Designing for Future Flood

A systems-based approach to mitigating flood vulnerabilities in Hillsborough County

Studio Projects

University of South Florida
The Florida Center for Community Design & Research

in collaboration with:
The School of Architecture & Community Design and The College of Public Health

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Designing for Future Flood Studio

A comprehensive study of the potential effects and mitigation strategies for storm surge, sea level rise and inland flooding in Hillsborough County.

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Designing for Future Flood Studio

In Hillsborough County, flood has been identified as the greatest potential hazard to the community. The future for people, place, and property may be uncertain. There are numerous physical elements at risk from downtowns to farmland, from transportation infrastructures to job centers. People and their well-being are also vulnerable potentially losing access to healthcare, social networks, and opportunity. Economic development, housing costs, issues of gentrification and equity are factors which will be impacted by future sea level rise conditions.

The built environment and its relationship with water will require adaptation. This includes aspects of drainage, building and construction and landscape. Design response must take into account aspects of policy, health, community, and disaster preparedness. These design proposals bring together multiple disciplines through architecture studio to engage this very complex subject, and to generate solutions for adapting to the Perils of Flood.

How will rising water transform the urban environment? How can urban and rural environments be organized to create better places, while anticipating a flooded future?
Acknowledgments

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Preface

The studio was part of an overall project for Hillsborough County, within The Florida Center for Community Design and Research (FCCDR) at the University of South Florida (USF). This project, titled the Hillsborough Community Vulnerability Study, identifies region-specific vulnerabilities to flood, and seeks to design strategies for reducing those risks, whether through mitigation or adaptation. In both the studio and in the Center research, the project is accomplished through an interdisciplinary approach, with involvement from faculty and students from architecture, urban design, planning, public health, and engineering. The design project moves beyond identifying impacts. The goal was to introduce new strategies to the region, to safeguard the community’s future and prepare for future flood scenarios. The forward-looking project, applied projected data for the year 2045.

Prior to the studio class, the FCCDR generated a comprehensive review of potential vulnerabilities to sea level rise and three base storm surge levels. These scenarios served as the starting point for course research, to map vulnerabilities within Hillsborough County. The class became a microcosm of the overall project, critiquing current urban infrastructures and developing project concepts. In the end, the interdisciplinarity of the class helped to establish systems-based projects, with multi-functional outcomes and cumulative effects.

Projects will be as part of the larger report. The projects and approaches to risk reduction will play a critical role in providing technical guidance as well as imagination in planning efforts.
Landscape Systems Across Hillsborough County

The following images showcase the multiple landscape typologies found throughout Hillsborough County. These studies were created by students from Professor Brian Cook’s “Landscape and Urbanism” class. These studies served a foundation for the Perils of Flood Studio, providing important information about the hydrologic and ecologic systems in the Hillsborough County region.

**Flatwoods** dominated by longleaf pines, slash pines, and low-growing saw palmettos, are more common in Florida than any other plant community. Flatwoods usually contain 50 to 75 species of plants per acre, these are usually interrupted by cypress swamps and hardwood hammocks. Some parts of the flats are predominantly dry, some moist or wet. At the wet end of the moisture gradient, flatwoods support wetlands. The majority of Florida’s wildlife living in swamps and hammocks, also inhabit flatwoods for a portion of the year.

**Ponds and Lakes** have several different zones that divide the water column from top to bottom and side to side. These “zones” are determined by depth and distance from the shoreline. The Limnetic zone is generally classified as the open water area of the lake or pond, the Littoral zone is the home of rooted plants. This zone is the shallow and receives nutrients from runoff and non-point source pollution, therefore it has an abundance of aquatic plant and algae growth. The Riparian and Upland zones act as a barrier to contaminants such as seepage from septic tanks, fertilizers and pesticides.

**Wetlands** are areas whose soils are relatively wet, either permanently or at intervals for significant periods. Florida’s interior wetlands include marshes, bogs and swamps that support a predominance of plants that have adopted for life in water-saturated soils. These plants filter water, for example, pickerelweed naturally absorbs excess pollutants while serving as a food source to animals.

**Rivers** transport water by gravity, from headwaters to ocean. The natural process is relentless, closing the hydrologic cycle lasts an average of eleven days; that is, globally, the entire amount of surface water is replaced every eleven days. Rivers provide a source of fresh water that is replenishable within a short time frame.

**Estuaries** are partially enclosed coastal bodies of brackish water with one or more rivers flowing into it. Estuaries form a transition zone between river environments and maritime environments known as ecotone. The mixing of marine influences such as tides, waves, saline water and riverine influences, fresh water and sediment, provides high levels of nutrients in the water column and in sediment.
Fig. 5 Florida Landscape: Flatwoods. Source: Brian Cook
Fig. 7 Florida Landscape: Wetlands. Source: Joshua Orner
Fig. 8 Florida Landscape: Rivers. Source: Brian Cook
Fig. 9 Florida Landscape: Estuaries. Source: Brian Cook
Introduction

Each studio team was comprised of six different disciplines: architecture, urban design, regional planning, public health, environmental engineering, and structural engineering. The graduate student teams generated maps of concentrated vulnerability, which assessed more than 100 different vulnerabilities in three categories: the built environment, population and public health, and ecology. Students researched case studies from around the world and translated successful strategies to their issues, while fitting them to a site-specific context. Major considerations for mitigation and risk reduction emerged through the studio process.

To provide additional and first-hand observations for understanding these issues, students and faculty visited Copenhagen and various cities throughout the Netherlands. These cities and regions have taken a proactive stance toward issues of flood, resiliency and planning; and have been recognized as leaders with specialized knowledge. Faculty from the Urbanism Department at Delft University of Technology shared their research, and provided tours of major projects related to flooding and flood mitigation infrastructure. In Amsterdam and Rotterdam, professional offices such as Architecture CIE, Architects for Urbanism and BASTA Urbanism shared their work with students, providing incredible insight for designing for flood and state-of-the-art practice.

Creating a robust, interdisciplinary analysis, the class developed a nuanced understanding of Hillsborough County—its history, its weak points, and its strengths. Projects were encouraged to be multi-functional and to address multiple issues with singular gestures. A series of concentrations emerged including providing equal access to safety during a hurricane, creative methods of educating citizens about the potential for flood, the importance of ecologic and hydrologic systems, human dependency on ecological frameworks, and the importance of proactive planning through a systems-based approach were at the forefront of adaptive design strategies to envision more resilient communities.
Major Vulnerabilities in Hillsborough County

Major vulnerabilities in Hillsborough County were identified by students in the studio. Student work built upon this foundation of research, created strategies for mitigating risk and increasing resiliency. The following are major vulnerabilities identified in Hillsborough County:

- Concentration of critical facilities and resources at the Port and in Downtown Tampa.
- Increased capacity issues and water elevation in the drainage system.
- Concentration of hazardous chemical sites.
- Reliance on a roadway network that is largely submerged during a category 3 hurricane.
- Reliance on static ‘gray’ drainage infrastructure with an increased capacity.
- Growth in south Hillsborough County, and the absence of emergency support services due to lack of density.
- The health of ecologic systems, especially in the estuary (that is affected by upland systems).
- The expansion of impervious surfaces.
- Residential populations in low lying, flood prone areas, especially in South Tampa, Davis Islands and Palmetto Beach.
- Low value creation with current development strategies.
- Loss of local and traditional knowledge in coastal communities.
- Habitat migration due to sea level rise, and impairment of this with large scale, fixed infrastructures.
- Lack of awareness.
- Separation between urban hydrologic systems and other uses, such as passive recreation, ecologic function, etc.
- Vulnerable populations that are unable to evacuate because of lack of vehicle access, stigmas, or individual circumstance.
- Lack of localized sheltering option and equal access to sheltering and evacuation.
- Lack of walkable districts or commercial centers.
- Lack of emergency services associated with new development (due to sprawl).
- The evacuation process being foreign, especially for new residents.
- Depletion or loss of vegetated buffers.
A Systems Approach: Four Projects

Soaking the Sponge

When weather events occur, pipes will not have enough capacity to handle large volumes of water. This project examines a system approach to sustainable, resilient and cost-efficient urban development in which the built environment, public use and drainage infrastructure is interwoven. This resilient stormwater system promotes the health of humans and habitat, and improves the hydrologic function of our region.

F.E.A.T.U.R.E Parks

This project claims existing historic areas as strongholds of urban space, these places of culture and community that have developed over time and should be protected. However, they should not remain the same. Densification and extended transport networks will help to add economic vitality, emergency services and community ties. A purposefully designed open space system allows for sea level rise and storm surge inundation around and clustered development, while creating value for the community.

Multi-Hubs

The research for this project identified groups within Hillsborough County that lack the social or physical capability to evacuate in an emergency event. Those with fewer financial resources, without transportation or with disabilities comprise a high percentage of individuals within Hillsborough County. This project proposes a transportation network utilizing historic railroads, connecting local and regional communities through new transit options and intermodal facilities. This will improve resiliency of vulnerable communities by daily familiarity, economic development, and hubs of commercial districts with emergency support.

Secondary Sites

The downtown and port areas in Hillsborough County are identified as high-risk locations. These areas have a concentration of infrastructures, hotels and fuel. This project examines a new approach to future development that combines spatial design with overlapping hydrologic, transportation, refuge and energy systems.
Fig. 11: Chains of Pools Proposed to Ease Flooding. Source: Copenhagen Cloudburst Plan.
Soaking the Sponge

A sustainable, resilient stormwater system that promotes the health of the environment, animals, individuals and the communities, through multi-functional blue-green infrastructure.

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Introduction

Blue-Green solutions are approaches to reducing impervious surfaces, and to create spatial, experiential and usable drainage infrastructure. Green infrastructure such as green roofs and swales can yield multiple urban benefits. These benefits include reduction of water and air pollution, mitigation of flood risk and heat islands. With sea level rise, the capacity of pipes during heavy rainfall events will ultimately be overwhelmed. There needs to be a decrease in dependency on fixed infrastructure in a dynamic changing environment.
Locating Vulnerability

Particular vulnerabilities were identified through GIS maps, such as the road network, drainage infrastructure. Site visits and diagramming of the drainage infrastructure also pointed to issues pertaining to single-use engineering of drainage.

Priority sites were identified, including Downtown and South Tampa, in which an overall approach and relationship to water through the hydrologic system is proposed.

Fig. 12 GIS Map: Roads.

Source: Tampa Bay Regional Planning Council, aligning with Climate Science Advisory Panel recommendations.
Fig. 13 Identifying Elevation and Water Flow.
Fig. 14 GIS Map: Residential Property.

![Residential Property]
- Residential Low Density < 2 Dwelling Units
- Residential Medium Density 2 > 5 Dwelling Units
- Residential High Density

Fig. 15 GIS Map: Commercial Property.

![Commercial Property]
- Commercial

Fig. 16 Current 100 Year Floodplain. Source: Tampa Bay Regional Planning Council.
Core Values

- Re-introduce the natural water cycle.
- Reduce the impact placed on traditional stormwater infrastructure.
- Improve the health of Hillsborough County waterways, aquatic plants and animals.
- Create an environment that is resilient to flooding and sea level rise.
- Promote public health and community connectivity by introducing interactive multi-purpose green space.

Water System

Delay
Employing programmed space for water storage, and being aware of infrastructures that ‘slow the flow’, such as trees.

Seepage/Absorption
Maintaining a pervious surface that works as a sponge by absorbing and infiltrating water.

Transport
Moving the water from one system to another.

Purification & Reusage
Use natural systems to process and clean water.

Fig. 17 Water System
Case Study: Principles of Copenhagen Cloudburst Plan

Game Changer

In July 2011 Copenhagen was hit by a destructive flood leaving 50,000 homes without heat for a week, resulting in more than 90,000 insurance claims and upwards of $1 billion in property damages.

A study revealed that the community was spending $60 million per year in flood related issues. To combat this, the City of Copenhagen created a system of projects to effectively deal with future storm drainage while using a more open and vegetated system, which also adds value to the community.

Copenhagen Cloudburst Management Plan

The Cloudburst Management Plan is guided by the Climate Adaptation Plan. It is designed to adapt, and prioritizes solutions with multiple functions to maximize utility and investment. The recommendations from the Climate Adaptation Plan 2011 describes standards for sewer capacity, which need to increase capacity above the 10 year rainfall standard. The long term goal is to allow only a maximum of four inches of water on the ground for a 100-year rain event.

Methods of Implementation

Keep water out of sewers and prevent water from reaching low-lying areas like Copenhagen Central station.

Create new urban spaces, opportunities for better quality of life, that double as stormwater management.

Incorporate into City Comprehensive Plans and investments.

Finance clear water features by water rates to be paid by the utility.
Eight Urban Intervention Tools

These tools were developed to mitigate streets, parks, and plazas. The Cloudburst Toolkit combines hydraulic engineering ‘gray solutions’ with ‘Blue-Green’ solutions to establish a model for universally-applicable flood mitigation tools.

Tool: Green Streets

Green Streets utilize lowered street profiles to create a Safety Zone and a Flood Pathway Corridor. Shared public spaces integrate pedestrians, cyclists, motorists, and alternative transportation along a common public realm.

Transformation to a Blue-Green City

Green Street

800 l/s flow capacity
max WL 2.15

Safety Zone
Flood Pathway

Fig. 20 Copenhagen Map. Copenhagen Cloudburst Plan.

Fig. 21 Intervention Tools. Source: Copenhagen Cloudburst Plan.

Fig. 22 Green Street. Source: Copenhagen Cloudburst Plan.
Understanding the Landscape

To create resiliency and protect the Hillsborough community from sea level rise and flood conditions, it is important to understand the regional landscape and its hydrological function. How water moves throughout the urban landscape and their functions are a critical component to understanding how the system has been manipulated and its lasting effects.

**Flatwoods**

1. Open zone.
2. Edge zone.
3. Pine zone.

**Wetlands**

1. Edge- Open water
2. Swamp zone- Forested wetland.
3. Bog zone- Wet and spongy ground, house predominately herbs and shrubs.
4. Marsh zone- Wetland dominated by herbs rooted in saturated soil.
5. Edge- Upland

**Rivers, Streams, and Springs**

1. Hammock- Retains rain water and prevents erosion to the river.
2. River- This zone transports and discharges water.
3. Water Edge- Provides structural support for the river soils.
4. Bulk.
The section above was used to study habitat zones in relation to the river system (at Cotanchobee/ Fort Brooke Park). The following elements can be described as having function relating to sea level rise and drainage:

1. Oyster reefs can outpace sea level rise providing a natural barrier to flood waters.

2. Hundreds of meters of mangroves are needed to significantly reduce waves (wave height is reduced by 13-66% per 100m of mangroves). The more obstacles the better: Dense aerial root systems and branches help attenuate waves.

3. Storm drains and basins promote drainage towards the bay to reduce the impact of flooding but potentially increasing the pollution that enters the water, which can impact the health of sea grass, oyster reefs, and mangroves.

4. Water quality is monitored for compliance with section 320 of the Clean Water Act. The National Estuary Program was created to protect and restore water quality and ecological integrity of estuaries.

5. Mangroves contribute to an increase in soil volume by capturing riverine or coastal sediments. Properly managed mangroves can keep up with sea level rise with high rates of sediment input.

6. Florida Statute 403.9322 governs mangrove trimming and preservation. Mangroves cannot be trimmed less than 6 ft in height.
Analyzing the Existing Network

South Tampa is a region where flooding creates high levels of vulnerability, especially related to the roadway network. It is surrounded by Tampa Bay on the west and Hillsborough Bay on the east. The project looks for opportunities, and creates typologies, where corridors can be enhanced to circulate and store water, as well as create beneficial use for the community.

Typologies were created for Dale Mabry Highway, Interbay Boulevard, Gandy Boulevard, Westshore Boulevard, Bay to Bay Boulevard and Bayshore Boulevard. Each of these corridors were correlated with the Copenhagen Cloudburst Plan Typologies: downtown, hybrid park, neighborhood commercial, commercial and residential.

1. Residential Typology- Bayshore Beautiful District

This area is small scale with parking and roadway between residential lots. The opportunity here is to create a hierarchy of approaches to infiltration and break-up of impervious surfaces.

2. Downtown Typology- Morgan Street

This area has the most impervious surface. It also has a dense population of people. Again, parks and hydrologic function are separated, but there are parks to work with.

3. Commercial Typology- Dale Mabry Boulevard and West Gandy Boulevard

This area is characterized by large expanses of parking and roadway, techniques that mirror nature are necessary to filter pollutants and provide habitats.
4. Neighborhood Commercial Typology - Westshore Boulevard and Interbay Boulevard

This area has a high concentration of pervious area, compared to other streets, but green infrastructure approaches are often not addressed. There is no direct connection between destinations along this typology, there are possibilities to create walking and cycling connections between neighborhoods and activity centers.

5. Hybrid Park Typology - Bayshore Boulevard

This typology gives opportunity to mitigate existing flood issues. Storm drains can be utilized in the unused park space as well as lakes. Lakes in the park can provide flood storage and protect surrounding areas from flooding.

Design Concepts

Concepts consolidate nature and the flow of water to re-introduce, reduce, improve, create and promote typologies and the mitigation of problems caused by flooding. Green strips are added adjacent to lanes with cuts in the curbs to allow stormwater flow into green spaces. Bio-retention swales are added to parking lots and parking dividers for water flow. This green infrastructure can reduce urban heat island effect associated with impervious surfaces, this is accomplished by reducing surface and air temperatures through shading and evapotranspiration.

1. Residential Typology - Bayshore Beautiful District

In this area, walkability becomes an important component due to its residential scale. To improve walkability and create opportunity for infiltration, pervious area is added to the sidewalk portion of the streets.
2. Downtown Typology - Morgan Street

This typology offers the opportunity to create green spaces and green water squares by replacing unused or partially used parking lots. As seen in the section, the green use area can help with water infiltration, rainwater drainage systems and also improve the quality of water.

3. Commercial Typology - Dale Mabry Boulevard and West Gandy Boulevard

Taking the large spaces dedicated to parking and turning them into parks for green use, can reduce the urban heat island effects associated with these impervious surfaces. This will reduce energy costs for businesses by decreasing air conditioning dependency.

4. Neighborhood Commercial Typology - Westshore Boulevard and Interbay Boulevard

This design concept enhances parking lots by adding pervious surfaces and decreases the amount of roadway/ impervious area in the neighborhood. Green spaces will be dedicated for the residents and people will be able to have connections between their destinations.
5. Hybrid Park Typology- Bayshore Boulevard

This design concept removes medians, expands sidewalks, and reduces the automobile footprint in the community along with dynamic and playful design to enhance the space in order to mitigate flooding.

Principles in Action

Along Morgan Street in Downtown Tampa, multiple unused or partially used parking lots were identified for this blue-green urbanism design concept. Green spaces and green water squares replace parking. Water squares help with infiltrate water and improve water quality. Play areas, green areas and residential functions are also part of the water squares. Lower-lying areas in the squares can be filled with water in case of heavy rainfall.
Water Squares absorb and retain water. They allow for substantial fluctuations in water levels and buffer the downstream flow. They can incorporate walkability into everyday life, promote health and environmental and economic benefits. Additionally these squares connect people and nature in an urban setting.
F.E.A.T.U.R.E. Parks


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Introduction

In South Hillsborough County there are concentrations of low socioeconomic populations living in areas vulnerable to flood. These areas are also currently clustered, with remaining open space between communities. This project presents the opportunity to catalyze economic growth, provide amenities for underserved communities and connect the population to issues of sea level rise and storm surge while also mitigating risk to flood.

A main tenet of the project is to create flow through landscapes with more dense, clustered development. Research has shown that less dense areas also have infrequent commercial centers and emergency support services. Transportation and access issues create a strain on the area and no future economic growth is supported.
Identifying Vulnerabilities

The following maps of Hillsborough County showcase areas at risk of inundation. In addition, they show vulnerabilities in the built environment, for the populations, and for ecology. In South County there are high concentrations of vacant land and low income households.

Low income households are defined as those earning less than twice the federal poverty line. Public housing and low income areas are not likely to have proper hurricane protection for windows or mitigation measures in place for flooding.

Fig. 49 GIS Map: Low Income Households.

Source: Tampa Bay Regional Planning Council, aligning with Climate Science Advisory Panel recommendations
Hospitals and Ambulatory Care

Hospitals become overwhelmed in a disaster scenario and are additionally challenged by power outages and gaps in clean water supply. They must be able to provide continuous care for existing patients and for those injured during the storm.

Data Source: Hillsborough County's Geohub public platform.

Year 2045 projections aligning with Climate Science Advisory Panel recommendations.

Source: Tampa Bay Regional Planning Council, Year 2045 projections

GIS Map: Residential Property.

GIS Map: Hospitals and Ambulatory Services.

GIS Map: Commercial Property.

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Commercial Property

- Major Roads and Highways
- Commercial
- Sea Level Rise (SLR)
- Cat. 1 Hurricane, Intermediate Low SLR
- Cat. 1 Hurricane, High SLR
- Cat. 3 Hurricane, Intermediate Low SLR
- Cat. 3 Hurricane, High SLR
- Cat. 5 Hurricane
- 100yr Flood

Hospitals and Ambulatory Services

- Hospitals and Ambulatory Care Outside Hurricane Projections
- Hospitals and Ambulatory Care

Residential Property

- Residential Low Density < 2 Dwelling Units
- Residential Medium Density 2 > 5 Dwelling Units
- Residential High Density

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Fig. 50 GIS Map: Commercial Property.

Fig. 51 GIS Map: Hospitals and Ambulatory Services.

Fig. 52 GIS Map: Residential Property.
The Issue

According to the following maps, how can we create public spaces in vulnerable communities that will serve the community and mitigate flood?

The lack of density in high risk areas is an opportunity to create safe spaces for water to infiltrate, provide parks to serve as community space, and preserve and restore natural ecosystems.

Goals

1. Create a safe public space for water to infiltrate to protect communities.
2. Provide green spaces to serve as a community third place.
3. Acquire and re-purpose vacant land to serve a productive function.
4. Preserve and restore natural ecosystems.
5. Increase neighborhood value.

Strategies

1. Parks
2. Parks
3. Parks
4. Parks
5. Parks

Fig. 53 GIS Map: Sea Level Rise and Hurricane Inundation.

Legend:
- Sea Level Rise (SLR)
- Cat. 1 Hurricane, Intermediate Low SLR
- Cat. 1 Hurricane, High SLR
- Cat. 3 Hurricane, Intermediate Low SLR
- Cat. 3 Hurricane, High SLR
- Cat. 5 Hurricane
- 100 yr Flood

Year 2045 projections

Source: Tampa Bay Regional Planning Council, aligning with Climate Science Advisory Panel recommendations.
Principles of Case Studies

Room for the River

The project encompasses four rivers: the Rhine, the Meuse, the Waal and the IJssel, located in the Netherlands. The rivers were widened in places where it was least harmful in order to protect vulnerable populations. Main takeaways from this case study:

- This is a different approach than building higher dykes
- Prioritize public safety
- Reconnect people to the rivers by adding spatial quality to areas surrounding the river.
- Adapt to climate change through flexible design
- Create and grow a natural environment connected to water movement

South Bay Sponge

East Palo Alto is home to many minority and low-income families situated in one of the lowest-lying communities in the Bay Area. Addressing rising sea levels and flood waters in addition to current problems faced by residents of the Bay Area such as overpopulation, inadequate mixed housing, and lengthy commutes has created a difficult problem. The concept behind the South Bay Sponge is to utilize nature, in the form of wetlands, marshes, tidal wetlands and managed ponds, to act as “sponges” to absorb floodwaters. Main takeaways from this case study:

- Utilize nature to act as ‘sponges’ to absorb flood water.
- Design frameworks for adaptation.
- Utilize dike infrastructure
- Incorporate nature and technology to improve resiliency of cities, social fabric, and community health.
F.E.A.T.U.R.E. Park Principles

The feature park principles inform community resiliency by connecting people to public spaces and integrating, restoring and enhancing natural flood defense barriers. Additional principles include: reducing economic loss through re-purposing acquired land, providing a risk mitigation park as a community asset, education through recreation, introducing recreational green spaces into vulnerable communities, creating ecological flood defense landscapes and improving local knowledge through interactive green spaces.

The overall takeaway is that making space for water is a key strategy to flood mitigation. Applying these studies and principles to locations in Hillsborough County can prove to have economic value through design and development.
Community Centers and Libraries
Areas lacking public libraries and community centers are prioritized in order to locate a communal gathering space.

Social-Economic Status
Populations of low-SES status are prioritized due to research indicating they are more vulnerable in disasters. In orange are household incomes below $38,000 a year and in yellow are household incomes below $51,000 a year.

Mangroves
Incorporating existing mangrove forests in our design indicates areas that could benefit from implementing mangroves as natural barriers. Mangroves reduce coastline erosion and protect from hurricane destruction.

Parks
Parks provide recreational green space for communities to improve their mental and physical health. Current parks were mapped within the coastal zone and areas lacking parks were identified to indicate communities in need.

Vacant Land
Vacant land provides an opportunity to benefit the surrounding areas. Public lands can be managed for multiple uses and are flexible for improvements since they are government owned.
Locating F.E.A.T.U.R.E. Parks

By layering maps, multiple locations emerged in South Hillsborough County that show where populations are ill-equipped to withstand a natural disaster. Of the 158 miles of coastline and 1.4 million residents living along it, 22% live in flood prone areas. Additional research has found direct associations with a person’s SES status and level of disaster vulnerability due to limited resources and ability to participate and contribute to society.

The following are three chosen locations along the Hillsborough County coastline, in which three different typologies of F.E.A.T.U.R.E. Parks could be implemented for flood mitigation purposes.

**F.E.A.T.U.R.E Type 1**
Mangroves as a natural defense system can absorb large amounts of flood waters. This typology would be implemented in coastal areas isolated from communities.

**F.E.A.T.U.R.E Type 2**
Multi-purpose parks can accommodate activities and stormwater management needs in areas of high risk to flooding.

**F.E.A.T.U.R.E Type 3**
Clustered development that integrates comprehensive land use plans with hazard mitigation will conserve land and discourage development in vulnerable areas.
Proposed Development for Cluster Community: Gibsonton

The town of Gibsonton is selected based on its high vulnerability, due to social and environmental threats, as well as the opportunities this region presents for future development. Gibsonton is a small community of approximately 2,800 residents situated along the edge of Tampa Bay and between the Alafia River and Bullfrog Creek. The proposed F.E.A.T.U.R.E Park plan for Gibsonton is to develop a dike that will protect the residential and commercial zones. The dike will be designed to allow vacant and natural areas to flood while protecting residential and commercial areas. The dike will also serve to encourage future development in the protected areas, helping the community to grow and improve.

Task List

- Ecological Preservation
- Flood Defense
- Pollutant Filtering
- Community Development
- Community Engagement
- Recreational Activities
- Smart Growth

Low Impact Development

LID’s preserve and mimic natural landscape features. By minimizing impervious surfaces in urban design, stormwater will be treated as a resource as opposed to a waste product. The current Comprehensive Plan for Hillsborough County has guidelines to maintain, preserve, and protect vulnerable coastal zones to reduce human and environmental loss.
Smart Growth

In the future, the community should develop as clusters with economic and ecological assets. Economic density can attract more development to invest in this area and building ecological infrastructure helps attract visitors. New Urban and Smart Growth strategies provide green infrastructure for sustainability and climate resilience. Smart Growth prioritizes independent development through creating local commercial, ecological, and recreational land for Gibsonton. By developing a walkable community to residential and business neighborhoods, we will effectively prevent urban sprawl and create better modes of transportation and access for all populations.
Gibsonton F.E.A.T.U.R.E. Park

The proposed solution combines principles of case studies. It creates development with community centers, natural barriers to flooding and open spaces for recreational activities.
Fig. 77 Category 1 Without Barriers

Fig. 78 Proposed Gibsonton Development
Multi-Hubs

During a weather storm emergency, there are two courses of action that affected populations can take. These options are to leave or stay. These options, which defines whether one might be safe or remain in danger, are not available to all. Some, despite the need to evacuate, do not have the means or the physical capabilities to do so. This project addresses that problem.

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Introduction

Certain groups within our communities lack the social or physical capability to freely leverage their option to remain safe in an emergency or crisis. Those with fewer financial resources, without transportation, and with disabilities comprise a high percentage of individuals who do not or cannot evacuate. People do not leave mandatory evacuation zones due to poverty and lack of resources. Highly vulnerable housing - including poor construction, aging structures, and mobile home parks - is another challenge that is prevalent in low income neighborhoods. These are homes that should be evacuated regardless of storm surge risk in a hurricane landfall area. People do not evacuate these structures due, again, to a lack of means or to lack of understanding the dangers.
Locating Vulnerable Populations in Hillsborough County

This project began by identifying populations that might not be able to evacuate. Unemployment and poverty levels were selected as the criteria for financial inability and elderly populations. No vehicle access and limited English proficiency were selected for social isolation.

---

**Low Income Households**

- 0 - 28
- 29 - 65
- 66 - 224

**65 Years and Older**

- 0 - 17
- 18 - 51
- 52 - 115

---

Fig. 79 GIS Map: Low Income Households.

Fig. 80 GIS Map: 65 Years and Older.

Source: Tampa Bay Regional Planning Council, aligning with Climate Science Advisory Panel recommendations.
Those without vehicular access are left without many options in a time of crisis. Hillsborough County relies heavily on automobiles as a main form of transportation. This limits the distance a person can travel, to reach loved ones and get out of harm’s way.

**Fig. 81** GIS Map: Limited English Proficiency

**Limited English Proficiency**
- 0 - 9
- 10 - 27
- 28 - 91

**Legend**
- Major Roads and Highways
- Sea Level Rise (SLR)
- Cat. 1 Hurricane, Intermediate Low SLR
- Cat. 1 Hurricane, High SLR
- Cat. 3 Hurricane, Intermediate Low SLR
- Cat. 3 Hurricane, High SLR
- Cat. 5 Hurricane
- 100yr Flood

Year 2045 projections
Source: Tampa Bay Regional Planning Council, aligning with Climate Science Advisory Panel recommendations

**Fig. 82** GIS Map: No Vehicle Access

**No Vehicle Access**
- 0 - 9
- 10 - 27
- 28 - 91

**Legend**
- Major Roads and Highways
- Sea Level Rise (SLR)
- Cat. 1 Hurricane, Intermediate Low SLR
- Cat. 1 Hurricane, High SLR
- Cat. 3 Hurricane, Intermediate Low SLR
- Cat. 3 Hurricane, High SLR
- Cat. 5 Hurricane
- 100yr Flood

Year 2045 projections
Source: Tampa Bay Regional Planning Council, aligning with Climate Science Advisory Panel recommendations
Vulnerable housing is a common challenge in many low-income and socially isolated communities. The maps below show vulnerability in housing as defined by year built, of poor quality (mobile homes) and an evacuation zone map. These are areas that would have to be evacuated regardless of storm surge risk.
Identifying the Issue

There is an Inequitable Access to Mobility

Transportation can be divided into local and regional levels. Certain modes of transportation are more accessible to vulnerable populations. These include active mobility choices or low-cost public transit options, like walking, bus, or train. Private transportation options are less accessible to these groups, but are currently the primary form of mobility throughout Hillsborough County.

Re-imagining an Interconnected Transportation Network

Local
Walking, biking, bus, train/ trolley, taxi/uber car.

Regional
Train, interstate bus, boat, plane, car.

Increase Mobility
Increase Community

Populations with the following characteristics are vulnerable:

- Financial Inflexibility
  - Unemployment
  - Below poverty limits

- Physical Inability
  - Age (over 65 years)
  - Disabled

- Social Isolation
  - No vehicle
  - Limited English ability

- Vulnerable Housing
  - Low quality construction
  - Aged housing
  - High-density housing
Best Practices and Case Studies

**Florida Historic Rail**  
**Tampa, FL 1800s**

Type of Use: Transport System

Rail travel first arrived to Florida in the 1860s with a line running from Fernandina Beach to Cedar Key, then expanded Tampa in late 1890s. The purpose was to create an effective transportation system connecting the state and establish tourism. This railroad reshaped local agricultural manufacturing businesses and provided transportation for agricultural goods. Small cities grew at points of intersections or along the path of travel. These places encompassed all aspects of urban life.

**Stop the Kindemoord**  
**Amsterdam, NL 1970s**

Type of Use: Policy

Mass bicycle demonstrations and protests led to a critical change in the political attitude of urban planning and lifestyle. This became a reaction to auto-dependent development and the increase number of traffic related fatalities. Preserving the long-standing tradition of cycling helps protect the city from hegemony of cars. Today Amsterdam is the bicycle capital of the world with 22,000 miles of bicycle paths.

**Tenri Station Plaza**  
**CoFuFun Tenri, Japan 2017**

Type of Use: Multi-functional Park

The concept behind the project is to revitalize local community for both residents and tourists. This 7,500 sq meter area is famous for the ancient minimalistic tombs known as “cofun”. The new plaza will include bicycle rental, cafe, shops, info kiosks, play area, outdoor activities, event space and more. This project reflects specifics of existing landscape and culture, while providing opportunities for social mobility.
Amsterdam Rail Station: Studio Visit

Fig. 89 Amsterdam Train Station. Source: Brian Cook.

Fig. 90 Amsterdam Train Station. Source: Brian Cook.

Fig. 91 Students in TU Delft. Source: Brian Cook.
Framework: Normalizing Mobility in Hillsborough

Goals

1. Improve resiliency of vulnerable communities through enhanced connectivity and mobility. Activate community space and allow people to move freely using multi-modal local and regional transit systems.

2. Increase economic opportunity for traditionally dense, clustered railroad towns. Create a regional system of vibrant, fortified, supported areas that can also be used in time of crisis.

3. Normalize evacuation by introducing distant and accessible travel or a day-to-day basis, to be also used during disaster.

Principles

1. Increasing community and connectivity increases resiliency, and vulnerable populations need accessible spaces and reliable sheltering in emergency evacuation situations. Transit-connecting community centers normalizes paths of travel, in case for evacuation and in daily life.

Strategies

1. Introduce passenger rail service operation on existing railroad tracks, connecting local and regional public transit through intermodal facilities. Develop transportation centers with the ability to serve as evacuation and shelter locations for the community.
The university area is an intersection of multiple areas of vulnerability that necessitate and limit evacuation. The chosen site is an undeveloped green space that sits in an upland, lower risk flood area. It is ideal for sheltering outside of major storm surge in up to a Category 5 Storm. This hub is also in close proximity to one of the main special needs shelters in the Yuengling Center.

Plant City is a historic rail community that is at an intersection of multiple areas of vulnerability. This is another upland community with reasonably lowered risk of flood from storm surge or inundation. This hub may serve as a shelter in up to a category 5 storm.
3. Valrico Multi-hub

Valrico is one of the smaller communities on this master plan. It has a large population categorized under financial inflexibility in the top levels of financial inflexibility and physical disabled. There is a density of populations living in vulnerable housing with room to grow. This site is upland well outside of projected storm surge and ideal for another Category 5 storm shelter.

4. Seffner Multi-hub

The Seffner community has a lower representation of evacuation-prohibitive vulnerability, but is a centralized location between several areas of such vulnerability. Seffner is located in an upland location nearer to populations centers than Plant City. This site’s location in an upland, low-risk flood area makes it another ideal Category 5 Storm Shelter.

5. East Tampa Multi-hub

East Tampa has an intersection of financial inflexibility, social isolation, and vulnerable housing. Sections of this community are within projected storm surge levels for major hurricanes, but are not on the evacuation zone. This hub is within a low-risk flood area but adjacent to higher-risk areas.

6. Lowry Park Multi-hub

This site is located within a densely populated area near communities of various housing and evacuation-limiting vulnerability. This site is similarly located within lower-risk flood area but is adjacent to high-risk areas. It would serve as a viable sheltering alternative to the University area site except in greater than Category 3 projections.

Imagining Site Specifics: USF

The university area is an intersection of all three aspects of vulnerability: financial inflexibility, physical inability, and social isolation. This area also has high density housing and mobile home parks, but is also an area that can receive migrating populations from south county and further south in the state. The site is ideal as a sheltering space, as it is located outside of any projected storm surge.
**Phase I**

Develop the corner of Bruce B. Downs Boulevard and Fowler Avenue to create a multi-hub. This will increase walkability and safety for pedestrians while satisfying several community needs. This space will also house other community features such as a community development center, which can be used for sheltering.

**Phase II**

Extend the rail system through the University of South Florida on Maple Drive. The rail lines will connect Fletcher Avenue to the already existing North/South rail line. This connection will create further pedestrian mobility. It will provide a more direct connection to the Yuengling Center, a special needs shelter during emergency activation.
**Phase III**

University Mall is expected to transform to address community needs more effectively in the University area. The layout will direct people towards the multi-hub created in Phase I.

**Phase IV**

PepsiCo will be engaged as a stakeholder, and future design or redevelopment will consider them as a significant partner in developing the carrying capacity and activity of this area.

**Phase V**

The remainder of Fowler Avenue will be reconfigured to enhance walkability, similar to the goals addressed in Phase I of the project. This phase will further connect, by rail, the university to the town of Temple Terrace, and to I-75 and Plant City.
Imagining the USF Site.

Train Platform (Refer to Section 4)

This rendering shows the train platform that serves as a waiting and loading area for trains destined in either direction. The area is covered and allows maximum air flow for comfort and safety in the hot summer months. The platform and amenities are ADA compliant to ensure maximum accessibility by all vulnerable populations. Signage and information kiosks provide public education about this site as a point of safety and shelter for the local and larger Tampa community.
Retail Public Space (Refer to Section 4)

This site was built with accessibility in mind, and connections are created between the train station and community amenities. Green landscape creates a more pleasing environment and maximizes shade for visitors. This space connects those who get off at this hub to access the various amenities: doctor’s offices, shared office spaces, various retail, day care, adult education centers, and a post office. This space also has enough area to function as a farmer’s market and other activities for community engagement.

Crosswalk (Refer to section 1)

This rendering details the crosswalk that would be constructed on Fowler Avenue connecting the two sides of our transit-oriented development. The design was created with accessibility and safety in mind. Bioswales will be implemented on either side of the road to maximize stormwater capacity and a bus lane will prioritize public transportation. Trees increase walkability of the area and allow for a more inclusive environment for those more at risk of heat stress and stroke.
Public Green Space (Refer to section 2)

The public green space located towards the south-east corner of the site emphasizes a lush environment along with public circulation and activity. With open access to the street from the site, it becomes a large gathering space. A water feature will serve as a retention feature for the site and the space is flexible for programming and activities. This green space connects the plaza, train station, and other major spaces with a pleasing environmental aesthetic.
Mainstreaming Evacuation

**Residential/Commercial: Residential**
Multiple housing structures are located in the site, mainly on the second level and above. These are built to withstand a category 5 storm and allow for sheltering in place.

**Residential/Commercial: Office**
Office spaces include private and shared spaces for student entrepreneurs. These spaces can be utilized as shelter in case of emergencies.

**Residential/Commercial: Retail**
Located on the street level, these spaces create an active edge for the community. They also provide commercial support in times of emergency.

**Transportation: Parking**
Parking spaces will be located on levels 1 through 4 and would be used for long term and short term parking for retail and residential amenities. In emergencies, trucks are able to access the parking structure.

**Transportation: Bus**
Public transit via bus, tram or uber/taxi will converse here. In emergencies, buses can further transport evacuees to sheltering spaces.

**Transportation: Train**
The train station can intake large amounts of people daily and create connectivity throughout Hillsborough County and beyond. During an emergency the trains can take large amounts of vulnerable populations to safe areas.

Fig. 107 Residential, Office, Retail Axonometrics.

Fig. 108 Transportation Axonometrics.
**Exterior Public Space: Water Management**
This is a critical component due to the issues of flood. With the implication of private and public green spaces, they serve as water retention parks or water filtration areas that then connect to stormwater management networks to be processed further off site.

**Exterior Public Space: Public Space**
The importance of strengthening community is crucial within this project, the public spaces fill the need for a physical community space. Implementing parks, plazas and community recreation spaces, all populations can begin to come together especially in a time of emergencies.

**Emergency: Emergency Activation**
In case of a storm, where populations would need to evacuate from vulnerable areas, these spaces would transform into mass sheltering. Vulnerable populations who may otherwise not evacuate would have an incentive to use the spaces with the easy accessibility of public transit (trains, buses, trams).

**Final Axonimetric Drawing**
*Illustrating the USF Site as a Multi-Hub*
Secondary Sites

Although creating redundancies in our public infrastructure may have significant up-front costs, there are substantial benefits and long-term cost savings. Moreover, innovate strategies using localized opportunities and assets of site can provide substantial effects in terms of resiliency. This designed coupling of building infrastructure redundancies and localized design response may allow for resource recovery and overall sustainability.

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Introduction

In Hillsborough County the downtown and port area have been identified as high risk locations with a concentration of both hard and soft infrastructures. County infrastructures at that location include: tourism, business, power, sanitary sewer, fuel tanks, a major hospital and port activities. While the redevelopment of downtown has been beneficial to many, the continual concentration of growth and development in a single area will create challenges in the future as sea level rise increases. The worst case scenario shows downtown Tampa inundated with a category 3 hurricane potentially bringing 37 feet of storm surge, which would cover the entire area up to the 275 highway.

With over $3 billion of new investments coming on-line and thousands of new residents flocking to Tampa’s core, not only are downtown and the port area located in vulnerable areas, but they also stand to lose the most. Combined with Hillsborough County’s lack of redundancies, this creates a perfect storm of challenges for the community and region to bounce back in the event of a disaster; its ‘resiliency’. We propose providing secondary sites, the key principle of building network redundancies. This means building connections to couple infrastructures in ways that foster redundancy and resource recovery.
Evaluating Community Vulnerability

Access to evacuation routes, gas facilities and shelter in place

As shown in the maps, there are significant exposures to risk, with both local and regional implications. The Tampa Port is one of the main storage and distribution hubs for the county and surrounding areas. The Port processes 4,000 fuel trucks a day and moves fuel all across south and central Florida. 1/10 gallons of fuel in the state of Florida is provided by Marathon, which uses the Tampa Port as their main storage facility.

The following maps showcase vulnerabilities across Hillsborough County, including hospitals, wastewater and industrial sites.
**Evacuation Zones & Evacuation Routes**

- Major Roads and Highways
- Evacuation Route
- Evacuation Zone A
- Evacuation Zone B
- Evacuation Zone C
- Evacuation Zone D
- Evacuation Zone E

**Downtown Tampa: Commercial Property**

- Major Roads and Highways
- Commercial
- Sea Level Rise (SLR)
- Cat. 1 Hurricane, Inter. Low SLR
- Cat. 1 Hurricane, High SLR
- Cat. 3 Hurricane, Inter. Low SLR
- Cat. 3 Hurricane, High SLR
- Cat. 5 Hurricane
- 100 yr. Flood

Year 2045 projections

Source: Tampa Bay Regional Planning Council, aligning with Climate Science Advisory Panel recommendations.

*Fig. 112 GIS Map: Evacuation Zones and Evacuation Routes.*

*Fig. 113 GIS Map: Commercial Property.*
Layer Description:
Hotels can be used for tourism or in evacuation settings, provided they are not located in mandatory evacuation zones.

Data Source:
This data was retrieved from the North American Industry Classification System [NAICS]. The codes for hotels include 721110, 721120, and 721191. The data is available through catalog.data.gov.
Layer Description:
The physical damage caused by collapsed structures is not the only risk. The facilities hold gasoline on site which provide evacuation opportunities as well as act as a potential contamination of water source. Studies have shown that storm surge is responsible for the majority of petroleum releases, and the failure of storage tanks was the most common mechanism of release.

Data Source:

Fig. 116 GIS Map: Wastewater Facilities.

Fig. 117 GIS Map: Gas Stations.
Creating Redundant Urban Infrastructures

Expansions of critical resources need to occur outside of the Downtown and Port area. Additionally, density outside the downtown district can create redundant urban infrastructures while serving populations during a storm and flood events.

Downtown Critical Resources

Urban recreation, events, walkability, public transit, employment and entertainment are part of the downtown social structure, these are supported by government, density, cultural and educational facilities.

Port of Tampa Bay Critical Resources

Fuel distribution, power distribution, wastewater treatment, employment and cargo distribution all take place in the Port area of Hillsborough County. These support the economy, material distribution, construction and ship repair.

Case Study: Hunt’s Point Lifelines

10 interdisciplinary teams were asked by the U.S Department of Housing and Urban Development’s Rebuild by Design to select the best site in their region to showcase innovative and scalable solutions that would increase the long term resiliency of the region and demonstrate the capabilities urban design in responding to the challenges posed by climate change.

Hunt’s Points peninsula is a 690 acre in the South Bronx, is the hub for the region’s food supply chain, yet it is physically, socially and economically vulnerable. Investing in Hunt’s Point would provide food, protect jobs and people in the region, and serve as an example for water fronts everywhere.
Opportunity

Hunt’s Point has great potential for development as a thriving inter-modal hub. It is well positioned to play a role as the nexus for an east coast maritime emergency supply chain, significantly reducing supply loss risks and ensuring continuity in regional food distribution during weather events when roads, tunnels, and bridges are impassable.

The city, in partnership with the Community Planning Board and non-profit organizations, have generated a number of detailed and highly-regarded community-based plans, which align well with an integrated flood protection system at the edge of the peninsula, complemented by a range of other resilience strategies.

Hunt’s Point Lifelines works at every scale, from the individual lot to the vast expanse of the east coast, to demonstrate a model for maritime industrial areas. The proposal includes four LIFELINES:

**Lifeline 1: Integrated Flood Protection**

The physical design is a combination of a protective levee, wetland system, and connective waterfront greenway integrated with the South Bronx Greenway and a string of destinations, designed ecologies, research stations and critical utilities.

**Lifeline 2: Livelihoods**

An aim of LIFELINES is to demonstrate that local communities can participate in climate adaptation, understand its dynamics and risks, and benefit from public and private sector investments in resilience without compromising the integrity of the flood protection project.

**Lifeline 3: Cleanways**

The Cleanways are a series of infrastructure elements that improve connectivity, sociability, air quality, safe passage for pedestrians through truck routes, food access, commercial activity, and filtration of stormwater in major rain events.

Fig. 119 NY Hunt’s Point: Lifeline. Source: NY Hunt’s Point Project.
Lifeline 4: Maritime Supply Chain

Research identified the opportunity to create a base of operations in Hunt’s Point for distribution of goods, personnel, and equipment to areas under emergency. The first mode of transportation restored after most events is maritime access.

The proposal builds on the Marine Highways, Cities Readiness Initiative, and Disaster Relief and Mitigation programs of the federal government to explore the viability of establishing a maritime emergency supply chain for the east coast, with Hunt’s Point as a major distribution node and potential supply stockpile site.

Flood Protection: Phased Protection

Flood Protection design can be implemented in two phases. The first phase protects the critical infrastructure of the regional food supply and Waste Water Treatment Plant. In each phase the levee is designed to tie back to high ground, allowing continuous flood protection for each section.

Flood Control Structures

Adaptive Edge

Adaptive edges are located in places where there is either no room to build flood protection on land, or at strategic locations where at-grade access to the greenway or waterfront is desired. These are temporary deployment areas, where infrastructure can be installed when needed.
Thin Edge

Thin edges are where space is restricted or where there is no room to make a more dynamic tidal slope. Flood protection along these thin edges is accomplished either by steep stabilized earth or constructed walls and bulkheads. They are typically constructed directly adjacent to the water boundary; therefore, they can protect assets near the waterway. These structures are typically constructed of a concrete wall supported by a steel or concrete sheet pile foundation.

![Thin Edge Diagram](image1.png)

Fig. 122 NY Hunt’s Point: Thin Edge. Source: NY Hunt’s Point Project.

Thick Edge

Thick edges are where there is room to cut into land, creating a more tidally dynamic shoreline and building up an earthen berm away from the water’s edge.

![Thick Edge Diagram](image2.png)

Fig. 123 NY Hunt’s Point: Thick Edge. Source: NY Hunt’s Point Project.
**Stormwater Design**

Protection at the edge alone is not enough to prevent flooding, inland stormwater must also be managed. The NY Hunt’s Point project proposes high-volume stormwater design to avoid flooding of necessary infrastructure in storm scenarios, in which rainfall could create a bathtub effect behind the surge protected edge. These stormwater features are also designed to improve water quality and habitat in typical storms.

For stormwater to be managed in an extreme event, pumps would need to be used to overcome the high pressure occurring from the tidal surge. Another option is to allow for parking lots adjacent to the treatment wetlands to flood for a short period of time, thus avoiding the use of pumps.

**Catchments and Conveyance**

To better manage stormwater, the team created sub-catchments within the peninsula. These sub-catchments were delineated based on: (1) Existing conditions (such as walls, medians and curbs); (2) available area for stormwater management; and (3) feasibility for proposed topographic changes.

**Treat and Release**

All treatment wetlands are designed to manage stormwater runoff that occurs behind the IFPS. Runoff will be conveyed to the treatment wetlands through a system of proposed separate storm sewers and vegetated swales. The wetlands will be lined with an impermeable EPDM liner and placed above the water table. An additional inlet will be placed above the first one, and will be sized to release water from the 100-year rainfall event, also within 24 hours. Both orifices will release stormwater to the waterways by gravity alone.

**Fig. 124 Treatment wetland and levee stormwater management.**
Source: NY Hunt’s Point Project.

**Lifelines 3: Cleanways**

This section expands on resilience strategies addressing social and economic vulnerabilities. They connect neighborhood, industry, and waterfront, and minimize the impacts of the food cluster on its residential neighbors. This proposal directly addresses these concerns through physical design, policy, and operations.

Objectives include, improving air quality and access to open space, increasing access to healthy food, proving mobility and safe passage and offering a more resilient power supply.

**Better Truck Routes, Safe Pedestrian and Bike Routes**

Revisions to truck routes are necessary for the safety of pedestrians and reduction of congestion. The project also proposes a street-based network for bicycle and pedestrian use. This provides additional ecosystem services such as stormwater management and air pollutant removal.
Air Quality and Resilient Energy

This lifeline also addresses air quality through advanced truck stop electrification, expanded refrigeration and optimized planting for the removal of air pollutants. This proposal also includes the creation of a micro-grid, which can operate independently through on-site gas fires turbines reducing carbon emissions and energy costs.

Community Food Access and Security

This lifeline is concerned with providing food accessibility for the community through a permanent farmer’s market, a regional food bank, a nutrition center for education and the promotion of urban farming.
Port Redwing Expansion

This site demonstrates the principle of building networked redundancies by creating dense urban areas outside of the urban core. Each hosts infrastructure such as water treatment, energy production, tourism and hotels, emergency management services, sheltering, transportation options and other facilities. In the site design natural surface patterns of water flow are aggregated and networked as water drainage infrastructure. This contrasts the often disconnected suburban retention pond proliferation and includes a combination of green, gray, and smart hydraulics.
Main Principles

Guiding principles of the proposal include utilizing natural and existing water flows to establish development patterns and water management practices. Also identifying natural low lying areas and preserving them as recreational green spaces, floodable landscapes to assist in water management and ultimately create a design driven network of parks.

Resiliency Plan Goals

The plan minimizes impervious areas within the streets, parking, and walkways. Permeable pavement allows rainwater to pass through into the ground below the surface. This strategy can be used in residential roads and driveways.
Resiliency Factor Applications

Housing
A blend of housing types contribute to a diverse and active neighborhood typology.

<table>
<thead>
<tr>
<th>20/40/40</th>
<th>Low Density</th>
<th>Medium Density</th>
<th>High Density</th>
<th>Accessibility</th>
<th>Green Space</th>
</tr>
</thead>
<tbody>
<tr>
<td>$$</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Services
Multi use zoning in high density areas creates economic opportunity for big and small businesses.

<table>
<thead>
<tr>
<th>Zoning</th>
<th>Commercial</th>
<th>Hotel</th>
<th>Dining</th>
<th>Corporate</th>
<th>Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Icon]</td>
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</tr>
</tbody>
</table>

Health and Wellbeing
Create and maintain a standard of community living that is attractive and responsible through the use of multi-functional interventions.

<table>
<thead>
<tr>
<th>Quality Control</th>
<th>Water</th>
<th>Air</th>
<th>Walkability</th>
<th>Aesthetics</th>
<th>Public Space</th>
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</tr>
</tbody>
</table>
Congregation
Development facilitates and encourages social interactions within the public realm.

Auxiliary Bypass
A constructed canal system reduces the flooding impact in the immediate and surrounding areas.

Utilities
State of the art systems reduce the impact on the environment and eliminate problems associated with flooding.

Ecological
Green infrastructure components create multi functional outdoor spaces that contribute to a healthy Florida landscape.

Overlay District
The Port Redwing’s Overlay District will serve to reinforce the shoreline protection through land use requirements and development regulations. The overlay district will require all development project to set aside twenty percent of their land for green space and to get fifty percent of their electricity needs from renewable energy sources, such as wind, solar, or biomass. The overlay district will also promote shared parking facilities whenever possible.

Zoning and Land Use
Port Redwing and the land immediately adjacent should be rezoned for industrial and recreational uses. The surrounding land should be zoned for office, other commercial uses and residential. Zoning is a way of regulating land use that divides jurisdictions into zones or districts. Zoning can be used to regulate uses, setbacks, easements, and more. Future land use maps should be update to reflect these zoning changes.
Fig. 131 Business District.

Fig. 132 Business District.

Fig. 133 Urban Mixed Use Hub.
Fig. 134 Urban Mixed Use Hub.

Fig. 134 Recreational Flood System- Dry.

Fig. 135 Recreational Flood System- Wet.

Fig. 136 Recreational Flood System- Dry.

Fig. 137 Recreational Flood System- Wet.
What Does It Mean To Be Resilient?

A resilient community is also a healthy community in which assessing community strengths is a vital component of understanding resilience. Key characteristics of a resilient (and healthy) community include:

- Community members who are physically and mentally well.
- Access to health care, healthy foods, and services as needed.
- Members of the community are self-sufficient and can take care of each other during difficult times.
- Residents are engaged in the community and connected to each other.

Transfer Development Rights

To preserve productive agricultural and environmentally-sensitive lands and promote development in the new communities near Port Redwing, an implementation of Transfer Development Rights program can help Hillsborough County. By providing compensation to landowners for choosing not to develop some or all of their land. Landowners are given an option to legally sever the development rights from their land and sell these rights to another landowner or a developer for use at a different location. The land that releases any development rights is permanently protected through a conservation easement or a restrictive covenant.
Fig. 142 District 1 Main Park.

Fig. 143 Boulevard Perspective.
**Building Network Redundancies**

This site demonstrates the principle of building networked redundancies on two different levels. First, by adding connected water storage and drainage components, and second, by coupling stored and flowing water with other infrastructure systems. These systems include community recreations amenities and resources from neighborhood-scale sanitary sewer treatments. This is accomplished via gray and smart hydraulics.

![Fig. 144 Map.](image)

**Underground Utility Service**

In this resiliency plan, underground electric service minimizes the obstacles between proposed development. However, the pad mounted transformers are not located within the street right-of-way as per the existing regulation.

![Fig. 145 Housing Plan.](image)

**Mixed-Use/ Housing Development**

The resiliency plan is a mixed land use development with higher densities. Residential units provide housing facilities for low to high income families. A higher density commercial corridor with retail spaces, shopping complex and hotels is located at the intersection of main transportation routes. Also, the development along the constructed wetland is a higher density residential area and includes multi-family units and townhouses.

This plan seeks a public-private partnership to provide affordable housing, providing affordable properties to minimize the dependency on public housing and keeping a below market rate interest program.

![Fig. 146 Site Section.](image)
Landscape Ecology: Streetscape Design Standard

The resiliency plan has building setback lines from a proposed canal with a generous public easement. Moreover, the design follows the comprehensive vision by creating a connection between various activities with the circular pedestrian connection and provides a direct connection between neighborhoods and retail stores. The aim of this strategy is to minimize the conflict between walkable spaces and vehicles. This planning indicated the model of new urbanism by providing multi-modal, compact, mixed and walkable development.

Water in Motion: Stormwater Management

To harvest rainwater, the Hillsborough County construction code, specifically plumbing code, should be revised. Sustainable rainwater harvesting can be helpful in this site to minimize runoff and allow water to navigate naturally through the built environment using green infrastructure techniques. The section below showcases the canal system allowing water management to become an amenity and design element within the urban fabric.
Fig. 154 Harney Perspective.

Fig. 155 Residential Perspective.
Social Capital

Our built environment can foster high levels of social engagement that builds resilient and integrated communities to reduce the barriers that affect both physical and social vulnerabilities. Community spaces cultivate relationships and builds the social capital needed to connect families in need with the resources and social support networks to help those in need before, during, and after a disaster. In addition, sense of place and sense of belonging encourages those that have been affected by flooding or storm surge events to come back.

Increased Walkability

Improved walkability of an area improves quality of life through improved physical and mental health. This allows residents to have improved access to heath care, education, healthy food options, and services that they may need in times of disasters. This also leads to prevention of chronic diseases such as diabetes, hypertension and asthma, because complications among populations with chronic diseases tend to lead to increased illness and death following the impact of a disaster. Walkable, connected and maintained sidewalks with proper lighting builds social networks and fosters social capital.

Mitigation Strategies For Resilient Community Design: Land-Use Planning Matters

The following are strategies learned from this project to apply to future developments:

• Target planning to identify zoning, regulations, and overlays that are applicable to that specific community.
• Revise building codes that take into consideration storm surge, flooding and sea level rise.
• Regulate stormwater and floodplain to supports flood defense and infrastructure projects.
• Elevate flood-prone structures for flood-proofing measures.
• Design to live with the water.
• Protect and restore natural systems.
• Minimize damages by understanding the natural systems and water flows to inform urban planning and development.
• Create education and awareness programs to build a culture of preparedness.
• Create urban design that supports and fosters social capital.
• Design communities to activate and promote social strengths and connections to a sense of place and belonging.
• Allow for access to affordable housing, resources, and services
Conclusion

Each of the studio projects represent approaches to the issue of flooding as a multi-faceted, multi-layered project. “There are no single answer solutions,” as our Dutch guest Robbert de Koning noted. Every project accomplishes multiple goals and in doing so, can create new opportunities for growth and economic development. As a collection of projects, this work provides a vision for amending systems, around which a future urban fabric can grow. It is a resilient infrastructure. The projects overlap and establish important commonalities; mobility, development, space for water, and spatial design. Flooding is a social issue, as much as it is one that affects property. It must be considered from all angles, and in doing so opportunities will open up. In the final presentation, a student team discussed how their family members could not evacuate from Hurricane Irma in 2017. The system was not set up for them to avoid what was being called the largest storm ever recorded on Earth. Their project develops a new transportation system that activates economic activity in peripheral cities, to create more resilient capacities and a flexible network for county residents.

The proposals are developed from an interdisciplinary lens, which was critical to generating projects that accomplish multiple objectives. A common language had to be established, as well as respect for each discipline’s perspective and method of working. In the end, the teams were able to collaborate and layer their projects to accommodate each others concerns and solutions into a single design proposals.

These projects show that resiliency is not something that occurs only during a time of emergency, it is something that is built upon on a daily basis, within communities, and in association with daily habits and infrastructures. Although each project could potentially be implemented, the focus, in the end, is on the goals and principles that can guide our way to a more resilient future. Projects establish priorities for mitigating risks anticipated for Hillsborough County. Flooding already occurs, causing burden to local resources. But as Hillsborough’s leaders look to the future, decision-making should recognize that our context is dynamic, and that there will be more water than there is now. The flooded future has the potential to become an extreme stressor -- on the built environment, and in social networks. But by acknowledging this and incorporating these new scenarios into proactive measures, we can prepare and reduce risk for communities. These projects look at water, and flood, as an impetus for better planning and development, and as something to incorporate into places as both community amenities and protective assets.

- Studio Professors, Brian Cook and Taryn Sabia
FUTURE FLOOD STUDIO

As an interdisciplinary research project and design studio, students have mapped vulnerabilities across Hillsborough County due to sea level rise and event-based flooding. They used this information to develop proposals for increased resiliency and adaptive potential. Their designs will visualize opportunities for systematic change, answers to the question: How will we deal with flood?

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Ashley Hydriick
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Tessa Saturday
Jeremy Moore
Dylan Schreiber
Mateo Igoyen Garzon
Justin Elcock
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Tamaryn Swickheimer
Diego Guerra
Adah Shair

Professors Taryn Sabia and Brian Cook

PRESENTATIONS OF FINAL WORK
TUESDAY, APRIL 30. 12PM - 4PM
USF TAMPA CAMPUS
C.H. FERGUSON HALL (BSN). ROOM 225

FINAL REVIEW

Architecture
Urban and Community Design
Planning
Environmental and Civil Engineering
Public Health
Fig. 142 District 1 Main Park.
Soaking the Sponge

Locating Vulnerability

Understanding the Landscape

Comprehensive Planning

Rivers, Streams, and Springs

Coastal Landforms

Defining the System

Blue-Green Urbanism
Soaking the Sponge

DESIGN CONCEPTS

Soaking the Sponge to make it more attractive to pedestrians, visitors, workers and students is the main concept of this project. This sponge can be used for various purposes such as absorbing water, purifying and storing water, providing shade for pedestrians, creating a green space, and enhancing the overall aesthetics of the area.

The main strategy of this project is to create a network of green spaces that are connected to each other, forming a green sponge that can absorb and store water. This green sponge will act as a filter, purifying the water and providing a clean and safe environment for the users.

The green spaces will be designed to be accessible and enjoyable for the users, providing shade, seating areas, and recreational spaces. The green spaces will also be designed to be integrated with the existing infrastructure, making them a part of the daily life of the users.

The green sponge will be designed to be sustainable, using local materials and technologies, and will be maintained in a way that is environmentally friendly. The green sponge will also be designed to be resilient, able to adapt to changes in weather and climate.

In conclusion, the green sponge is a key element of this project, providing a multifunctional space that is both attractive and functional. The green sponge will be a key component in creating a sustainable and resilient community.
**FEATURE Parks**

**VULNERABILITIES**

- Infusion of Hillsborough County
- Socioeconomic Status
- Population
- Income
- Employment
- Education
- Housing
- Health

**PROBLEM:** Lack of public parks in high-risk areas

**QUESTION:** How can we create public spaces in vulnerable communities that will be served by the community and mitigate flood catastrophes?

**WHY:** Public parks and recreational facilities are capable of serving a community for more than a space to promote physical activity, green infrastructure methods can incorporate flood mitigation and elevation into the design of public spaces. Our research revealed there were limited public parks in areas that will be most affected by flood inundation and hurricane storm surge. In addition, these areas that lack public green spaces comprise of vulnerable populations, such as those of lower socioeconomic status (SES). These populations are at a higher risk of experiencing negative effects before, during, and after a disaster. Individuals and families of lower SES backgrounds are often economically disadvantaged and therefore lack the resources to prepare and respond to disasters. To address this problem, FEATURE Parks will provide public recreational spaces that will serve as protective factors and build community resilience among vulnerable communities.

**GOALS:**

1. Create a safe public space for water to infiltrate and protect communities
2. Provide green spaces to serve as community third place
3. Acquire and repurpose vacant land to serve a productive function
4. Preserve and restore natural ecosystems

**STRATEGIES:**

- Promote low impact development
- Utilize smart growth
- Incentivize development of commercial zone
- Prioritize ecological protection

**CASE STUDY PRINCIPLES**

1. **Salty Urbanism**
   - Incorporation of higher density and higher activity land uses
   - Incorporate public safety to preserve higher value levels
   - Incorporate market and retail opportunity
   - Incorporate public green space and open space
   - Incorporate high density mixed use development

2. **Room for the River**
   - Incorporate stormwater and water management
   - Incorporate public safety to preserve higher value levels
   - Incorporate market and retail opportunity
   - Incorporate high density mixed use development

3. **South Bay Sporadic**
   - Incorporate stormwater and water management
   - Incorporate public safety to preserve higher value levels
   - Incorporate market and retail opportunity
   - Incorporate high density mixed use development

4. **Living Breakwaters**
   - Incorporate stormwater and water management
   - Incorporate public safety to preserve higher value levels
   - Incorporate market and retail opportunity
   - Incorporate high density mixed use development

5. **Rock Pond**
   - Incorporate stormwater and water management
   - Incorporate public safety to preserve higher value levels
   - Incorporate market and retail opportunity
   - Incorporate high density mixed use development

**FEATURE PARK PRINCIPLES**

1. Improve community resiliency by connecting people to public spaces
2. Integrate, restore, and enhance natural flood defense barriers
3. Reduce economic loss through supporting acquired land
4. Provide a risk mitigation plan as a sustainability asset
5. Elevate through recreation
6. Integrate exceptional green spaces into vulnerable communities
7. Create ecological flood defense landscapes
8. Engage and improve local knowledge through an interactive green space
Multi-Hubs

VULNERABILITY AND DISASTER

MAKING THE DIFFICULT DECISIONS

SAME DISTRIBUTION

DIFFERENT IMPACT

LOCATING VULNERABLE POPULATIONS

TRANSPORTATION OPTIONS

INCREASE MOBILITY

INCREASE COMMUNITY

REIMAGINING AN INTERCONNECTED TRANSPORTATION NETWORK

CURRENT MOBILITY AND EVACUATION SITUATION IN HILLSBOROUGH COUNTY

LOCAL

REIMAGINE

EQUALIZING REFUGE AND RECOVERY

BEST PRACTICES AND CASE STUDIES

EQUALIZING REFUGE AND RECOVERY

CONNECTING VULNERABILITY AND OPPORTUNITY

 Locating Vulnerable Populations in Hillsborough

Population at Risk Reduction - 2020

The locational analysis reveals that the majority of the vulnerable populations are concentrated in certain areas, particularly the urban and suburban areas. These areas have higher levels of poverty, lower access to transportation, and limited access to healthcare and emergency services. The analysis also highlights the importance of considering the interdependencies of different systems, such as transportation and communication, to effectively address the needs of vulnerable populations.

Best Practices and Case Studies

The best practices and case studies presented in this section provide valuable insights into effective strategies for addressing the needs of vulnerable populations. The case studies highlight successful approaches in different contexts, such as urban and rural areas, that can be adapted to local conditions. These practices include the development of inclusive planning frameworks, the integration of technology to improve accessibility, and the enhancement of community engagement to ensure the participation of all stakeholders.

The findings and recommendations presented in this document emphasize the importance of a multi-hub approach to disaster preparedness and response. By focusing on the needs of vulnerable populations, the strategies aim to reduce the disparities and improve the resilience of communities. The integrated planning and design considerations are critical in creating a more equitable and sustainable future, where all residents have the opportunity to thrive regardless of their vulnerability.
Multi-Hubs

REALIZING SITE SPECIFICS (USF)

MAINSTREAMING EVACUATION

EQUALIZING REFUGE AND RECOVERY