitation solutions are environmentally and financially sustainable over the long term

Timescale: Planning began in 2011 and infrastructural improvements continue to this day, with future planning efforts in place for up to 2040

Actions:
- Build the West End Wastewater Treatment Plant (WWTP)
- Establish a water quality program that tests and analyzes local waters

Funding: CORAL and The Mesoamerican Reef Fund (MARFUND) contributed to this project through grants. Other in kind and monetary donations were made by members of the West End community.

Water Quality Monitoring by BICA Roatan

Source: "Honduras – Wastewater Pollution." Reef Resilience, April 12, 2021. https://reefresilience.org/case-studies/honduras-wastewater-pollution/.

The WWTP

Source: "Honduras – Wastewater Pollution." Reef Resilience, April 12, 2021.

ABOUT THE PROJECT

In Honduras, only 3.2% of human wastewater receives treatment.[5] This poses a significant barrier towards ocean cleanliness, coral health, and a $1 billion tourism industry that depends on water based recreation.[5] This is because the sediments, nutrients and pathogens found in wastewater can be significantly harmful to marine life, especially corals.

In 2011 the mayor of Roatan identified the need for a wastewater treatment facility after discussing with and observing the community.[5] With the help of CORAL, the West End Wastewater Treatment Plant (WWTP) was built. The plant, operated by Polo's Water Association Waterboard, is designed to provide secondary treatment of sewage through digestion, anoxic and aeration tanks, clarification, drying, and aeration pumps that create activated sludge and then disinfect effluent with chlorine prior to discharge.[5]

The wastewater plant relies solely on user fees to operate, making effective management key in its operations.[6] Integrated community management and sustainable budget modeling has been the cornerstone of the WWTP's successful operation and allowed for community based management.[6] Third party evaluations of the plant's infrastructure and technologies are used to evaluative effectiveness and identify potential improvements.[6] Already, there a plans for future infrastructure investments for the WWTP up to 2040.[6]

Based on the success of the WWTP, plans for a multi-million dollar wastewater infrastructure investment between Honduran coastal communities, the Inter-American Development Bank (IDB) and the Central American Bank for Economic Integration (CABEI) are currently in the works.[5]

Wastewater Pollution

Roatan, West End, Honduras

MAJOR LEARNINGS

Design standards and Land Use Planning

- Concrete SBMP's, especially those designed with community stakeholder perspectives, improve coral reef health and reduce coral disease [5]

Tourism and Livelihoods

- Establishing SBMP's at a local level is key to engaging those such as young female professionals in the water and sanitation value chain [5]
- Water quality monitoring is critical to ensure water and sanitation issues are successfully addressed, also providing new opportunities for local job creation [5]

Policies, Legal and Governance Structures

- The WWTP management model can be replicated and altered in communities across Honduras and other areas within the Mesoamerican Reef [5]

Funding and Finance

- Establishing trust and cultivating relationships in the community allowed for the establishment of potable water and wastewater treatment rates and fees [5]
- Budget modeling is a tool used in this model to design annual budgets based on a range of economic scenarios [6]
- Commercialization of the treatment process (sludge composting) could be an economically beneficial future practice [6]
- Sustainability of the management model must be based on strict financial planning that considers reinvestment of revenue into the system (e.g 62 solar panels installed in 2020 resulted in 80% energy savings and reduced operating costs that were reinvested into third party evaluations and increased treatment capacity) [5]

Planning Upgrades for the WWTP

Source: "Honduras – Wastewater Pollution." Reef Resilience, April 12, 2021.

Installation of Solar Panels in 2020

Source: MAR Team - Coral Reef Alliance. "Ensuring the Sustainability of Wastewater Operations in West End, Roatán." PANORAMA, April 12, 2021. https://panoramatest.tbodev.de/en/solution/ensuring-sustainability-wastewater-operations-west-end-roatan-0.

OUTCOMES AND RESULTS

97% of homes and businesses in the West End are treated by the WWTP [5]
WWTP treats 28 million gallons of wastewater per year [5]

Thanks to water quality monitoring, it's clear that the significant reduction of untreated sewage discharge has had a measurable and positive impact on water quality [5]

Half Moon Beach has received an Ecological Blue Flag certification, qualifying the beach as safe for tourists and water based recreation [5]

OUTSTANDING QUESTIONS

- With increased development in coastal communities, how do waste management facilities plan to respond to increased service demand over time?
- How will Sanitation Best Management Practices (SBMP's) change with location/community?

ADDITIONAL SOURCES

- Honduras – Wastewater Pollution (Reef Resilience)
- Ensuring the Sustainability of Wastewater Operations in West End, Roatán

Wastewater Treatment and Fishing Legislation

Bonaire National Marine Park, Bonaire

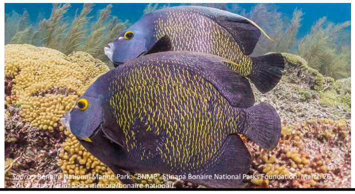
Contributors: STINAPA (Stichting Nationale Parken Nederlandse Antillean), Bonaire National Marine Park, Department of Physical Planning, Department of Agriculture and Fisheries

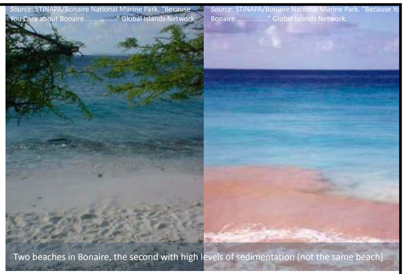
Goals:
- Improve water quality and reduce all stresses in Bonaire National Marine Park through comprehensive infrastructure reform, community programs, and legislation

Timescale: Basic legislation and monitoring began as early as 2004, and major infrastructure updates ended in 2014, a ten year time period

Actions:
- Built one permanent and one temporary wastewater treatment facility
- Passed formal legislation that banned parrot fishing and fish trapping (2010) and created two fish protected areas (FPA's) in 2008
- Drafted official construction guidelines to minimize environmental impact
- Created a nutrient monitoring program that assessed water quality
- Began "Reef Rangers", a standardized training program for local dive staff that promotes them as reef ambassadors
- Implemented a community outreach campaign, "Nature is our livelihood", that aimed to raise awareness about conservation

Funding: The Nutrient Monitoring program was funded by the National Fish and Wildlife Foundation (NFWF) and the 2011-2013 monitoring was funded by the Ministry of Infrastructure and Environment. The Reef Ranger Course was funded by the Dutch Caribbean Nature Alliance (DCNA). The Community Outreach Campaign "Nature is our Livelihood" was funded by WWF and community donors.


Source: Bonaire National Marine Park. "BNMP." Stinapa Bonaire National Parks Foundation, March 26, 2019. https://stinapabonaire.org/bonaire-national/.


Source: STINAPA/Bonaire National Marine Park. "Because You Care about Bonaire…………" Global Islands Network.

Source: STINAPA/Bonaire National Marine Park. "Because You Care about Bonaire…………" Global Islands Network.

Two beaches in Bonaire, the second with high levels of sedimentation (not the same beach)

ABOUT THE PROJECT

Bonaire National Marine Park (BNMP) is home to 2700 hectares of coral, seagrass, mangrove, and other marine ecosystems.[7] Natural and human activities are placing continuous stress on the environment, impacting the areas unique biodiversity. The mission of the BNMP is "to protect and manage the island's natural, cultural and historical resources, while allowing ecologically sustainable use for the benefit of future generations."[7] With this in mind the BNMP began implementing a comprehensive set of actions encompassing the goals of their conservation management plan that specifically addresses overfishing, coastal development, pollution, and negative impacts of tourism through legislation, marine monitoring, wastewater treatment, sustainable construction guidelines and both community training and outreach programs.[7]

The construction handbook created was one of the most tangible examples of sustainable land use management in Bonaire. This resource provides guidelines to those interested in building on Bonaire regarding best practices in keeping the marine environment and coral reefs on the island as intact as possible. Recommendations were made using the perspectives of diverse stakeholders, including local community members in Bonaire. This handbook gives recommendations for site design, preserving vegetation, keeping construction sites clean, specific rules for shoreline modification, sanitary waste systems and even tips for landscaping and gardening.[8]

The combination of these interventions provide a holistic approach to conservation in Bonaire.[7]

Wastewater Treatment and Fishing Legislation

Bonaire National Marine Park, Bonaire

MAJOR LEARNINGS

Design standards and Land Use Planning

- A construction guidelines handbook can offer advice to those looking to build on Bonaire [7]
- Construction guidelines included a wide range of perspectives from the local waste management company, construction companies, land owners, developers, and local NGOs [7]

Tourism and Livelihoods

- The development of a course similar to the "Reef Ranger" program can improve the sustainable practices of reef divers and other water sport practitioners [7]

Policies, Legal and Governance Structures

- Create clear rules, laws and procedures. People are more willing to support what they understand and trust [7]
- Involve all stakeholders from the beginning; demonstrate that what you want to implement (with their help) has unique value, and that they are the beneficiaries of this plan/action [7]
- Transparency and communication between government officials is key in conservation planning [7]

Funding and Finance

- STINAPA, the organization that manages Bonaire's marine parks, receives its funding from the following sources: tag sales, fundraising, grants and mooring fees [8]

Source: Bonaire National Marine Park. "BNMP." Stinapa Bonaire National Parks Foundation, March 26, 2019. https://stinapabonaire.org/bonaire-national/.

Aerial Map of Bonaire

OUTCOMES AND RESULTS

A total of 17.5 to 35 tons of nitrogen a year will be removed from wastewater due to wastewater treatment plant infrastructure [7]

An increase in parrotfish population density and biomass has been observed after 2011 [7]

Despite a decrease in coral abundance due to bleaching, coral cover has begun to increase again [7]

Sampling has showed a slight improvement since 06-08 values, but marine nutrients remain at threshold levels [7]

ADDITIONAL SOURCES

- Bonaire – Land-Based Pollution (Reef Resilience)
- Bonaire Construction Guidelines
- Bonaire National Marine Park Website
- Bonaire National Marine Park Management Plan

OUTSTANDING QUESTIONS

- How successful was the wastewater treatment plant, and what management models were specifically used to run the plant?
- How are construction guidelines enforced?
- What was the efficacy of the communication campaign "Nature is our livelihood"? The goal was to ensure 70% of local people agree with Bonaire's environmental conservation legislation
- How was the wastewater treatment plant in this case study funded?

Nature Based Coastal Resilience

Grenville Bay, Grenada

Contributors: The Nature Conservancy, Government of Grenada, Grenada Red Cross, Grenada Fund for Conservation

Goals

- Empower communities to assess climate risk on marine environments that inform management and planning [15]
- Build local capacity and empower local leadership [15]
- Implement a range of community developed conservation projects that demonstrate Ecosystem Based Adaptation (EBA) solutions to climate change [15]
- Integrate monitoring and evaluation processes into each EBA project [15]
- Share lessons with local, regional, and global decision makers [15]

Timescale: Planning and implementation began in 2013. A five year initiative, projects halted in 2018.

Actions

- GIS and census data were used, alongside participatory workshops, to create a vulnerability mapping system
- GIS training workshops were provided to local communities and industry
- In partnership with Grenada Red Cross, a Vulnerability Capacity Assessment (VCA) was conducted
- Community members were trained to collect, care for, and plant mangrove seedlings
- Reef pilot structures were installed to promote coral health

Funding: The following funders supported this project: Angell Foundation, Carnival Cruise Line, German Federal Foreign Office (specifically for pilot reef structures) and the Nature Conservancy

Early pilot reef structures

Source: "Grenada – Coastal Resilience." Reef Resilience, May 10, 2016.

Community members constructing 3D models of the area

Source: "Grenada – Coastal Resilience." Reef Resilience, May 10, 2016. https://reefresilience.org/case-studies/grenada-coastal-resilience/.

ABOUT THE PROJECT

Grenada is a caribbean island that, like many others, is being impacted heavily by climate change. The 'At the Water's Edge' project is an effort spearheaded by the Nature conservancy in an effort to address climate threats with Ecosystem Based Adaptation (EBA) solutions to climate change.[12] With a subsequent focus on capacity building and community empowerment, this project provides an example of how nature based solutions can be used in attempt to build resilience in reef communities.

While the actions taken through this project focused largely on mangrove restoration and reef enhancement, the concept book written in collaboration with local community members identifies a range of opportunities that do include gray infrastructure as well and nature based adaptations in both the "greenway" and the "blueway" (coastal land areas and coastal waters themselves), respectively.[13] The following were mentioned as potential opportunity areas in Grenada:[13]

- Vegetation and tree planting
- Stormwater retention ponds
- Updating and enforcing building and land use regulations (increasing setbacks and elevation)
- Gray/green shoreline stabilization with land grading and vegetation
- Nearshore habitat enhancement (mangrove planters, designing for species migration over time)
- Reef enhancement
- Review and enforce fisheries management, marine protection plans, and regulations

While actions taken through 'At the Water's Edge' were not designed to directly impact sustainable coastal development, the physical opportunities addressed in their concept planning provide a comprehensive overview of physical interventions that community members identifies as potential solutions within land use and development frameworks. Additionally, the highly participatory model used in this project is a strong example of what community engagement in coastal decision making processes can look like.[12]

Nature Based Coastal Resilience

Grenville Bay, Grenada

MAJOR LEARNINGS

Design standards and Land Use Planning

- Ecosystem Based Adaptation can provide new and innovative solutions to climate change such as storm protection, runoff mitigation, and increased habitat for fish and wildlife [12]

Tourism and Livelihoods

- The development of GIS, mangrove restoration, and climate leadership workshops were used to promote sustainable livelihoods [12]

Policies, Legal and Governance Structures

- TNC and community members were able to provide technical advice and local knowledge to government agencies in support of the AWE program [12]

Funding and Finance

- Recommendations were made to secure further funding that would provide 300 meters of artificial reef structure, enough to protect the entire bay [11]

OUTSTANDING QUESTIONS

- Has coastal development in Grenada been impacted at all by the opportunities outlined in this project's concept plan?
- How do nature based solutions work to mitigate impacts of coastal development, industrial activities, or human behavior in general?
- How can nature based solutions be integrated into coastal development design?

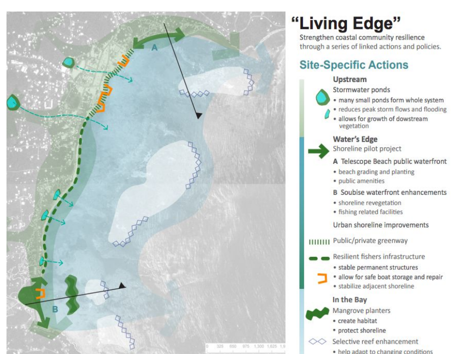
OUTCOMES AND RESULTS

30 meters of artificial reef structures were installed in 2015 [12]

The structures have withstood winter swells, are crusting over with crustose coralline algae, recruiting coral, dissipating wave energy and, serving as a nursery and habitat for fish [12]

ADDITIONAL SOURCES

- Grenada - Coastal Development (Reef Resilience)
- AWE Concept Book
- Grenville Pilot Reef Breakwater
- At the Water's Edge (AWE): Project Factsheet
- At the Water's Edge (AWE): Coastal Resilience Brochure



Source: Arquitectonica. "At The Water's Edge - Nature Based Adaptation Concepts for Grenville Bay Grenada." Conservation Gateway, 2013. https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/Caribbean/science/adaptation/Documents/Grenada%20Grenville%20Bay%20EBA%20Concepts%2010042013.p

Coral Relocation and Port Infrastructure

Tuas, Singapore

Contributors: The Maritime Port Authority of Singapore, National University of Singapore (NUS), National Parks Board (NParks)

Goals

- To relocate corals that will likely be damaged by future port development

Timescale: Coral relocation efforts began in 2013, while port development continues to this day and is estimated to be complete in the 2040s

Actions

- Remove corals from Sultan Shoal, where the port is being built
- Develop coral nurseries underwater to cultivate and grow corals
- Transplant corals into new environments in the Southern Islands
- Monitor health of corals remaining at Sultan Shoal as well as those that have been relocated

Funding: $6 million dollars spent on coral relocation alone, paid for by The Maritime Port Authority of Singapore. The entire Tuas Terminal will cost upwards of $15 billion dollars

Volunteers relocating coral

Source: Tan, Christopher. "Singapore Spends $6m to Relocate Corals That Were in the Way of Tuas Port Development." The Straits Times, April 23, 2016. https://www.straitstimes.com/singapore/environment/singapore-spends-6m-to-relocate-corals-that-were-in-the-way-of-tuas-port.

ABOUT THE PROJECT

Maritime activities in Singapore contribute 7% of the national GDP.[23] Because of this booming industry, the Maritime Port Authority of Singapore has developed and begun implementing plans to consolidate the nations five existing ports into one "mega-port", named the Tuas Terminal.[16] Planning of this port began in the early 2000s, and full implementation is estimated to occur in the mid 2040s, with tiered openings of the many terminals beginning in 2021. As part of the development of the Tuas Terminal, an Environmental Impact Assessment was conducted in 2012 that highlighted the many risks that this development will have on coral reef health.[16] In response, the Maritime Port Authority of Singapore, the National University of Singapore, and the National Parks Board began a coral relocation project that would remove corals from Sultan Shoal, near the port development, and move them to a variety of places in the Southern Islands such as St. John's and Sister's Island, with some coral fragments in East and West Lazarus Island and Kusu Island. [16]

50 local volunteers assisted with the movement of these corals, removing both fragments and whole coral colonies from Sultan Shoal.[21] Fragments were then transferred to underwater nursery sites where they could grow, and full coral colonies were directly moved to their new planting sites.[21] Some of the corals were planted on existing seawalls.[21] Overall, this program seems to be successful, with relatively high coral survival rates, between 80-90%, depending on location.

The movement of these corals was needed due to the land reclamation planned to build and develop the Tuas Terminal. The plans for this terminal utilize state of the art technology that digitize and automate conventional operations, reduce emissions, and increase overall efficiency.[17] Some of the caissons, the retaining structure used as a sea wall in port construction, were built with cement mortar patches to encourage biodiversity and coral growth.[22] With all of singapore's maritime business consolidated to one port, Tuas Terminal is estimated to support up to 65 million TEU's (one TEU is a 20ft long, 8 ft wide and 8 ft tall shipping container).[17] Land use planning for the discontinued ports has already begun in some locations, as a few of the old port's leases end in 2027. With this in mind, huge development planning is currently underway in for a new urban living hub named the Great Southern Waterfront Project.[20] With planning still underway and some port leases not set to expire until 2040, much is still to be determined regarding land use and design planning for retired ports in Singapore.[20]

Coral Relocation and Port Infrastructure

Tuas, Singapore

Source: Woo, Jacqueline, and The Straits Times. "PSA's Early Move from Tanjong Pagar May Spark Quicker Project." The New Paper, August 14, 2017. www.tnp.sg/news/singapore/psa-s-early-move-tanjong-pagar-may-spark-quicker-project.

Overview of the port relocation plan

Artistic interpretation of the future port

Source: "5 Things You Should Know About the Tuas Mega Port." Maritime Singapore Connect. Accessed January 19, 2022. https://www.maritimesingaporeconnect.com/news/5-things-you-should-know-about-the-tuas-mega-port/.

MAJOR LEARNINGS

Design standards and Land Use Planning

- The high survival rates of corals in this project highlights that coral relocation, even onto man made structures such as seawalls, is conducive to marine life. This could help mitigate the impacts of coastal development and marine life loss [21]
- The World Resources Institute said the cost of destroying 1km of coral reef ranges between US$137,000 and $1.2 million over a 25-year period, although there is no particular estimate of what this project's coral relocation is worth, nor is it easy to put a value onto ecological health or services [16]

Policies, Legal and Governance Structures

- Maritime issues have risen in response to Tuas Terminal development between the government of Singapore and Malaysia, as both are claiming rights over certain waters, stemming from conflicts in the 1970s. In 2019 they reached a legal agreement to mutually suspend their overlapping port limits and to not authorize or suspend commercial activity in that area. [18]

Tourism and Livelihoods

- With the ongoing Tuas Terminal project, more growth is expected in Singapore's maritime sector [19]

OUTCOMES AND RESULTS

2800 corals moved, 2300 of which survived [16]

50 volunteers engaged in relocation activities [21]

ADDITIONAL SOURCES

- 5 Things You Should Know About the Tuas Mega Port
- Article: Singapore spends $6m to relocate corals
- Article: Consolidating singapore's ports
- Article: Singapore and Malaysia dispute port boundaries

OUTSTANDING QUESTIONS

- What will the survival rate of corals be in the long term? How will ecosystems change that did not originally have coral reefs there but now do?
- How will success of this program inform coastal development in other locations?
- What are the specific design plans for the retired ports?

Land Trusts and Affordable Housing

Deerfield Beach, Florida

Contributors South Florida Community Land Trust, City of Deerfield Beach, BirseThomas Architects, EXPO Studios, and Cadence

Goals
- The mission of the South Florida Community Land Trust is provide and preserve quality, sustainable, affordable housing for underserved populations in South Florida

Timescale Planning began in 2017 and homes were developed and ready for sale by 2019

Funding $1 million dollars in total funding was provided by Broward County, Enterprise Community Partners, and Iberia Bank.

Source: "Affordable, Green-Certified Homes for Sale." South Florida Community Land Trust, July 23, 2019. https://southfloridaclt.org/deerfield-forsale/.

3D model of Deerfield housing design

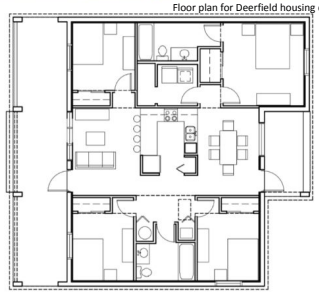
ABOUT THE PROJECT

Through a land donation from the city of Deerfield Beach, the South Florida Community Land Trust (SFCLT) has been able to fulfill their mission of providing affordable and sustainable housing to low income populations in South Florida.[24] With this donated land the SFCLT planned to build six new houses for this very purpose.[24] The SFCLT will continue to own the land, driving prices down, and subsequently allowing low income community members to rent or buy them. Rental rates will vary between $500 and $850 depending on family income, and housing prices will sit under $200,000.[24] When homeowners decide to move out, they will receive the money they paid and a portion of the appreciation.[25] Eligibility for these developments are determined by whether family income sits below the median income level of Broward County.[25]

These housing units were designed and developed by BirseThomas Architects, EXPO Studios, and Cadence.[24] Community workshops were designed to gather input from local people about neighborhood knowledge and for the community to learn about the team's design process.[27] The housing design included open floor plans, spacious porches, and outdoor living spaces.[24] The houses will be "Enterprise Green Certified", a certification specific to affordable housing developments which ensures a development gives residents a voice in the design process, provides a clear path towards zero energy, includes resiliency measures against climate disruptions, and requires specific water and healthy living standards.[26]

To purchase one of these homes, prospective residents are required to attend a pre-purchase workshop that provides detail of the Community Land Trust process.[25] Once ready to sign and buy, homeowners sign a 99-year ground lease agreement that can be renewed if desired.[25] Because homeowners are technically leasing the land from the South Florida Community Land Trust, they owe a $65 leasing fee every month.[25] To provide additional financial assistance, the City of Deerfield may provide additional down payments and closing costs on a case to case basis.[25]

Floor plan for Deerfield housing design



Source: "Affordable, Green-Certified Homes for Sale." South Florida Community Land Trust, July 23, 2019. https://southfloridaclt.org/deerfield-forsale/.

Land Trusts and Affordable Housing

Deerfield Beach, Florida

MAJOR LEARNINGS

Design standards and Land Use Planning

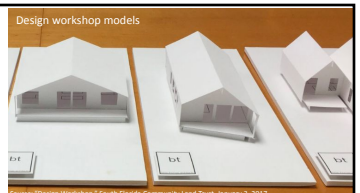
- The houses are "Enterprise Green Certified", a certification designed specifically for affordable housing developments that ensures a development gives residents a voice in the design process, provides a clear path towards zero energy, includes resiliency measures against climate disruptions, and requires specific water and healthy living standards [26]
- 2 design workshops were held to gather community feedback [27]
- Sustainable design interventions were utilized, including the planting of native plants that require less water and utilizing trees for shade [24]

Policies, Legal and Governance Structures

- Because the South Florida Community Land Trust owns the land, residents are able to purchase homes at a lower price point [28]
- To purchase one of these six homes, households must earn 80% or less of the county's median income [25]

Funding and Finance

- The city of Deerfield may provide additional financial assistance, though it is not guaranteed [25]



Design workshop models

Source: "Design Workshop." South Florida Community Land Trust, January 3, 2017. https://southfloridaclt.org/design-workshop/.

Design workshop activity

Source: "Design Workshop." South Florida Community Land Trust, January 3, 2017.

OUTSTANDING QUESTIONS

- What is the ethicality of building affordable housing in coastal area where flooding and sea level rise is likely to increase? Does this depend on who owns the land?
- Was a vulnerability assessment conducted on this parcel of land before development that was communicated to potential buyers?
- How are climate change impacts being incorporated into affordable housing development? Can innovative design mitigate these risks, and if so, how?

OUTCOMES AND RESULTS

Six affordable homes built in Deerfield Beach [24]

Two integrative workshops held with local community members to discuss design process [27]

ADDITIONAL SOURCES

- Article: Affordable Homes Being Constructed in Deerfield
- Article: South Florida Community Land Trust
- Enterprise Green Certification Criteria
- Workshop Invitation
- For Sale Announcement

Master Planned New Urbanism

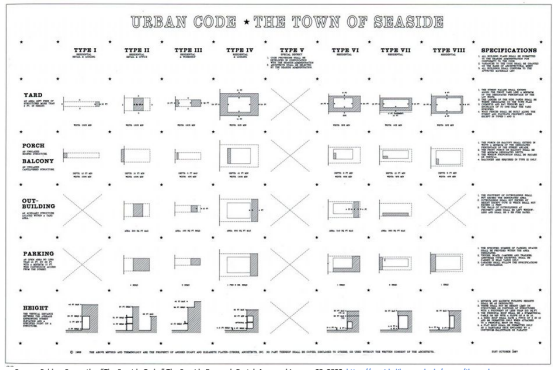
Seaside, Florida

Contributors Robert Davis, Daryl Rose Davis, Arquitectonica, Duany Plater-Zyberk and Company

Goals
- To build an old fashioned beach town focused on community living and utilizing new urbanism design

Timescale Robert Davis bought the plot of land in 1978, plans for Seaside were finalized in 1985, and development began before that in 1981

Funding Davis inherited the plot of land from his grandfather. Information about how the town was funded is unclear.



Source: Salden, Samantha. "The Seaside Code:" The Seaside Research Portal. Accessed January 20, 2022. https://seaside.library.nd.edu/essays/the-code.

ABOUT THE PROJECT

In 1978, Robert Davis inherited a 80-acre plot of land located on the Florida panhandle from his grandfather.[37] With a goal to transform the area into an old fashioned beach town, Davis recruited top tier architects and planners to draft up plans for the community.[37] While curating the design for Seaside, these planning professionals conducted ground research throughout the American South to drum up ideas for the planning of Seaside, which were eventually finished in 1985.[40] Because Seaside is privately owned by Robert Davis, his team of architects were able to draft their own zoning codes irrespective of any other planning municipalities.[36]

With goals to reimagine what land use planning looked like in the US, Seaside architects established a unique building code, the Seaside Code, that transitioned from traditional use based zoning to something new.[35] This code allows for the restriction of some uses (i.e the placement of a liquor store next to a preschool), but also recognizes that needs and economic landscapes often change over time, and as such, this code allows for that flexibility.[35] Another aspect of the Seaside Code that differs from other land use plans is that instead of consolidating building use type in a specific area, a practice that has historically segregated communities by class and race, the Seaside Code aims to mix building form amongst a variety of economic scales.[35] Additionally, no building in Seaside is able to have the same design, crafting a unique community feel.

Today, Seaside includes over 300 homes, nine pavilions, a repertory theatre, all faiths chapel, farmers market, cinema, charter school, wine festival, and more.[38] Seaside is a clear example of New Urbanism design: easily walkable, housing and shopping in close proximity, and accessible public spaces.[37] A 1500 square foot two-bedroom two-bath detached single family home is currently selling for $2,795,000.[38] Proponents of New Urbanism also prize it for environmental friendliness through decreasing urban sprawl which can place less stress on natural environments.[37]

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Seaside, Florida

MAJOR LEARNINGS

Design standards and Land Use Planning

- The plans for Seaside were drawn on transparent paper so that they could be layered on top of one another for comparison and review [37]
- Seaside code seeks a mixture of uses instead based on building form alone [35]
- Because the town was designed to avoid car use entirely, heavy tourism that brings in vehicles from all over the south has produced heavily trafficked and congested roads [41]

Tourism and Livelihoods

- The town's main industry is largely tourism, as many residents use Seaside as a summer getaway versus a permanent home [41]

Policies, Legal and Governance Structures

- Because Seaside is privately owned, no other municipalities have control over the land, and as such, architects were able to create a unique building code [36]

Funding and Finance

- Robert Davis himself has claimed that Seaside has failed at maintaining affordable housing stock, as housing prices rival than of Manhattan [41]

Source: "The Seaside Plan." The Seaside Research Portal. Accessed January 20, 2022. https://seaside.library.nd.edu/essays/the-plan.

OUTCOMES AND RESULTS

- The first "New Urbanism" town ever brought to fruition [37]
- 300+ residential homes built [39]

ADDITIONAL SOURCES

- Seaside Building Code
- Seaside Design Plan
- About Seaside

OUTSTANDING QUESTIONS

- How has urbanism changed over the last 30 years?
- How can climate change resilience planning be integrated into new urbanism design?
- How expensive are New Urbanist communities like Seaside compared to traditional towns? How do housing prices and cost of living impact who gets to enjoy the benefits of town like Seaside?

Cadence Urban Design Examples

Florida and Louisiana

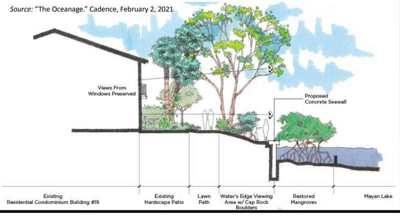
1 The Oceanage, Fort Lauderdale, Florida

Source: "The Oceanage." Cadence, February 2, 2021. https://cadence-living.com/projects/the-oceanage/.

Design standards and Land Use Planning

- Sea wall, vegetated buffers and, lake access for water sports [29]
- Florida native canopy trees for shade and visual buffering [29]
- Understory planting for wildlife (birds and butterflies) and privacy [29]
- Mangrove mitigation to stabilize the shoreline, soften the waters edge, and re-establish natural ecosystems [29]

Source: "The Oceanage." Cadence, February 2, 2021



2 Cut Walk Jetty, Bal Harbour Village

Source: "Cut Walk Jetty at Bal Harbour Village." Cadence, April 14, 2021. https://cadence-living.com/projects/bal-harbour-...

Design standards and Land Use Planning

- Improved coral and dune plantings [30]
- Native beach garden walk [30]
- Extended catwalks over the ocean to view and interact with marine life [30]
- Goal: "to remind them of their co-existence with Earth's other creatures, specifically the unique marine population that lives on Village's coastline" [30]

Source: "Cut Walk Jetty at Bal Harbour Village." Cadence, April 14, 2021.

Cadence Urban Design Examples

Florida and Louisiana

3 Jefferson Parish Canal, Metairie, Louisiana

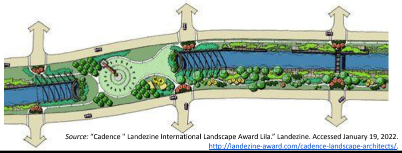
Source: "Jefferson Parish Canal Design." Cadence, February 7, 2017. https://cadence-living.com/projects/jefferson-parish-canal-design/

Design standards and Land Use Planning

- Six guiding principles: **beautify**, **repurpose**, **implement**, **define**, **grow**, and **engage** with this design [31]
- Programmed space for community events, a playground, several educational components including a pilot bioswale program that filters stormwater runoff, improved access and circulation through a hierarchy of access points, and unified signage [31]
- Design exists under the belief that the people of Jefferson Parish can bridge the gap between design and reality to enrich opportunities of the place they call home [31]

Funding and Finance

- An estimated $10.3 million dollar project cost [32]



Source: "Cadence " Landezine International Landscape Award Lila." Landezine. Accessed January 19, 2022. http://landezine-award.com/cadence-landscape-architects/.

ABOUT THE PROJECTS

Cadence is a Fort Lauderdale based Landscape Architecture, Urban Design and Planning company. Using forward thinking designs that connect physical and social landscapes, Cadence seeks to make the impact humans have on the natural environmental a positive one.[33] Cadence's design process follows six important steps:[34]

1. **Project Definition**: Outline objectives & prepare preliminary elements
2. **Site Analysis**: Document the physical & cultural aspects of a design & determine opportunities, constraints & principles
3. **Master Planning**: Through an on-site workshop the vision of the design is cemented & elements are decided on in detail to guide further development
4. **Design Development**: Plan the specific elements, design character, spatial relationships, & budgeting information
5. **Construction Documents**: Technical drawings drafted in 3D & plan view
6. **Implementation**: Cadence assists in locating contractors & provides construction observation if needed

These three urban design projects highlight how innovative design and infrastructure can reimagine coastal landscapes from residential to public spaces. Additionally, process of design that involves local stakeholders not only in decision making but the process of design itself is an interesting element to consider, specifically in the Jefferson Parish Canal example.[31]

OUTSTANDING QUESTIONS

- How can these coastal design examples be modified and adapted for alternate geographical locations with ranging social, cultural and economic landscapes?

ADDITIONAL SOURCES:

- Cadence: The Oceanage
- Cadence: Cut Walk Jetty
- Cadence: Jefferson Parish Canal
- About Cadence

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