Yankeetown-Inglis Adaptive Design

2013

Strategies for Adapting to Coastal Change

UF UNIVERSITY of FLORIDA

YANKEETOWN-INGLIS ADAPTIVE DESIGN
STRATEGIES FOR ADAPTING TO COASTAL CHANGE

Prepared by:

Kathryn Frank
Michael Volk
Sean Reiss
Rong Zeng
Jana Rosenbloom
Kevin Bennett

Sea Grant Florida

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For more information please contact: Kathryn Frank, Department of Urban and Regional Planning, University of Florida, PO Box 115706, Gainesville, Florida 32611, Phone: 352-392-0997 ext. 458, Email: kifrank@ufl.edu
Also please visit the project website: www. ChangingLevyCoast.org

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Introduction

This report describes work conducted in the summer of 2013 to examine strategies for adaptation to coastal change in Yankeetown and Inglis, both small rural towns within the Big Bend region of Florida's Gulf Coast. Inglis lies along the Withlacoochee River, while Yankeetown abuts both the river and the Gulf of Mexico.

Tide gauge measurements show that sea levels are rising throughout Florida as a result of human induced climate change, with the rate predicted to increase over the next several decades. **Figure 1** shows historic sea level rise as well as future sea level rise projections for Levy County based on the Cedar Key tide gauge. A commonly accepted sea level rise projection for Florida is 3 feet by the year 2100. In addition to sea level rise, changes in precipitation and temperature patterns, storm events, storm surge, and saltwater intrusion impacts on water supply and treatment infrastructure will also be issues that coastal communities in Florida must deal with in coming years. Levy County, Inglis, and Yankeetown in particular are vulnerable to these changes due to their low topography and geologic conditions.

In response, communities must begin planning now to adapt and respond to future coastal changes. Funded by the Florida Sea Grant, the work documented in this report is part of a larger project to address planning for coastal change in Levy County. The recommendations in this report describe a coordinated approach to adaptation planning in Yankeetown and Inglis, including designation of six unique "Adaptation Areas", and a combination of adaptation and redevelopment strategies. These may be used to guide future planning in Yankeetown and Inglis, but may also be adapted to other coastal towns with similar planning issues. This work is being conducted by a team from the University of Florida's College of Design Construction and Planning, with Dr. Kathryn Frank as Principal Investigator and in collaboration with community members and staff from Levy County, Cedar Key, Yankeetown, and Inglis.

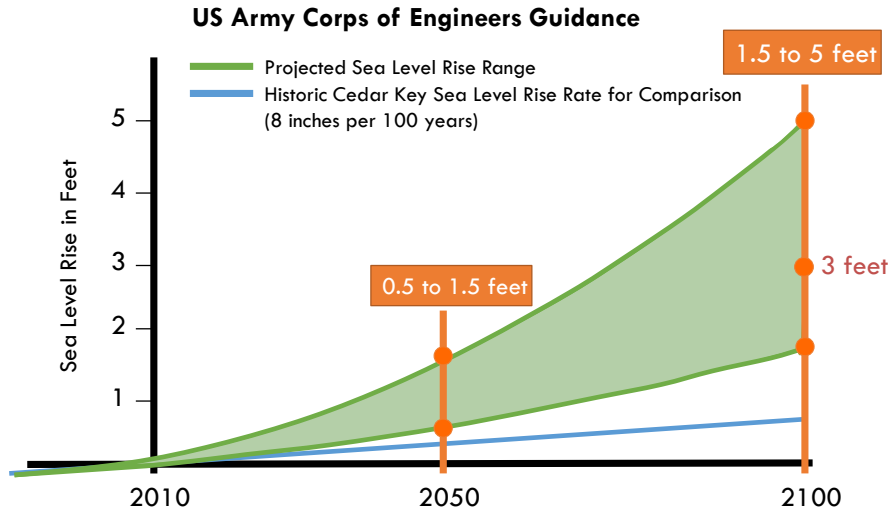


Figure 1: Sea Level Rise Projection
Projected sea level rise based on US Army Corps of Engineers guidance, and the National Oceanic and Atmospheric Administration (NOAA) tidal gauge at Cedar Key

Areas Likely to Experience Coastal Change

One of the first steps in this project was to identify areas likely to experience coastal change in Yankeetown and Inglis. For the purposes of this project, a basic projection of changes from a 3 feet rise in sea level was created using a tool called the Sea Level Affecting Marshes Model (SLAMM). All SLAMM data used in this report was produced and provided courtesy of The Nature Conservancy.

***SLAMM** is a software tool that can be used to simulate the potential changes in shorelines and coastal natural communities under various scenarios of sea level rise.*

In contrast to a model that assumes that all land below a certain elevation is inundated by sea level rise (commonly referred to as a "bathtub model"), SLAMM simulates dynamic wetland and shoreline processes as well. In the Yankeetown-Inglis project area, SLAMM projects extensive conversion of upland areas to wetlands, and projects a smaller amount of upland conversion to open water than might be seen using a simple "bathtub" model. We expect that these new "wetlands" will be less suitable for new or existing development, serving to underscore the importance of this project. In **Figure 2** on the facing page, the projected shifts in wetland communities are seen in the light green, with existing wetlands represented in the darker green.

Other potential changes that will occur in Yankeetown and Inglis due to sea level rise include impacts to water supply and septic systems caused by a rising water table, increased flooding, and saltwater intrusion into the underground aquifer. The adaptation strategies we provide in this report, as well as information in the appendices are designed to help community members begin to address these changes.

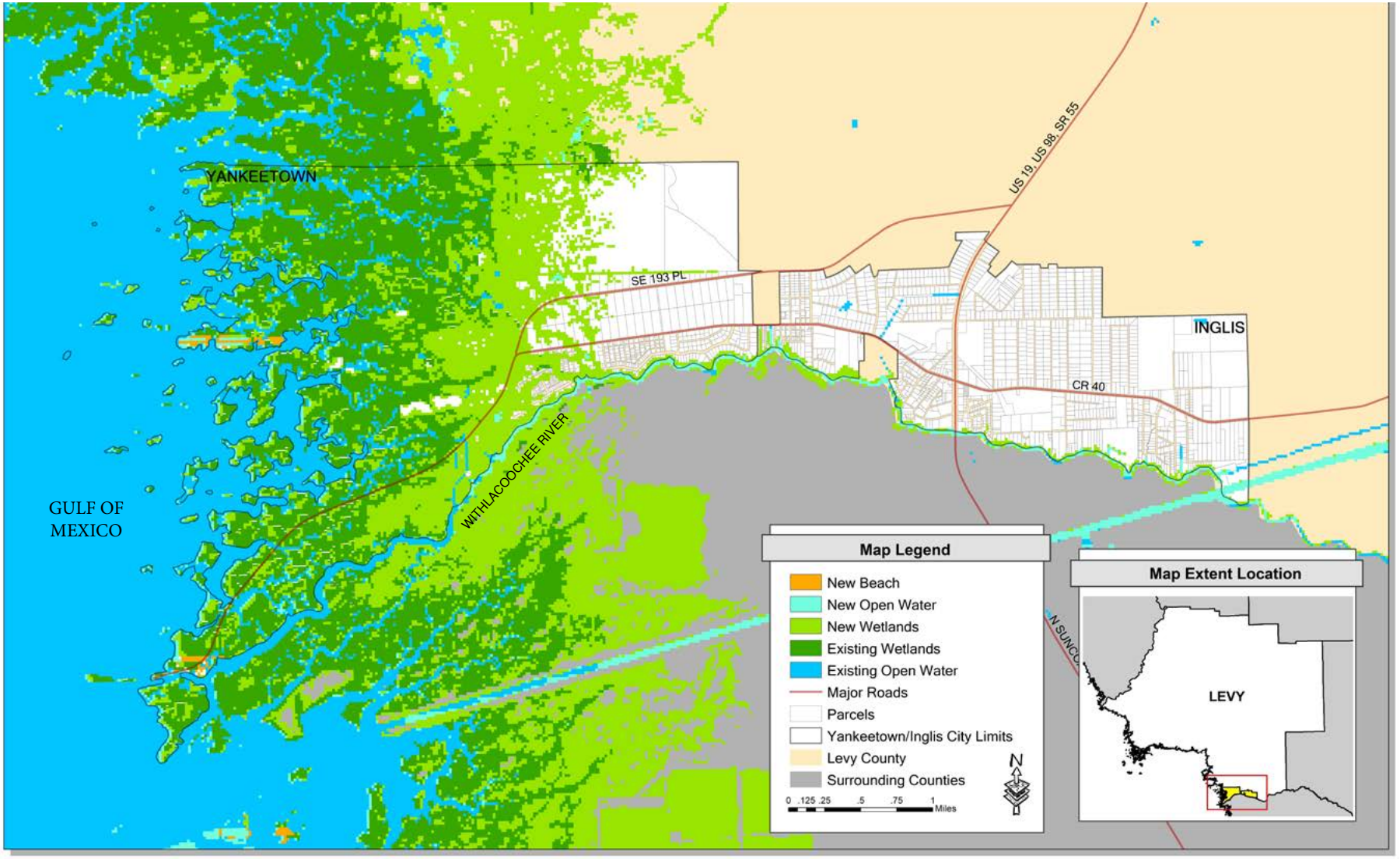


Figure 2: Areas Likely to Experience Coastal Change from 3 Feet of Sea Level Rise

SLAMM data produced and provided courtesy of The Nature Conservancy

Project Approach

The purpose of the Yankeetown-Inglis Adaptive Design Project was to focus attention on coastal changes, particularly sea level rise, in the Yankeetown-Inglis area in order to recommend locally specific strategies for community adaptation. A team of six University of Florida faculty, staff, and graduate research assistants conducted the project during the summer of 2013. Each member of the project team had prior experience and expertise with adaptation planning and design, including in Cedar Key as part of the Planning for Coastal Change in Levy County project, and other regions of Florida.

The Yankeetown-Inglis project followed an eight-step process for analysis, public input, and design:

1. Inventory and analyze social, economic, policy, and geographic data for the study area

A key analysis was geographic information systems (GIS) mapping of coastal change predicted by the Sea Level Affecting Marshes Model (SLAMM), using data provided by The Nature Conservancy. The scenario of focus was a 3-feet (1-meter) sea level rise by the year 2100, which, according to current science, is the mid-range scenario. The team mapped this scenario at 25-year increments. Given the gradually sloping terrain, and research demonstrating the accuracy of SLAMM in this area, the project team was confident in use of these data. The variety of other study area data are presented throughout this report, including in the appendices. These data were considered in an integrated fashion in the steps that follow.

2. Visit the study area and perform an informal visual analysis

The project team made several trips to the Yankeetown-Inglis area to comprehensively explore different places and take photographs. Of particular interest was capturing the identities and functions of different places as they relate to the whole study area, and their potential roles in adaptation. The team's personal observations during these and prior visits were critical to the designation of the six Adaptation Areas presented in this report.

3. Facilitate citizen and community leader input

Two public workshops provided local citizens and community leaders the opportunity to learn about coastal change and the Yankeetown-Inglis project, and to provide input for designing the adaptation strategies. The first workshop on was held in Yankeetown on July 11 and attended by eleven persons. The first workshop included team presentations of potential impacts of sea level rise and types of adaptation strategies, and participant input via a strengths, weaknesses, opportunities and threats exercise (see below) and a small group adaptation strategies role-play game. At the second workshop on August 15, held in Yankeetown and attended by nine persons, the project team presented the draft adaptive design recommendations. Although the number of people attending the workshops was small, attendees included those in leadership positions in both towns, such as elected or appointed officials and municipal staff. These persons will be critical to use of this report. Separate report sections detail the public input provided at the two workshops.

4. Establish project goals and objectives

The project team drew from their extensive experience and expertise with rural community and environmental planning, sea level rise adaptive design, and the larger project, Planning for Coastal Change in Levy County, to establish a set of project goals and objectives to guide the analysis and design process. These goals and objectives are presented in the next section so that readers will understand the motivations behind the design recommendations.

5. Identify strengths, weakness, opportunities and threats (SWOT)

SWOT analysis is a planning technique used to capture community priorities, concerns, and ideas for local action. In the case of this project, the change is primarily sea level rise, and there are associated community strengths, weaknesses, opportunities, and threats. The project team combined SWOT analyses conducted by the project team based on the first and second steps above, and the SWOT exercise at the first public workshop. The results are presented in a separate section.

6. Spatially analyze the interplay between sea level rise, community functions and needs, and visions for the future

The main analytic approach taken by this project was spatial analysis and visioning at the community to regional scales, with a focus on the built environment within the two municipalities. The SLAMM maps showed areas vulnerable to sea level rise between now and the year 2100. The project team overlaid the SLAMM year 2100 map with maps of the built environment, along with an inventory of included population, buildings, and infrastructure. The changes in Yankeetown, and along the Withlacoochee River in both

towns, were then related to planning for each individual town and in coordination across both towns and the region. This step resulted in the designation of six Adaptation Areas in this report, including each area's defining characteristics and roles in adaptation. Each Adaptation Area is described in detail later in this report.

7. Research adaptation strategies and planning options appropriate for the study area

The project goals and objectives specify that the strategies recommended in this report provide effective and implementable adaptation to local sea level rise. The strategies should be in keeping with local priorities and the particular aspects of the study area, especially the rural and small town characteristics. The team thus researched particular promising strategies, such as riverine site design and access, alternative housing and neighborhood types, appropriate wastewater technologies, and main street and transportation corridor designs. An additional line of research was the use of biomimicry as an adaptive design approach for the built environment. The results are presented for each Adaptation Area, and in the appendices.

8. Make recommendations for adaptation strategies using community planning and design principles

The project team synthesized information from the previous steps to provide examples of site/project, neighborhood, and community-level adaptation strategies for each Adaptation Area. These strategies are described for each Adaptation Area. To aid the towns' prioritization and implementation of strategies, the report contains a matrix comparing uses, pros, and cons of the various strategies. And, the report's conclusions offer guidance for coordinating the strategies within existing and future planning processes, policies, and funding mechanisms.

Goals, Objectives, and Planning Strategies

Based on community input, local research, and planning expertise, the project team created a list of goals and objectives to guide their analyses and recommendations.

Goal 1 - Maintain community functions and identities

Objective 1.1 - Uniquely plan for each town and maintain what makes each town special, especially at policy and cultural levels.

Objective 1.2 - Coordinate across the two towns and larger region.

Objective 1.3 - Honor small town and rural conditions and aspirations.

Planning Strategies - Design strategies to reproduce and reinforce local culture and economy to the extent desired by residents and community leaders. Be flexible in space, and innovative in development form, to accommodate changes, such as loss of residential neighborhoods, by considering alternative replacement opportunities across town, in existing neighborhoods, or outside of town. Create a joint plan for Yankeetown and Inglis as interacting parts of a combined system. Propose adaptation strategies suited to small towns and rural areas, and the specific physical conditions of the study area.

Goal 2 - Build resiliency and adaptive capacity

Objective 2.1 - Build resiliency in the built environment.

Objective 2.2 - Build natural environment resilience.

Objective 2.3 - Build economic resilience.

Objective 2.4 - Build social and cultural resilience.

Planning Strategies - Select adaptation strategies that create community diversity and resources, while being financially and administratively efficient. Project future growth and coastal change, and plan proactively. Support all local groups, neighborhoods, and sub-populations to foster community cohesion and quality of life, and to encourage residents to be active in community development. Maintain a vision while incorporating new information and priorities. Involve citizens and community groups in providing information about locally observed coastal change, and in designing and implementing strategies.

Goal 3 - Create an actionable plan

Objective 3.1 - Design adaptation strategies that are politically, financially, and administratively feasible.

Objective 3.2 - Integrate and leverage sea level rise planning with other community goals and needs.

Planning Strategies - Evaluate and communicate strategies according to "community return on investment", local priorities, and opportunities for incremental, yet timely, action that incorporates sea level rise information and designs. Foster planning buy-in by adding value to each community in an achievable way by capitalizing on local assets. Encourage local government to lead the way through decisions involving their facilities and programs. Integrate sea level rise information and strategies into existing plans and initiatives, especially Yankeetown's comprehensive plan. Identify catalyst projects or programs that would lead to a cascade of benefits.

Community Workshops

Initial Public Workshop

On July 11th, 2013, at the Inglis-Yankeetown Lions Club, we held our first community workshop related to identifying potential sea level rise adaptation strategies for Yankeetown and Inglis. This first workshop included a presentation of areas in Yankeetown and Inglis that are vulnerable to sea level rise due to low elevation as identified by SLAMM, and activities whereby participants noted areas of current impacts and planning priorities. Participants also formed small groups and engaged in a role- playing game to identify preferred, consensus- based adaptation strategies for a hypothetical small coastal community. Participants included community leaders and residents, and their input actively guided the next phase of work, which was the preparation of the adaptive strategy options outlined in this report.

Generally, participants were concerned about the saltwater intrusion that can be accelerated by sea level rise and is likely to affect water quality and supply in the areas of Yankeetown and Inglis. It was also noted that natural resources and rural character are very important in rural areas like Yankeetown and Inglis; there is a need to consider coastal changes and sea level rise issues in terms of long-term planning while maintaining rural community character. Participants were also concerned about how policies can be changed to address sea level rise issues in the local Comprehensive Plan, Land Development Code and Zoning Code. It was agreed that it is important to get support and help from the state and agencies when addressing coastal change and sea level rise adaptation planning in small towns and rural areas.

Final Public Workshop

On Aug 15th, 2013, we held our second community workshop at the Inglis-Yankeetown Lions Club. This final workshop included a coastal change oral history video, a presentation about our proposed Community Adaptation Areas and adaptive strategy recommendations for each Adaptation Area in Yankeetown and Inglis. Participants in this workshop also included community leaders and residents, and their valuable input will help guide the sea level rise adaptation planning in practice. Water resources and related issues were still big concerns of the participants. With regard to wastewater impacts and adaptation, there was discussion of a need to increase the use of composting toilets and the possibility that manmade marshes should be used to filter community waste water. There was concern about how to manage abandoned structures if communities in areas vulnerable to coastal change relocate inland. With regard to adopting the recommendations for Adaptation Areas, participants were generally concerned about finding the necessary funding needed to facilitate adaption planning in Yankeetown and Inglis.

Strengths, Weaknesses, Opportunities, and Threats

In collaboration with participants in the first community workshop we conducted a "SWOT" analysis for Yankeetown and Inglis. The goal of this was to identify strengths, weaknesses, opportunities, and threats within the two communities with relation to adaptation to coastal change. The results from this analysis are summarized in the list below.

Strengths

- Strong sense of community
- Engaged leadership
- Community connection with the University of Florida
- Friends of Withlacoochee Gulf Preserve (WGP) and other community groups such as the Withlacoochee Area Residents (WAR)
- Outstanding waterway and natural resources
- Ecotourism and water-based economy opportunities
- Rural character
- Little development on coast
- Open space
- Strong planning culture focused on preserving the rural way of life and small population
- Pride in preserving history
- Capabilities of marshes and coastal ecosystems to buffer storm effects and to accrete soil

Weaknesses

- Low and flat geography
- No natural barriers to sea level rise
- Small population
- Older housing and infrastructure
- Limited freshwater supply
- Location of wells and septic systems
- Karst substrate

Opportunities

- Water related tourism
- Restoration of infrastructure
- Conservation of upland natural areas
- Opportunities to discourage new development along the coast

Threats

- Impacts from coastal change on low lying areas
- Saltwater intrusion (affecting freshwater supply, wells, and septic systems)
- Impacts of coastal change on property values
- Ecotourism impacts
- Decreasing tax revenues

Strategies for Adaptation to Coastal Change

Overview

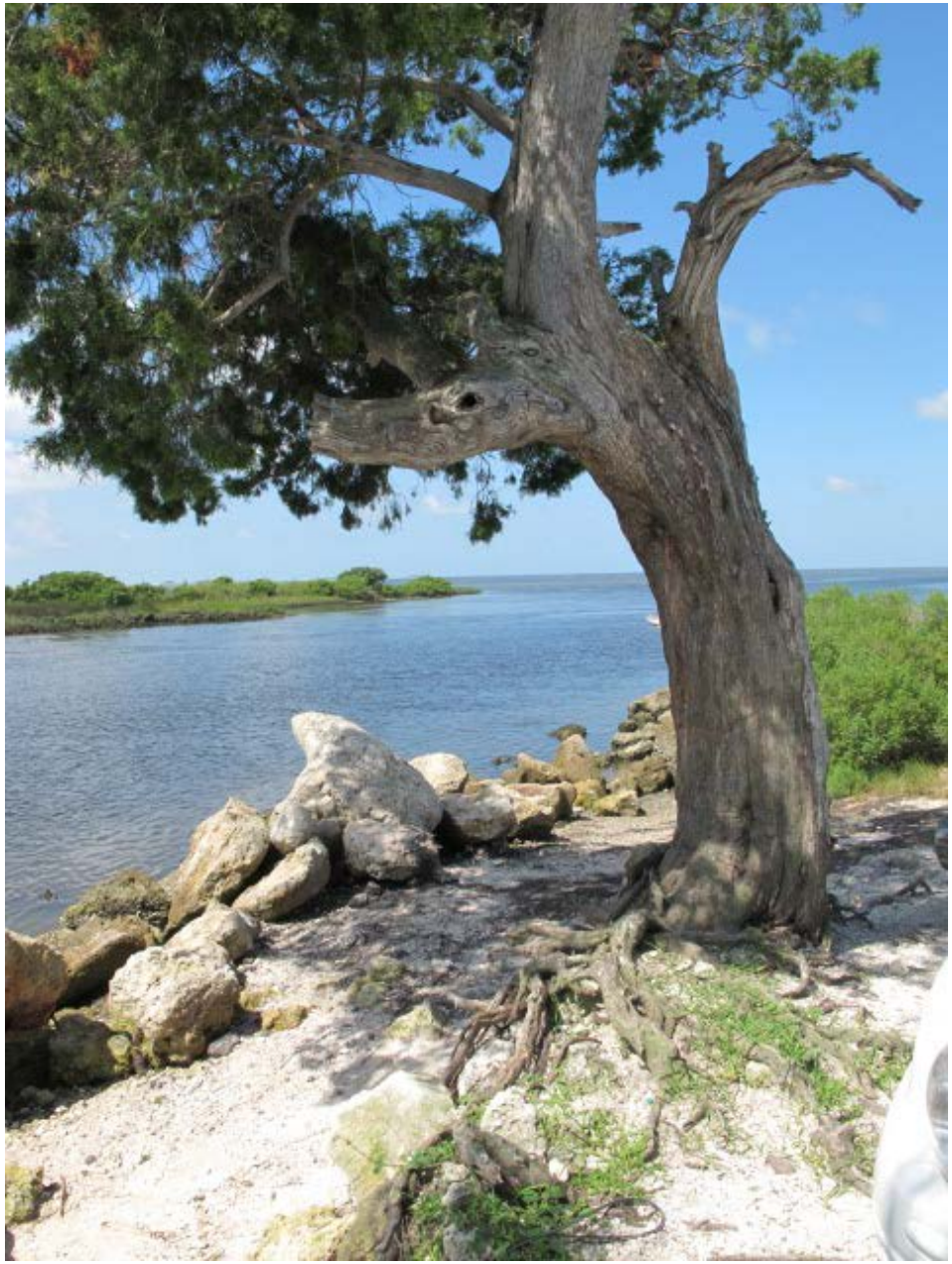
As a means of addressing the coastal changes that are projected to occur in Yankeetown and Inglis, and in order to stabilize the economy, attain fiscal responsibility, protect life and property, and maintain quality of life, we propose a planning framework of six geographically defined Adaptation Areas (AA's), within which various adaptation strategies may be implemented. The AA's represent different neighborhoods with unique characteristics, needs, and roles in adaptation.

A description of each of AA is included in the following pages, along with specific recommendations for adaptation to coastal change. At their crux, these recommendations are based on essentially two components.

First, in areas that are most vulnerable to the direct impacts of sea level rise during this century, especially AA-1 but also AA-2 along the Withlacoochee River and parts of AA-4, we recommend that future decisions about development and infrastructure take a long-term perspective, aim to reduce risk through accommodation and relocation/decommissioning strategies, and avoid protection measures that would encourage additional development and prohibit ecosystem migration. We recognize that funding and staff resources in small towns are limited, therefore we suggest that coastal change be considered in the usual timeframe for decision making as issues, needs, and opportunities arise, rather than as a separate agenda. Town officials and staff could adopt policies to facilitate the incorporation of coastal change information into decision making for vulnerable areas, such as through the post-disaster redevelopment plan, the capital improvements plan, and the construction permit program. Additionally, a moderate revision of Yankeetown's Transfer of Development Rights (TDR) program can designate the new sending area as everything at risk from coastal change, and the new receiving area as upland areas less at risk of change (AA-3 and portions of AA-2).

Second, relocation and redirection of future development should be combined with a careful approach towards redevelopment and economic stimulus within the upland receiving areas (especially AA-3, AA-5, and AA-6). We propose this begin with targeted improvements and infrastructure to support redirected development. Redevelopment may take the form of gradual relocation of civic buildings from AA-1 into upland areas, particularly along the CR 40 corridor, such as with a corridor plan. Done properly, relocation of civic buildings can be used to redirect other private development, and revitalize the upland portions of the town. Similar actions may be taken in Inglis, combined with a holistic plan for economic revitalization.

Finally, we note that this is a preliminary study. The scope and timeframe for this project did not permit us to develop solutions and plans for all the issues that need to be addressed. In the Conclusions section we have included recommendations for future studies and work.



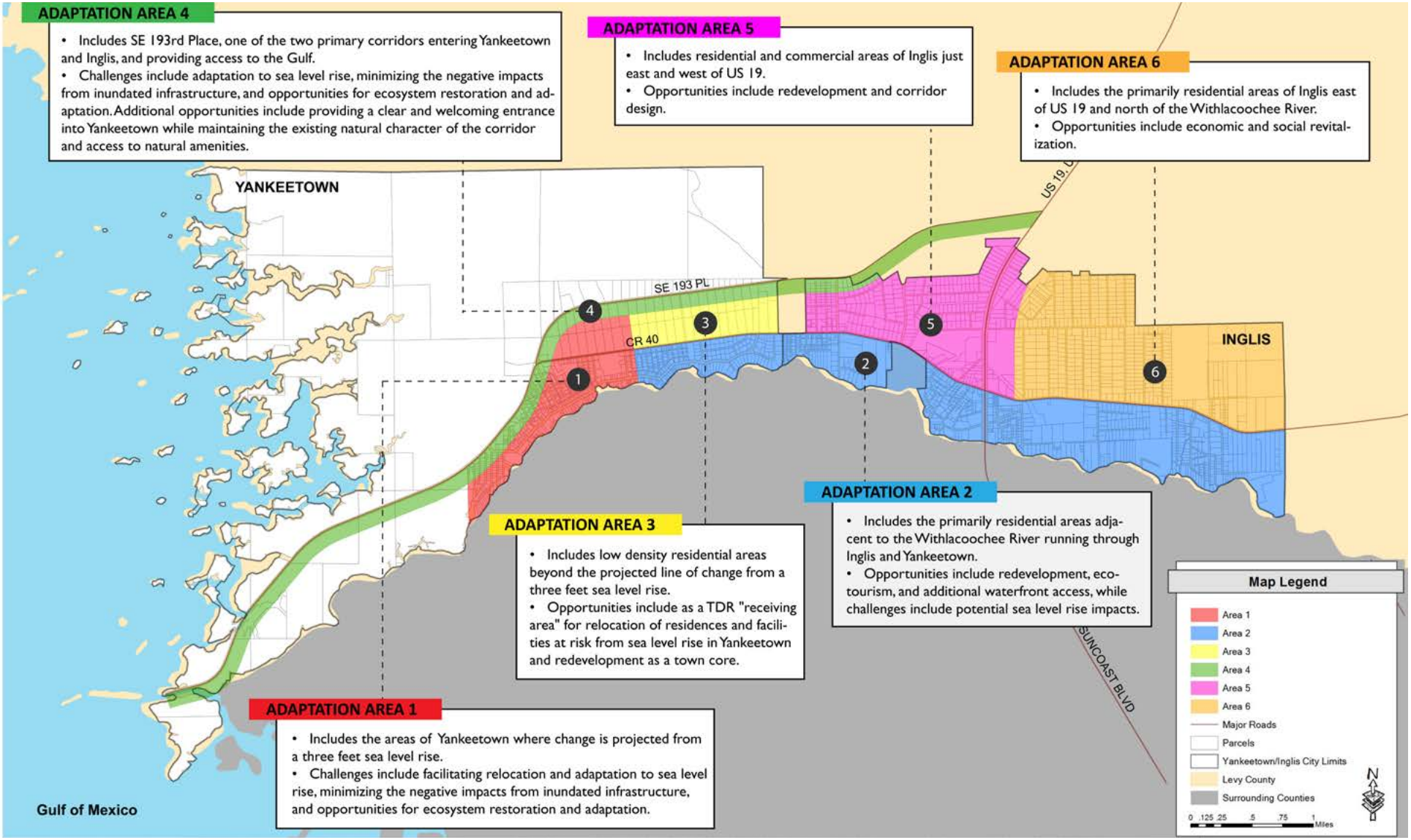
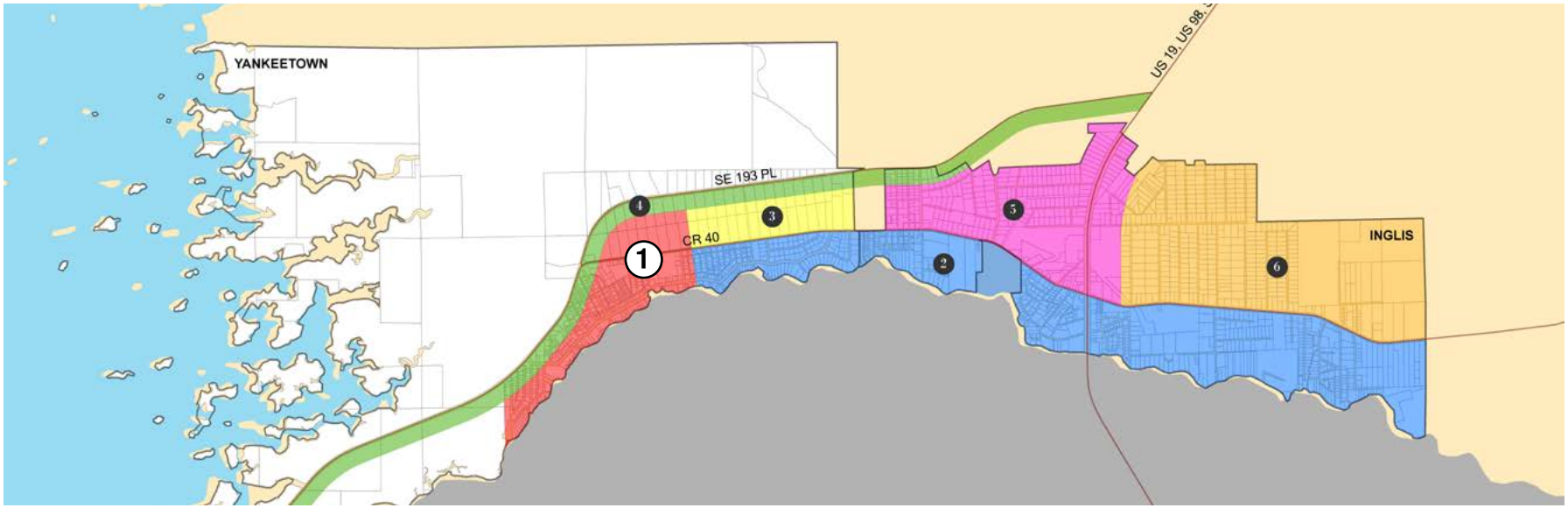


Figure 3: Proposed Adaptation Areas

Adaptation Area One: *Coastal Changes*

Adaptation Area One (AA-1) includes the western areas of Yankeetown where change is projected from three feet of sea level rise. The boundary extends east to 54th Street, north to the CR 40A corridor (SE 193 PL), and west to the canal adjacent to the western side of Palm Drive. The Withlacoochee River is the southern boundary. AA-1 is the important current "heart" of Yankeetown, where community and cultural buildings (e.g., Town Hall and the Izaak Walton Lodge), many of the town's residences, and the annual seafood festival are located (see the Appendix A for a more complete list).

Challenges here include coastal hazards, increasingly flooded infrastructure and buildings, saltwater intrusion into drinking water supplies, and possibly declining property values. Opportunities exist for maintaining some activities in this important "heart" of the town, while gradually relocating or redirecting development to other parts of the town, and ecosystem conservation, restoration, and migration. Additional challenges include identifying policies that avoid the risk of a "takings" claim of private property rights (see glossary for more information).



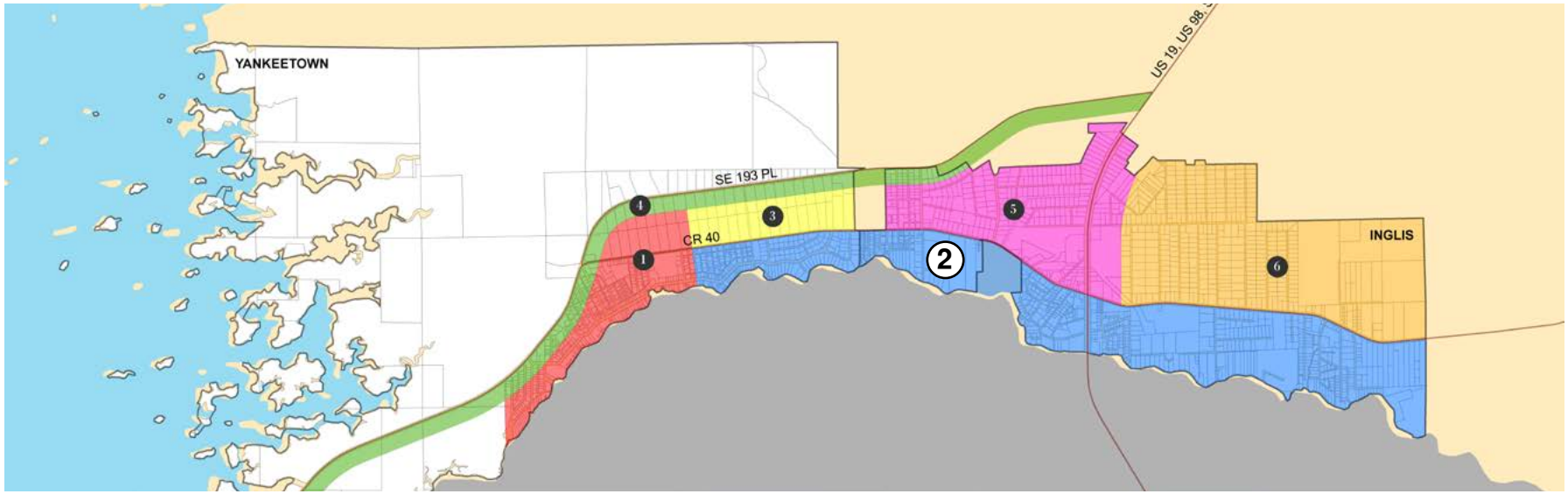
Recommendations for Adaptation Area One include the following:

1. AA-1 should be designated a Transfer of Development Rights (TDR) sending area to redirect new development. The existing TDR sending areas closer to the Gulf may be incorporated into one enlarged TDR sending area.
2. The Town of Yankeetown could lead the way by developing a plan to gradually relocate civic buildings and infrastructure, as opportunities arise, into AA-2 and AA-3 and along CR 40, and by reducing investment in new infrastructure in AA-1.
3. At the same time, incentives should be developed to encourage relocation of existing private development into the receiving areas.
4. Additionally, a financing and phasing plan should be developed to assist in transitioning and ultimately removing existing civic buildings and infrastructure, including utility and septic systems, to accommodate and minimize potential risks from future sea level rise.
5. Activities that are important for this area and deemed compatible with coastal change should be designed or redeveloped with accommodation strategies.
6. Finally, a plan should be developed to assist in ecosystem adaptation within this area, as well as along the Gulf coast to facilitate habitat migration. Such a plan would explore where habitat corridors could be established at the block level and prioritize areas for adaptation.

Adaptation Area Two: *River Changes*

Adaptation Area Two (AA-2) includes the primarily residential neighborhoods adjacent to the Withlacoochee River running through Inglis and Yankeetown, where change is projected from three feet of sea level rise. Its eastern border is the Inglis city limit, its western border is the edge of AA-1, and its northern border is CR 40, which is the main access to this area. The Withlacoochee River links the two towns and provides a high quality of life for adjacent property owners, town residents, and visitors.

Challenges include coastal hazards and sea level rise impacts along the river's shoreline and to adjacent development and natural communities. Existing infrastructure in this area may have limited capacity to handle sea level rise, rising water tables, or increased development density. Opportunities include accommodation strategies for existing waterfront development, including provision of additional public access to the waterfront, and clustered redevelopment on higher ground but still in AA-2 to maintain the communities' important relationship with the river.



Recommendations for Adaptation Area Two include the following:

1. Where sea level rise impacts along the Withlacoochee River are significant, relocation should be encouraged. If this is the case, building infrastructure (such as foundations and septic systems) may need be removed to minimize potential hazards. Yankeetown and Inglis should develop a plan for publicly or privately financing long term infrastructure removal, as well as providing incentives for relocation of endangered structures and shoreline restoration with the goal of enabling natural shoreline stabilization or if possible retreat (see glossary definitions).
2. Where impacts along the river are minimal to moderate, living shorelines and infrastructure updates (e.g., well relocation, dock refurbishment) could accommodate coastal change. Redevelopment of the waterfront could enhance public amenities for economic development and quality of life in areas of lower hazard. A redevelopment plan could include design for public waterfront access for existing and new opportunities as shown in Figure 5.
3. An infrastructure investment and management plan should be developed for the entire AA-2 to maintain vibrant downtowns in Yankeetown and Inglis. Redevelopment towards CR 40 could include the creation of an attractive, pedestrian friendly streetscape, which is attractive to residents and visitors. Suitable areas in AA-2 should be considered for addition as TDR receiving areas for relocated uses in AA-1.
4. Guidelines should be established for new development in AA-2 that includes the following considerations (in addition to those just mentioned).

    » Encouragement of water dependent and related uses through zoning changes that incentivize such uses (see inset)
    » Requiring development design standards in-keeping with the existing historic and small town character of Yankeetown and Inglis
    » Requiring development that uses low impact development techniques (see glossary definition)

Water Dependent Use: *Water-dependent uses are land uses for which water access is essential and which could not exist without water access. (Lee County Comprehensive Plan) Examples could include fishing piers, boat ramps, or marinas.*

Water Related Use: *Activities which are not directly dependent upon access to a water body, but which provide goods and services that are directly associated with water-dependent or waterway uses. (Citrus County Comprehensive Plan) Examples of water-related businesses include kayak/canoe shops, bait and tackle shops, maritime history museums, and others.*

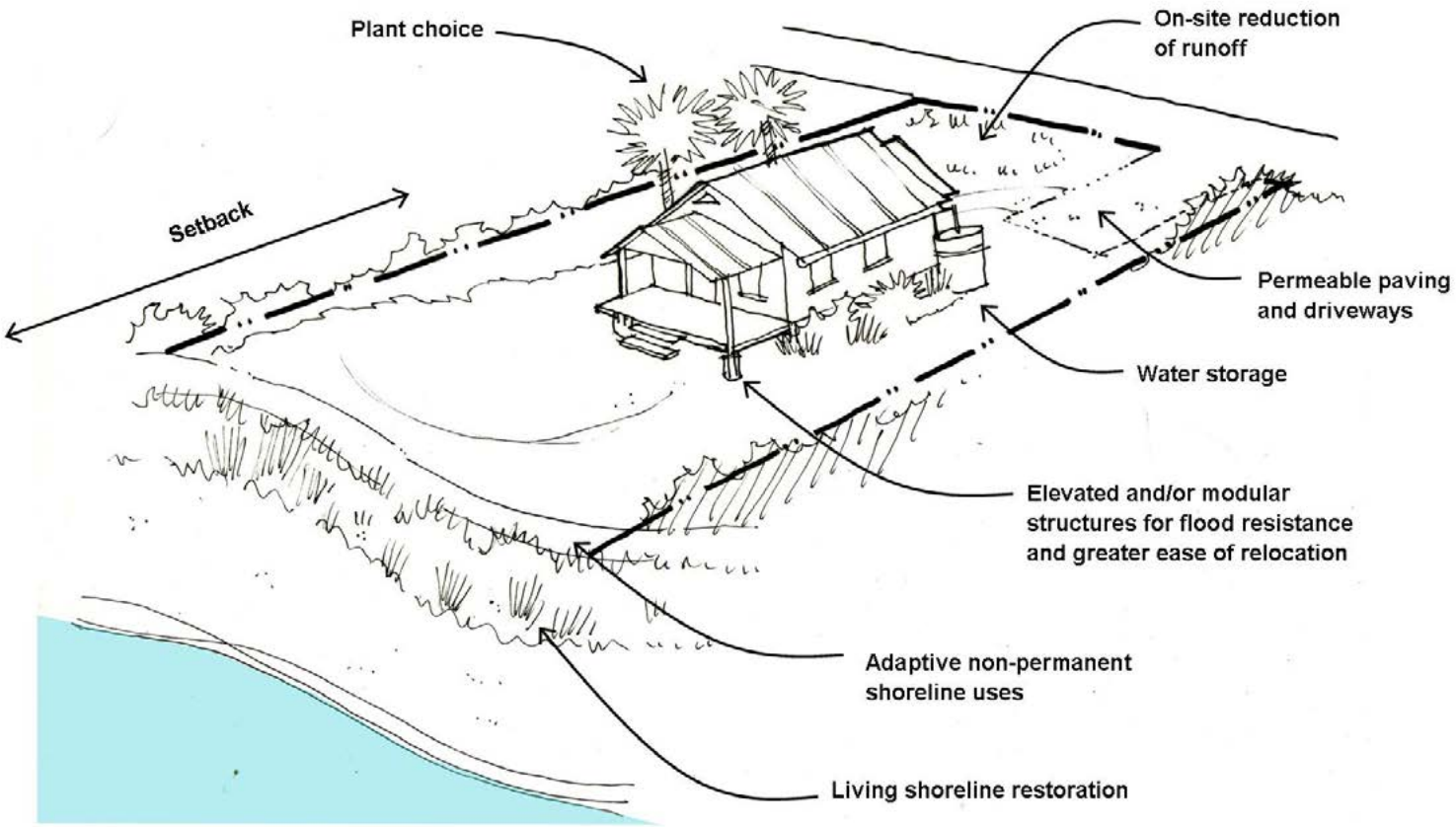


Figure 4: Example of Riverfront Site Design for Adaptation Area Two
This image illustrates the use of low impact design principles at an individual parcel scale. These are not only good design principles to use today to maintain healthy shorelines and water bodies, but also can be used to address future sea level rise impacts.

Figures 5 and **6** illustrate lot design and layout options for shoreline redevelopment and adaptation along the Withlacoochee. The lot layout options here are most applicable for new development but may apply to existing development as well. Figure 5 illustrates an option whereby buildings on piers may be relocated upland on narrow lots as sea levels rise. Figure 6 shows a "cluster development" design (see glossary definition) which allows for preservation of larger natural undeveloped areas (which may help shoreline ecosystems adapt to sea level rise), provision of ecosystem services (such as more land for onsite stormwater drainage) and also provides opportunities for visual and physical public access.

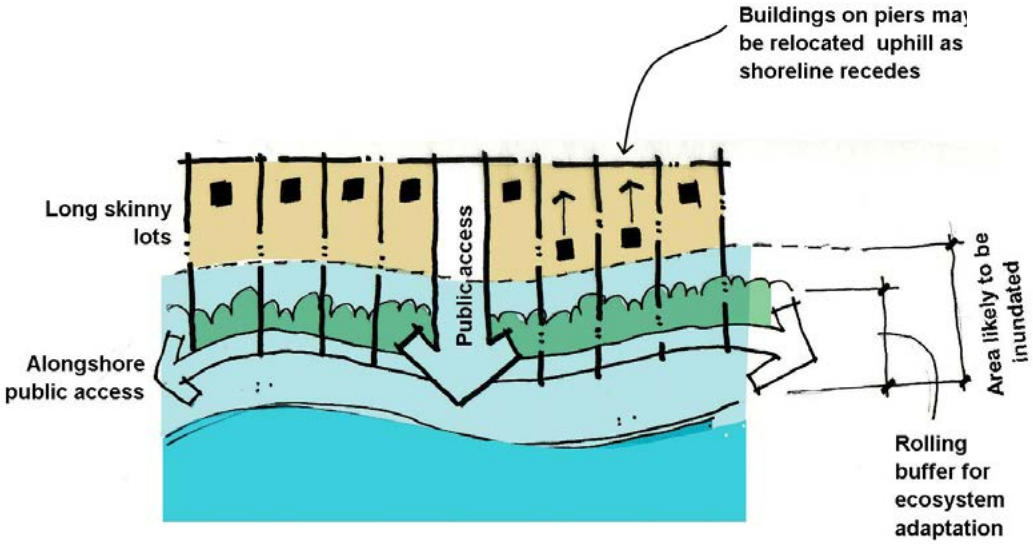


Figure 5: Shoreline Adaptation Option One

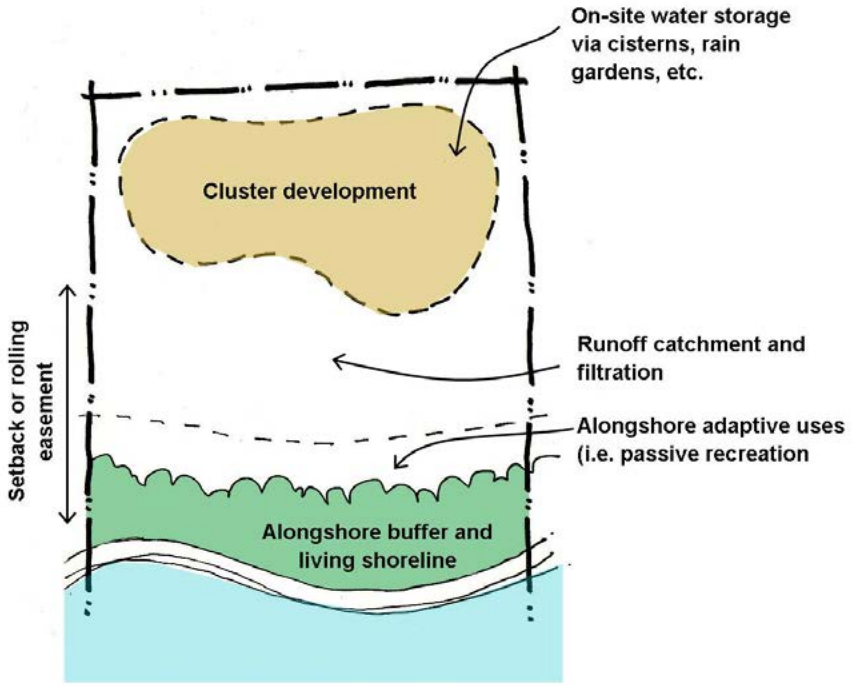


Figure 6: Shoreline Adaptation Option Two

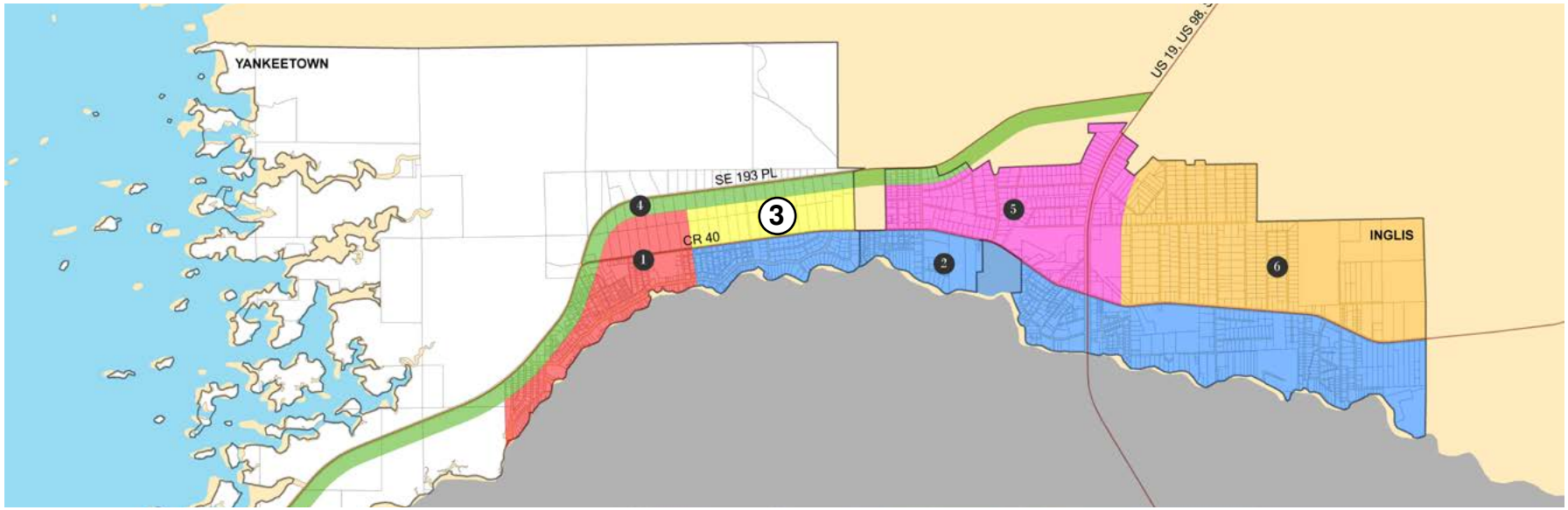
Infrastructure upgrades might be necessary if additional development occurs in AA- 2 (such as alternative decentralized sewage technologies or cluster sewage systems). New development should be discouraged in high hazard areas, and new buildings should be sited to avoid relocation if possible from the start. Finally, in both of these options an alongshore buffer is maintained which allows for natural shoreline migration inland as waters rise, as well as potentially public access (shoreline conditions permitting). Any construction in these areas should be non-permanent or relocateable. Note that there are legal mechanisms still relatively untested in Florida (see glossary definitions of rolling easements and takings) that may be considered to enforce the ability for shorelines to naturally migrate inland.

Adaptation Area Three: *Yankeetown Upland*

Adaptation Area Three (AA-3) includes the low-density residential areas beyond the projected line of change from a one-meter rise in sea level. This area is bounded by CR 40 to the south, CR 40A to the north, and the Yankeetown city limits to the east. Opportunities here include revitalization and moderate redevelopment, particularly along the CR 40 corridor, as well as the potential for AA-3 to serve as a TDR "receiving area" for relocation of residences and facilities at risk from sea level rise in Yankeetown. Challenges in this area include maintaining Yankeetown s natural aesthetic and small town character while accommodating infill and redevelopment. Additionally, existing infrastructure does not support increased development intensity and soil and environmental factors highly constrain decentralized wastewater and sewage systems.

Source: www.maps.google.com, 2013.

Existing conditions: CR 40



Recommendations for Adaptation Area Three include the following:

1. AA-3 should be designated a TDR receiving area for development at risk from coastal change. It may also be a focus for new infill and redevelopment of the town core outside of the vulnerable area beginning with institutional buildings as a catalyst for new investment.
2. Minimum lot size requirements in this AA- should be reduced or eliminated to allow for additional density.
3. Zoning codes should be revised to allow for multi-use development within certain portions of this AA-, particularly along CR 40. Residential zoning may remain appropriate elsewhere in the AA-.
4. Targeted infrastructure improvements should be considered, addressing potential impacts from coastal change. This may require a specific study and recommendations by infrastructure experts and planners (see water resource adaptation appendix for further information).
5. AA- 3 is within/adjacent to the proposed Natural Resource AA-A. Therefore low impact development (LID) principles should be used, in conjunction with conservation design principles, such as provision of buffers adjacent to conservation areas.
6. Physical and visual connections are encouraged to the multi-use trail proposed along CR 40A and orientation of development towards CR 40.

Source: www.maps.google.com., 2013

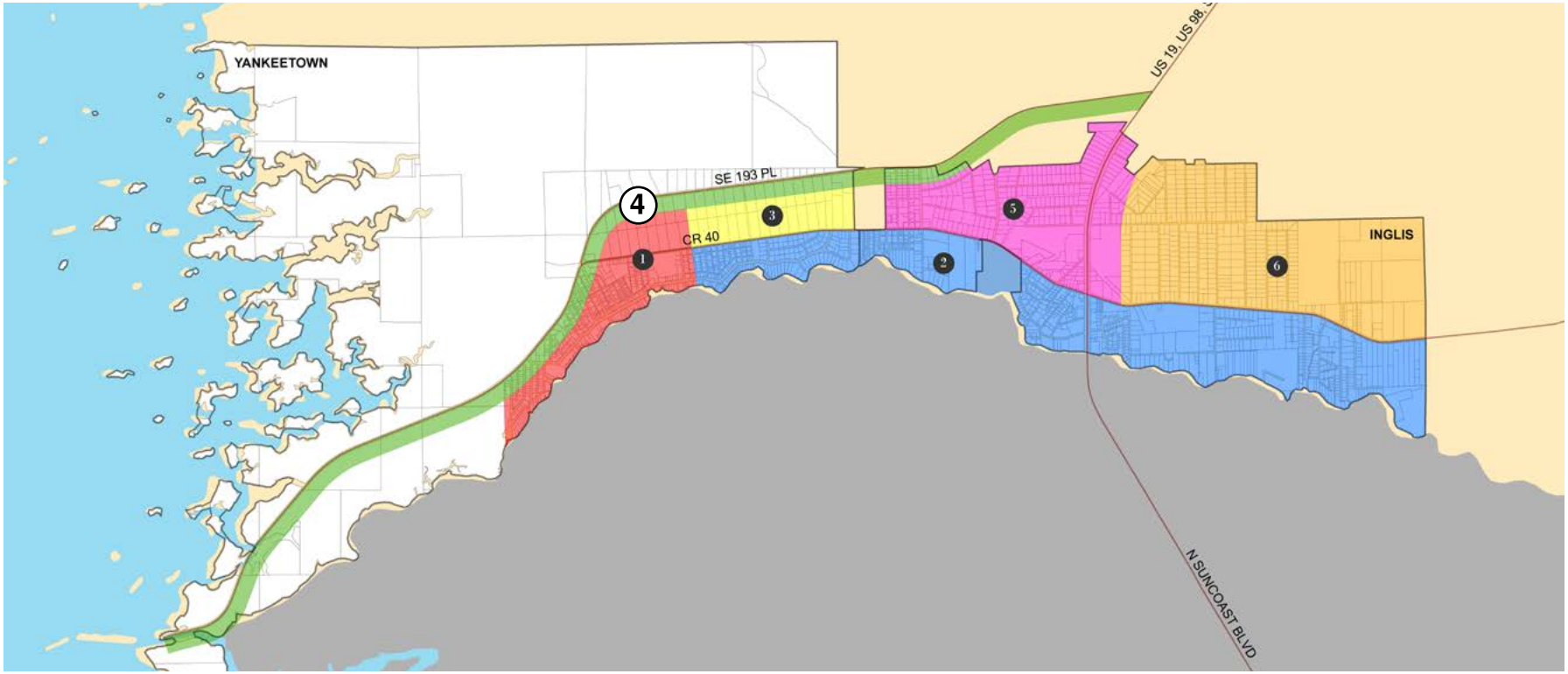
The area along CR 40 has the potential to become a new town core, once uses in the existing historic core of Yankeetown are relocated or less inhabitable because of coastal changes. Design guidelines should guide the development along the corridor from the start, with relocation of civic buildings as a catalyst for new private development.

The image above is an example of a streetscape that is similar to CR 40. Note the low density character and placement of buildings and the pedestrian scale of the street (including sidewalks, native street trees, on-street parking, and 1-2-story buildings close to the roadway).

The image at right represents a style of residential development which may be suitable for AA-3, but is also developed at a higher density, which in AA-3 might be necessary due to the limited land available.

Adaptation Area Four: *Coastal Gateway*

Adaptation Area Four (AA-4) includes the southern portion of the SE 193rd Place right of way, which is one of the two primary corridors entering Yankeetown and Inglis. The proposed area begins at the intersection of CR 40A and US 98 and continues until it ends at the Gulf. Challenges here include providing a clear and welcoming entrance into Yankeetown, while maintaining the existing natural character of the corridor. Opportunities include the same: to create a clear and welcoming entrance to Yankeetown, helping draw new visitors to support the ecotourism opportunities that Yankeetown and Inglis offer. CR 40A is an imporant corridor connecting Yankeetown and Inglis from east to west and to the Gulf, therefore pedestrian access along this corridor, and good design of the entrance into the community is important.



Recommendations for Adaptation Area Four include the following, coordinated as need be with Levy County:

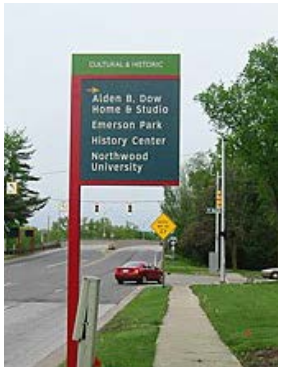
1. Construct new signage at the intersection of CR 40A and US 98 which clearly identifies it as an entrance to Yankeetown and Inglis. This should be of a design in keeping with the natural and rural character of the two communities.
2. Space permitting, create a multi-use trail, which can be used by bikers and pedestrians within the CR 40A right of way. This should include additional wayfinding signage and lighting.
3. Connections should be created from this trail into the cores of Yankeetown and Inglis to encourage connectivity and use. The trail should provide connections to natural areas, and be designed to accommodate coastal change.
4. Maintain to the greatest extent possible all existing non-invasive/exotic vegetation along the corridor, particularly shade trees, with the goal of maintaining the natural and rural character of the corridor.

Source: www.maps.google.com, 2013.

Existing conditions: Intersection of US 98 and CR 40A

Source: Wisconsin Department of Transportation, 2011.

Source: MacDonald, S. , n.d.



Source: City of Midland, MI, n.d..

Source: Walter, F.B, 2006.

Examples of signage and roadway design. Note the elevated pathway, which could extend the multi-use trail in areas inundated by sea level rise to allow pedestrian access to the Gulf. Temporary, elevated, relocateable, or replaceable designs should be considered in areas at risk from coastal change.

Adaptation Area Five: *Inglis Core*

Adaptation Area Five (AA-5) includes the western portion of Inglis that is not at direct risk from sea level rise impacts. The southern border runs south to CR 40, east to include US 19, and north and south to the city limits.

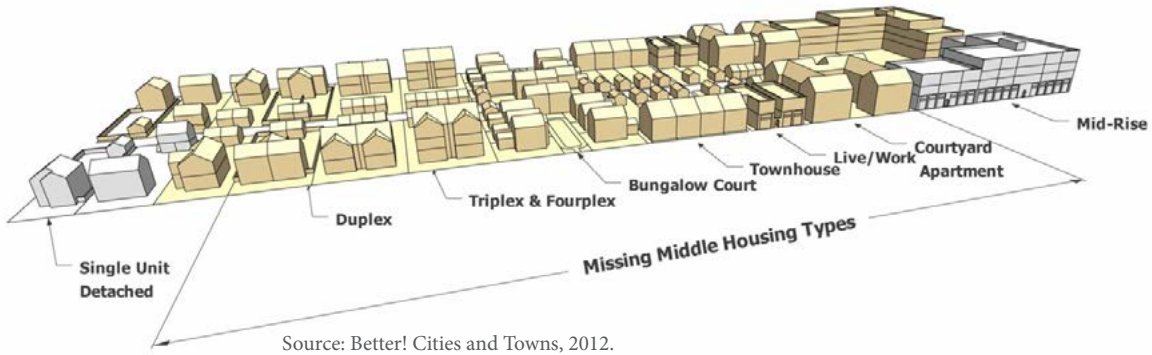
Opportunities and challenges include corridor design for CR 40, economic development potential as a result from coastal change, and guidance for potential infill within the Adaptation Area to accommodate future growth.

Source: www.maps.google.com, 2013.

Existing conditions along US 19

Recommendations for Adaptation Area Five include the following:

1. A "Corridor Design Plan" is needed for CR 40 and US 19 where it runs through the area. Ideally, the character of CR 40 as it is redeveloped in Inglis may be differentiated from the streetscape where it runs through Yankeetown. Pedestrian crossing and connectivity across US 19 must be addressed.
2. AA-5 needs a redevelopment plan to address social, economic, and infrastructure revitalization
3. Physical and visual connections should be made to AA-2, which lead pedestrian and vehicular visitors to the waterfront, and AA-4, which lead pedestrian and vehicular visitors into the center of town. These may include signage or pedestrian right of ways for example, which connect to pedestrian paths leading into town.
4. Consider application to the Florida Main Street program as a means of receiving technical support for redevelopment needs.
5. Consider encouraging a range of alternative housing types and mixed uses (see examples below).



Source: Better! Cities and Towns, 2012.

Existing structure/asset in AA-5

Source: National Trust for Historic Preservation, n.d.

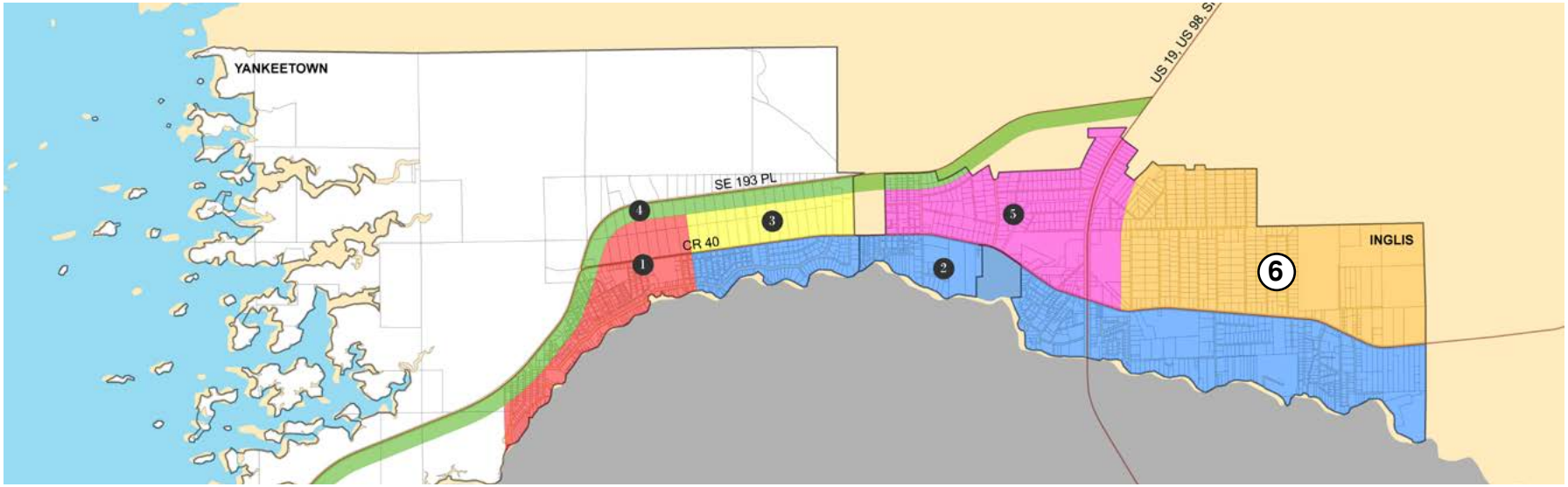
Example of a vibrant commercial area

We see revitalization of AA-5 as a primary need, which can occur as part of the process of careful adaptation planning to coastal change. AA-5 can build off of existing assets, identity, and community values (possibly identified through a visioning process) to create a plan for redevelopment in this area.

Adaptation Area Six: *East Inglis Upland*

Adaptation Area Six (AA-6) includes the primarily residential areas of Inglis east of US 19 and north of the Withlacoochee River. Challenges and opportunities here include corridor design for CR 40, and economic and social revitalization combined with redevelopment within the Adaptation Area as a whole.

Source: www.maps.google.com, 2013.
Existing conditions



Recommendations for Adaptation Area Six include the following:

1. We recommend that the City of Inglis develop a redevelopment plan for this area, addressing social and economic redevelopment as well as infrastructure. This may be similar to the plans traditionally developed for Community Redevelopment Areas, but the area need not officially be designated/approved as such.
2. Redevelopment should consider both the CR 40 corridor as well as the inner neighborhoods. A Corridor Design Plan is recommended.

Source: US Department of Transportation, n.d.

Redevelopment within the neighborhoods and vacant parcels of AA-6 could consider using a more cohesive approach to neighborhood design. For example development of pocket neighborhoods (image at right) and pocket parks can be a way of encouraging interaction between neighbors and community spirit. This doesn't necessarily apply to existing development, but could apply to new infill development within the AA-, and relates to the concept of cluster development (see glossary).

Source: King County Housing Authority, n.d.

Equally or more important than physical design, we see the building of community and youth connections within AA-6 and Inglis in general as something critically important. This could be accomplished via community and youth programs in existing facilities, but ideally would involve visioning to identify needs that are currently not accommodated (such as a skate park or community center) and development of a funding plan.

Source: Ross Chapin Architects, 2013.

Conclusions

We believe that proactive, incremental adaptation to coastal change is possible in Yankeetown and Inglis. Adaptation will not be easy, particularly in the areas at risk of direct impact by sea level rise in the coming decades (especially Adaptation Area One), but if begun now and carefully planned with a combination of hazard mitigation, economic revitalization, and design strategies, the future for Yankeetown and Inglis can be positive. We have identified several concepts and approaches that are important in all the Adaptation Areas:

- Coordinate relocation, redevelopment, and restoration to ensure economic and social vitality, physical and visual waterfront access, and continued water dependent and water related uses.
- Increase functional connections between natural and built areas, Yankeetown and Inglis, and with surrounding Levy County and Citrus County, including for transportation (land and water), economic, social, and environmental aspects.
- Target investment, disinvestment, and a broad range of policies including incentives, disincentives, and regulations.
- Leverage resources through partnerships with federal, state, regional, and county governments, universities, and the private/non-profit sector.

In addition, we've identified several recommendations for follow-up work and studies. Some of these have been mentioned previously, but are summarized again here:

- A Relocation Plan that addresses incentives for development relocation from vulnerable areas in AA-2 and AA-1, as well as a financing plan for relocation of abandoned infrastructure.
- An Infrastructure Plan to address potential impacts from coastal change and adaptation of septic, sewer, and other utilities. This should relate to the relocation plan and include a procedure for amending and adapting the plan as coastal conditions change.
- Design guidelines for all Adaptation Areas, so new or relocated development is in keeping with the desired community character of Yankeetown and Inglis. These may also include "performance guidelines" to ensure that new development is compatible with local goals and needs (infrastructure, desired public amenities, economic benefits). Low Impact Development (LID) practices should be required or at minimum incentivized in all areas, as they directly affect the health of coastal ecosystems.
- Separate Corridor Plans for US 19 and CR 40 where they run through Yankeetown and Inglis, to attract redevelopment, enhance design, and increase the economic potential of these corridors.
- A Post-disaster Redevelopment Plan to facilitate relocation and accommodation strategies in areas subject to coastal change, as well as redevelopment in less vulnerable areas.

A combination of methods will be necessary to address the two pronged approach of adaptation and revitalization that we've outlined. Community visioning should be the first step to 1) continue to educate the community on coastal change issues, 2) identify a process for moving forward, and 3) to build community buy-in and support. A good outcome from this would be goals and objectives for both the adaptation and revitalization prongs.

Next, city staff may introduce and determine public preference for tools that can be used to meet community goals and objectives. It is likely that these tools will begin with comprehensive plan amendments, and may be followed by land development code and zoning changes. More specific plans and tools may be important as outlined elsewhere in this section. It will be important to coordinate policies for the six Adaptation Areas presented here with those in the proposed Natural Resource Adaptation Action Area. A second "Community" Adaptation Action Area could be designated, provided that planning for this area is well coordinated with other areas as we've recommend in this report.

Financing is an issue for both development of plans and their implementation (such as infrastructure updates). City staff should immediately begin researching funding options. This may include contacting state or county staff, university, or private consultants to carefully develop a list of prioritized funding options. A starting point for technical assistance and funding information is the Florida Department of Economic Opportunity (DEO) Office of Community Resiliency. All possible state and federal funding options should be explored, as well as local options such as tax increment financing (TIF) and utility improvement taxes. In particular, designation of an official Community Redevelopment Area (CRA) should be researched for both feasibility and benefit. The TIF which can be used by CRAs is potentially a valuable tool that could be ap-plied to the two pronged approach that has been outlined. Adaptation to coastal change must be a careful and deliberate process, which includes community and governmental partners. Yankeetown and Inglis have the planning and community capacity to be successful and possibly even thrive as coastal changes occur.

Glossary

Cluster Development: Cluster development is a land use planning strategy where new development is "clustered" within a particular portion of the site at a higher density, and other portions of the site are left undeveloped. In contrast with traditional site planning strategies, cluster development may have a smaller footprint and can be used to preserve significant open space or natural features on a site.

Coastal Change: Any physical change to the shoreline including processes such as erosion, coastal landslip, permanent inundation, and coastal accretion. Coastlines are naturally dynamic and change physically, chemically, and biologically from scales ranging from very local to global. Human activity influences coastal change further by modifying and disrupting coastal environments and the natural processes of change. In this report, "coastal change" generally refers to any change incurred to the coastline and its land cover that is associated with changing sea levels, storm surge, saltwater intrusion, or erosion/accretion patterns.

Living Shoreline: A shoreline stabilization technique and management practice that provides erosion control benefits; protects, restores, or enhances natural shoreline habitat; and maintains coastal processes through the strategic placement of plants, stone, sand fill, and other structural organic materials (e.g. bio-logs, oyster reefs, etc). (Adapted from NOAA-.gov).

Source: Lynnhaven River Now, n.d.

Living shoreline installation

Low Impact Development (LID): The US EPA defines LID as an approach to land development (or re-development) that works with nature to manage stormwater as close to its source as possible. LID employs principles such as preserving and recreating natural landscape features to create functional and appealing site drainage systems that treat stormwater as a resource rather than a waste product. LID encourages water management in a way that reduces the impact of built areas on the non-built environment and promotes

the natural movement of water within an ecosystem or watershed.

Rolling Easement: A rolling easement is a legal and policy tool that can be used to enable natural shoreline retreat in response to sea level rise and limit endangerment to human development. In Florida, lands below the mean high water mark are technically sovereign submerged lands. As sea levels rise, this policy is enforced and at the same time coastal protection is prohibited. Since shorelines are no longer protected, the mean high water line will migrate landward in response to sea level rise. With the exception of coastal protection measures, property owners are allowed to use coastal lowlands as they choose, but a legal mechanism is set up to ensure that the land is abandoned as it is inundated. To the authors' knowledge, this policy has not been used in Florida, however there are precedents for its use in other states.

Sea Level Affecting Marshes Model (SLAMM): SLAMM is a software tool that can be used to simulate the potential changes in shorelines and coastal natural communities under various scenarios of sea level rise. In contrast to a model that assumes that all land below a certain elevation is inundated by sea level rise (commonly referred to as a "bathtub model"), SLAMM simulates dynamic wetland and shoreline processes as well. In the Yankeetown-Inglis project area, SLAMM projects large shifts in wetland communities inland, and projects a smaller amount of upland conversion to open water than might be seen using a simple "bathtub" model. Other potential changes that will occur in Yankeetown-Inglis under sea level rise include impacts to water supply and septic systems caused by a rising water table, increased flooding, and saltwater intrusion into the underground aquifer.

Taking: The term "taking" is related to the Fifth Amendment of the United States Constitution, which states that, "No person shall be . . . deprived of life, liberty, or property, without due process, of law; nor shall private property be taken for public use, without just compensation." A taking can occur both if property is physically taken without just compensation, or even when an undue burden is placed on a property owner, such as through regulation, that unjustly limits the use or value of their property. In AA-1, qualified legal assistance and/or additional technical assistance should be consulted prior to implementing any land regulation that limits use or could be considered a taking as a precaution to avoid litigation.

Tax Increment Financing: Tax increment financing is an extremely useful funding mechanism that may be used in combination with a Community Redevelopment Agency to fund redevelopment, blight eradication, and infrastructure improvements. When a redevelopment area is designated, the current assessed values of properties within the area are assigned as the base year value. Tax increment revenue is generated by increases in tax revenues as property values increase within the area. The tax increment is the difference between the base value and any additional tax based on an increase in property values at the end of the year. The CRA can use this money for redevelopment activities, but usually the tax increment from each redevelopment area must be used within that same area.

Water Dependent Use: Water-dependent uses are land uses for which water access is essential and which could not exist without water access. (Lee County Comprehensive Plan) Examples could include fishing piers, boat ramps, or marinas. The need to create specific space for water related and dependent uses has come as a rising population has flocked to waterfront areas throughout Florida, causing land values to rise and pushing-out businesses that depend on proximity to waterways in order to transact business.

Water Related Use: Activities which are not directly dependent upon access to a water body, but which provide goods and services that are directly associated with water-dependent or waterway uses. (Citrus County Comprehensive Plan) Examples of water-related businesses include kayak/canoe shops, bait and tackle shops, maritime history museums, and others.

Example of a water related use. Note the care placed towards the building and site design.

Image Citations:

Better! Cities and Towns. (2012). Diagram of Middle Housing Types. [Drawing]. Retrieved August 2012, from: http://bettercities.net/news-opinion/blogs/dan-parolek/17698/missing-middle-housing-responding-demand-urban-living

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www.maps.google.com. (2013). [Existing conditions]. Retrieved August 2013, from: https://maps.google.com/

Appendix A: GIS Inventory and Analyses

A variety of inventory and analysis work was conducted in Yankeetown and Inglis prior to beginning work including collecting and reviewing the existing and future land use maps, regional conservation priorities, and information regarding water supply and wells. Additional data were collected including SLAMM model projections for the area, elevation data, and storm surge data. These were overlaid with conservation priorities, land use, and water supply data to assess potential impacts. These maps served as a basis for analyzing vulnerability to coastal change and supported our final proposed adaption strategies for the study area. Primary data sources included the Florida Geographic Data Library (FGDL); The Nature Conservancy, which provided SLAMM data for the region; and Yankeetown/Inglis City staff members.

In addition to the maps on the following pages, the following information includes a list of significant structures in Adaptation Area One, which we compiled in order to understand what was at risk of coastal changes within the Adaptation Area. In addition to the structures listed here, there are of course a number of historic residential structures, for which adaptation must be considered.

Significant Structures in Adaptation Area One

Civic Buildings
» Yankeetown Town Hall
» Yankeetown Fire Station
» Yankeetown Post Office
» AF Knotts Public Library
» Parsons Memorial Presbyterian Church
» US Coast Guard

Marina Facilities
» Yankeetown Boat Co.
» B's Cypress Marina & Campground
» Riverside Marina

Commercial Structures
» Ike's Old Florida Kitchen
» Sunrise Outpost Restaurant
» Riverside Marina & Cottages
» Yankeetown Real Estate

Parks
» Children's Park
» Fisherman's Park
» Cattail Creek RV Park

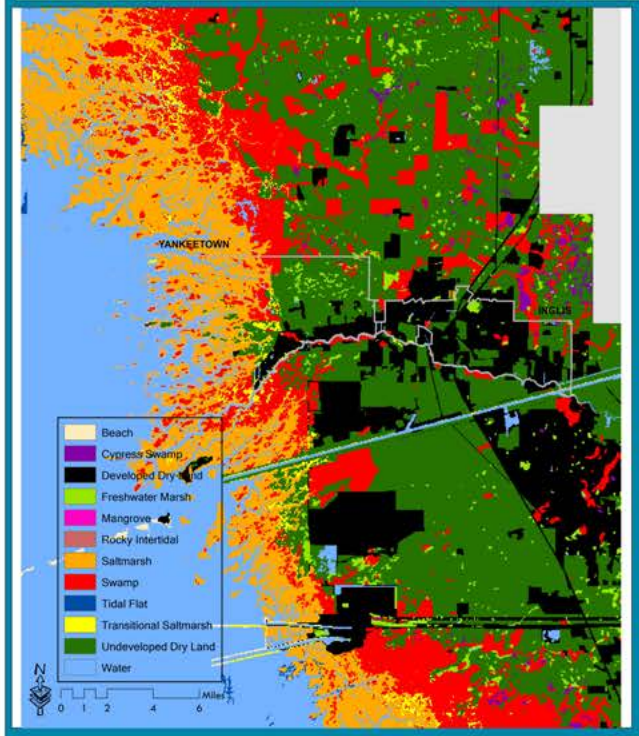
Well Construction Permit Location
» One irrigation well & Two monitor wells

Future Changes to Habitat and Land Uses: Coastal Levy County

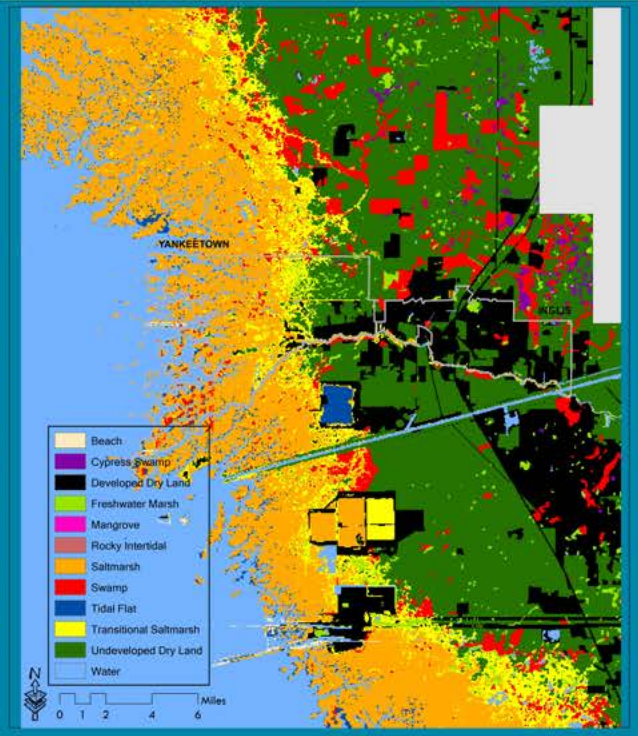
Sea Level Affecting Marshes Model (SLAMM)

SLAMM Maps
The Sea Level Affecting Marshes Model (SLAMM) simulates the dominant processes involved in wetland conversions and shoreline modifications during long-term sea level rise.

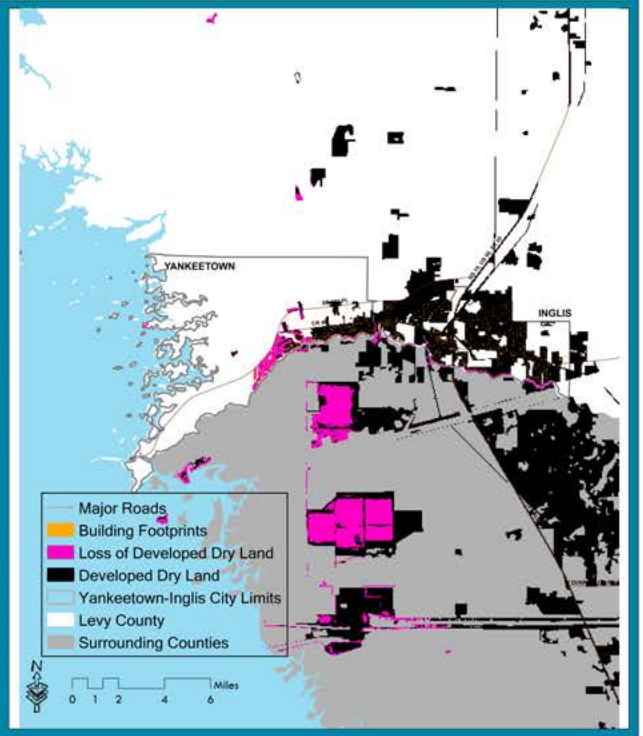
Current Habitats & Land Use



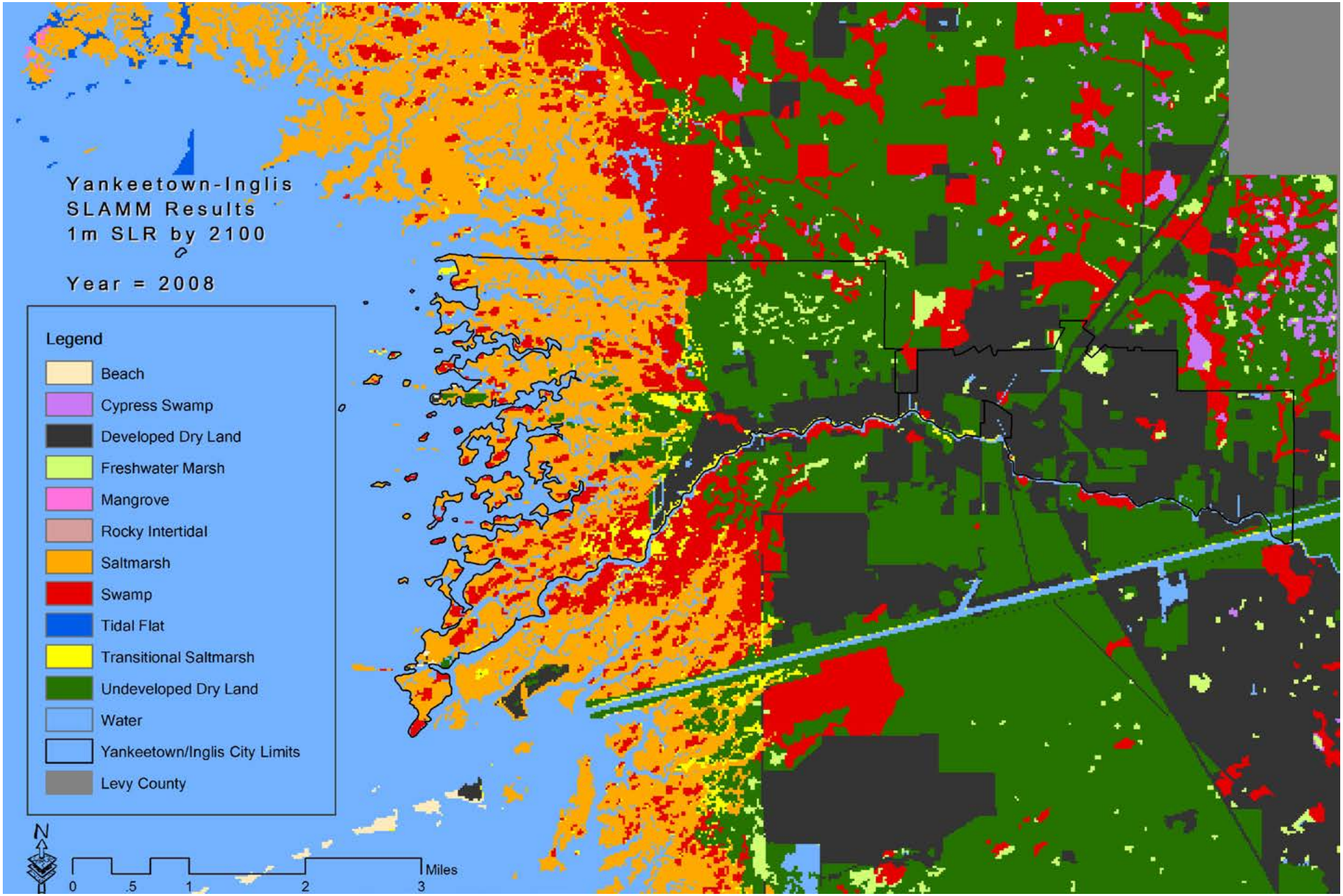
3 Feet Sea Level Rise With Change in Developed Lands



Loss of Developed Dry Lands With 3 Feet Sea Level Rise



Levy County SLAMM Results
Year: 2011
Source: Kathleen Freeman & Laura Geselbracht,
TNC Waccasassa Bay Project, unpublished data


Yankeetown-Inglis
SLAMM Results
1m SLR by 2100
Year = 2008
Legend
Beach
Cypress Swamp
Developed Dry Land
Freshwater Marsh
Mangrove
Rocky Intertidal
Saltmarsh
Swamp
Tidal Flat
Transitional Saltmarsh
Undeveloped Dry Land
Water
Yankeetown/Inglis City Limits
Levy County
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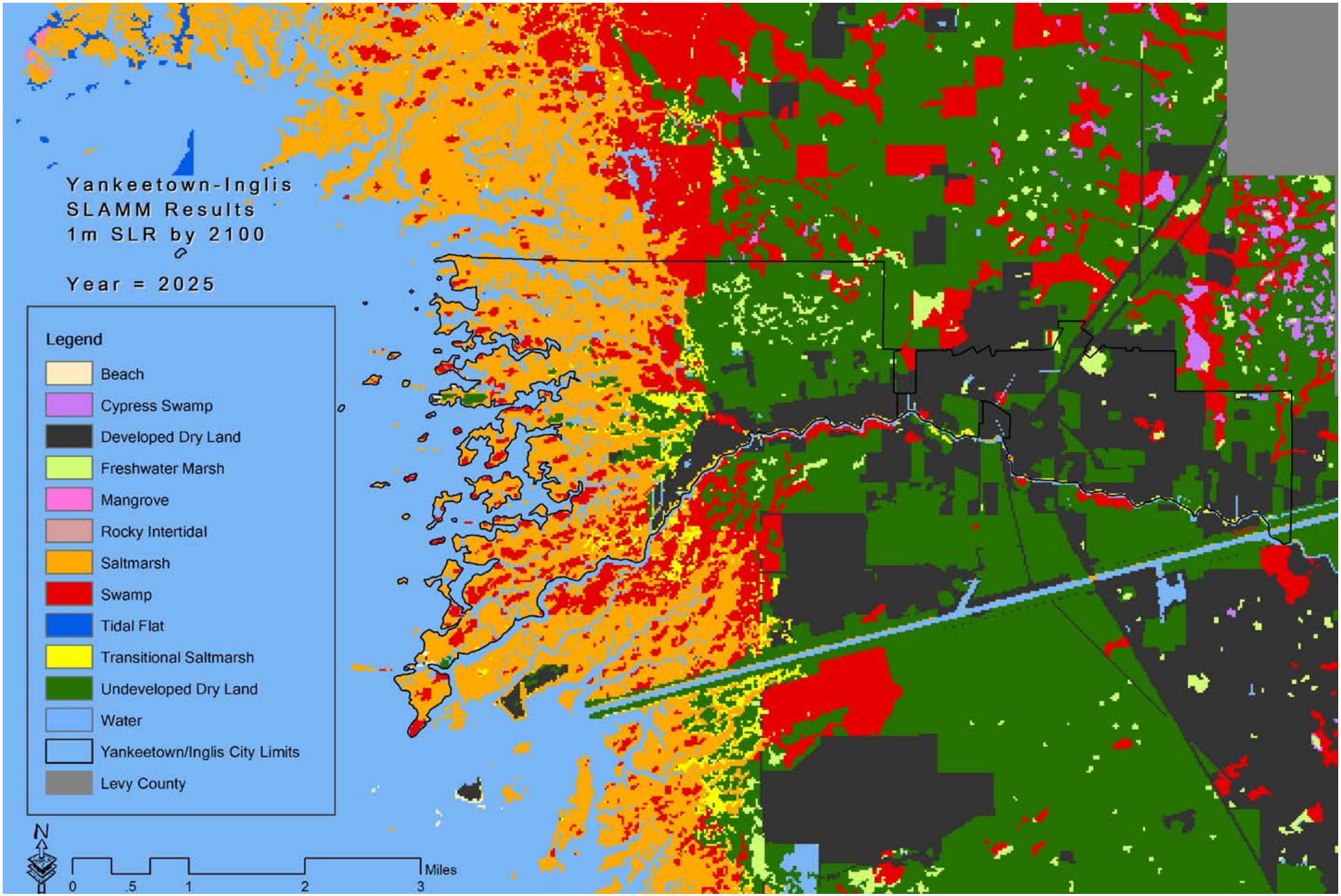
2
3
Miles


Yankeetown-Inglis
SLAMM Results
1m SLR by 2100
Year = 2025
Legend
Beach
Cypress Swamp
Developed Dry Land
Freshwater Marsh
Mangrove
Rocky Intertidal
Saltmarsh
Swamp
Tidal Flat
Transitional Saltmarsh
Undeveloped Dry Land
Water
Yankeetown/Inglis City Limits
Levy County
N
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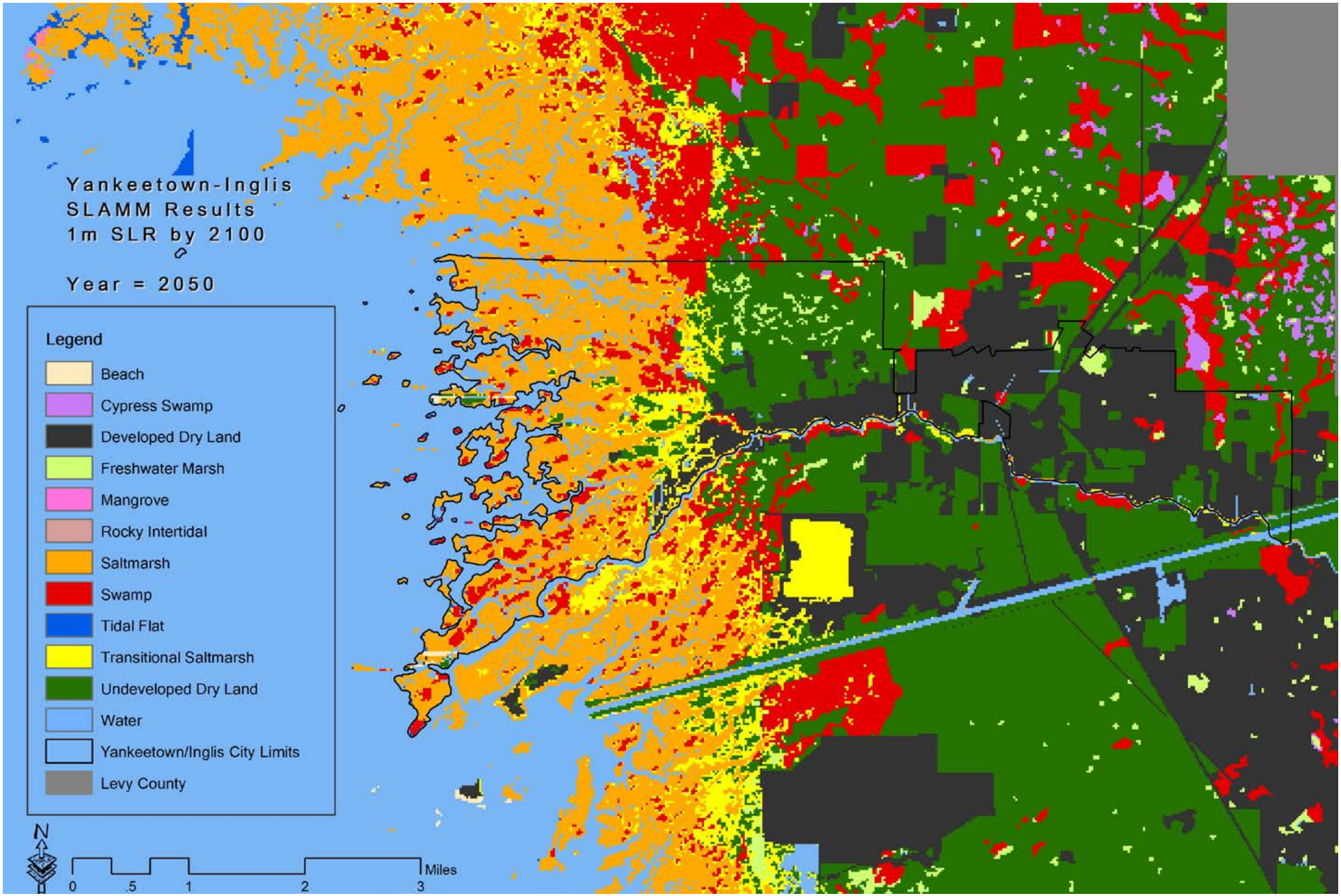
.5
1
2
3
Miles


Yankeetown-Inglis
SLAMM Results
1m SLR by 2100
Year = 2050
Legend
Beach
Cypress Swamp
Developed Dry Land
Freshwater Marsh
Mangrove
Rocky Intertidal
Saltmarsh
Swamp
Tidal Flat
Transitional Saltmarsh
Undeveloped Dry Land
Water
Yankeetown/Inglis City Limits
Levy County
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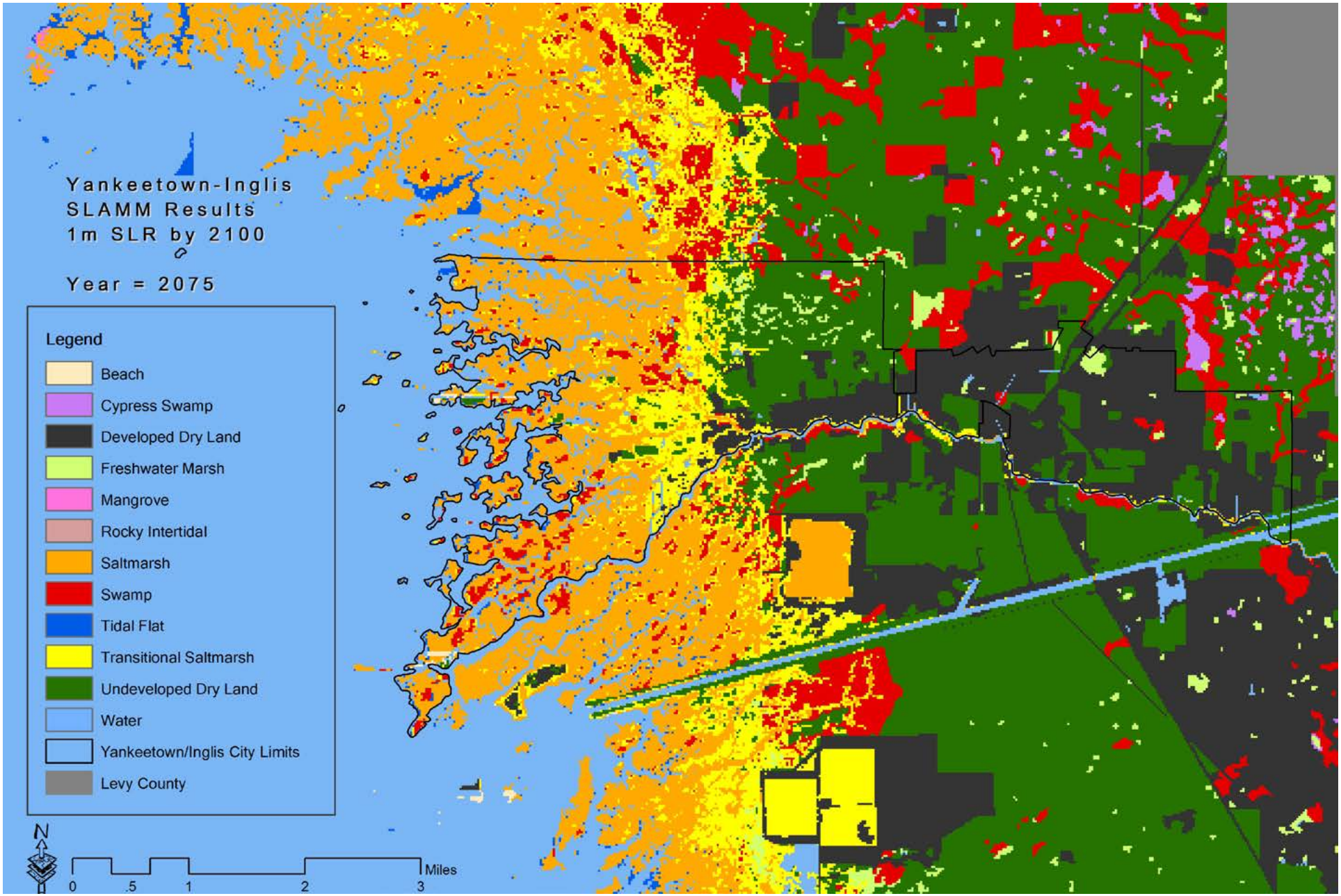
Yankeetown-Inglis
SLAMM Results
1m SLR by 2100
Year = 2075
Legend
Beach
Cypress Swamp
Developed Dry Land
Freshwater Marsh
Mangrove
Rocky Intertidal
Saltmarsh
Swamp
Tidal Flat
Transitional Saltmarsh
Undeveloped Dry Land
Water
Yankeetown/Inglis City Limits
Levy County
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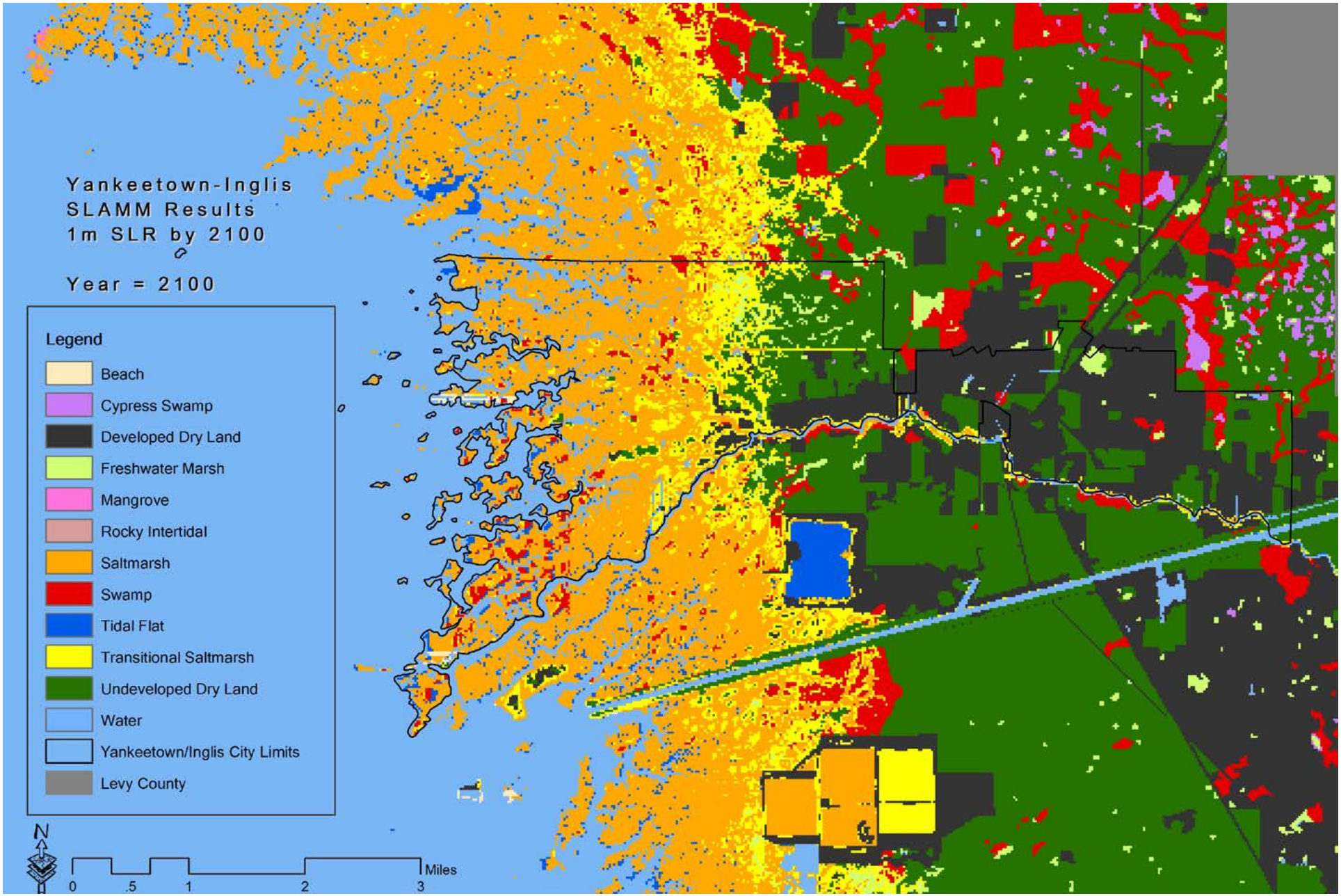
Yankeetown-Inglis
SLAMM Results
1m SLR by 2100
Year = 2100
Legend
Beach
Cypress Swamp
Developed Dry Land
Freshwater Marsh
Mangrove
Rocky Intertidal
Saltmarsh
Swamp
Tidal Flat
Transitional Saltmarsh
Undeveloped Dry Land
Water
Yankeetown/Inglis City Limits
Levy County
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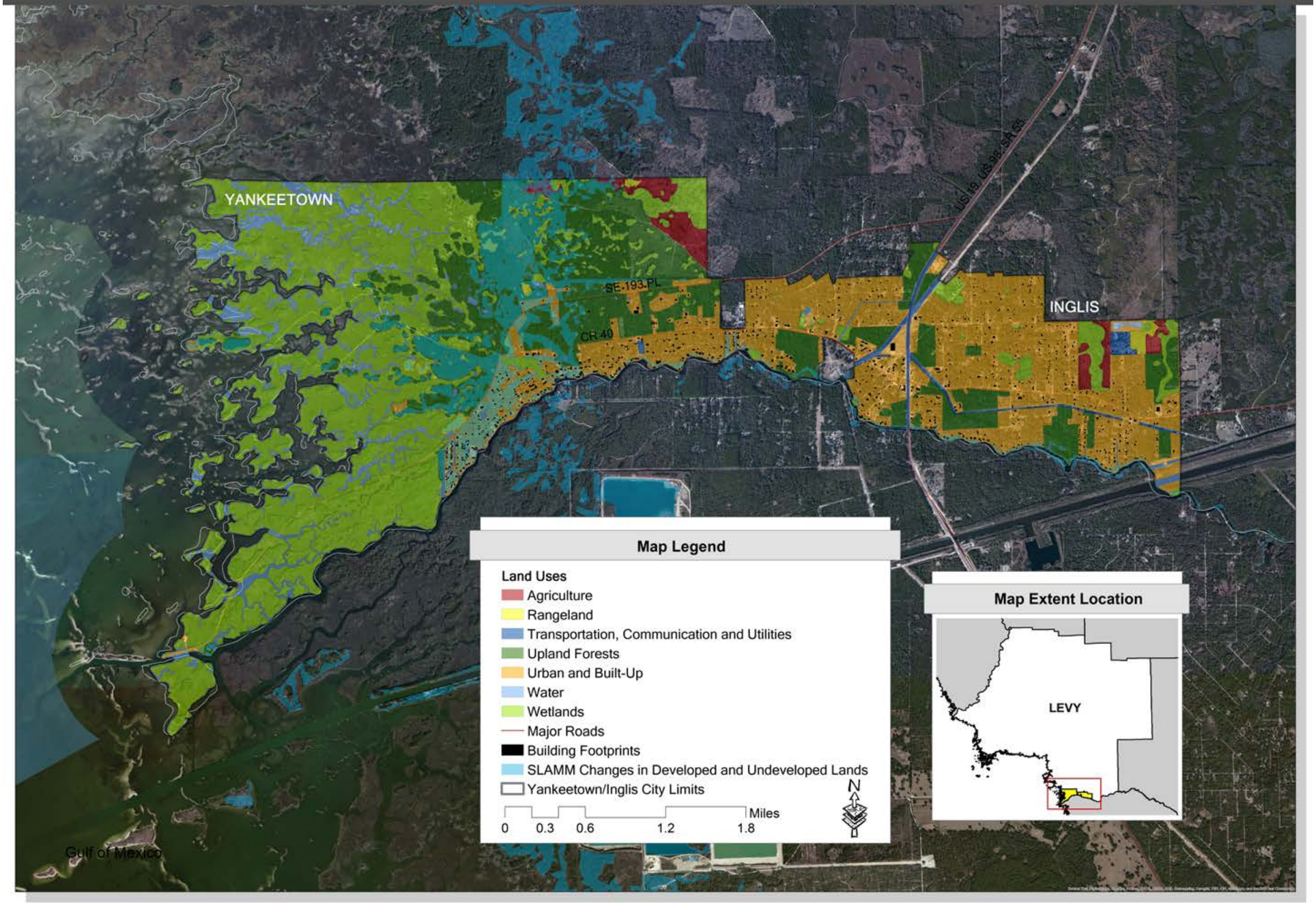
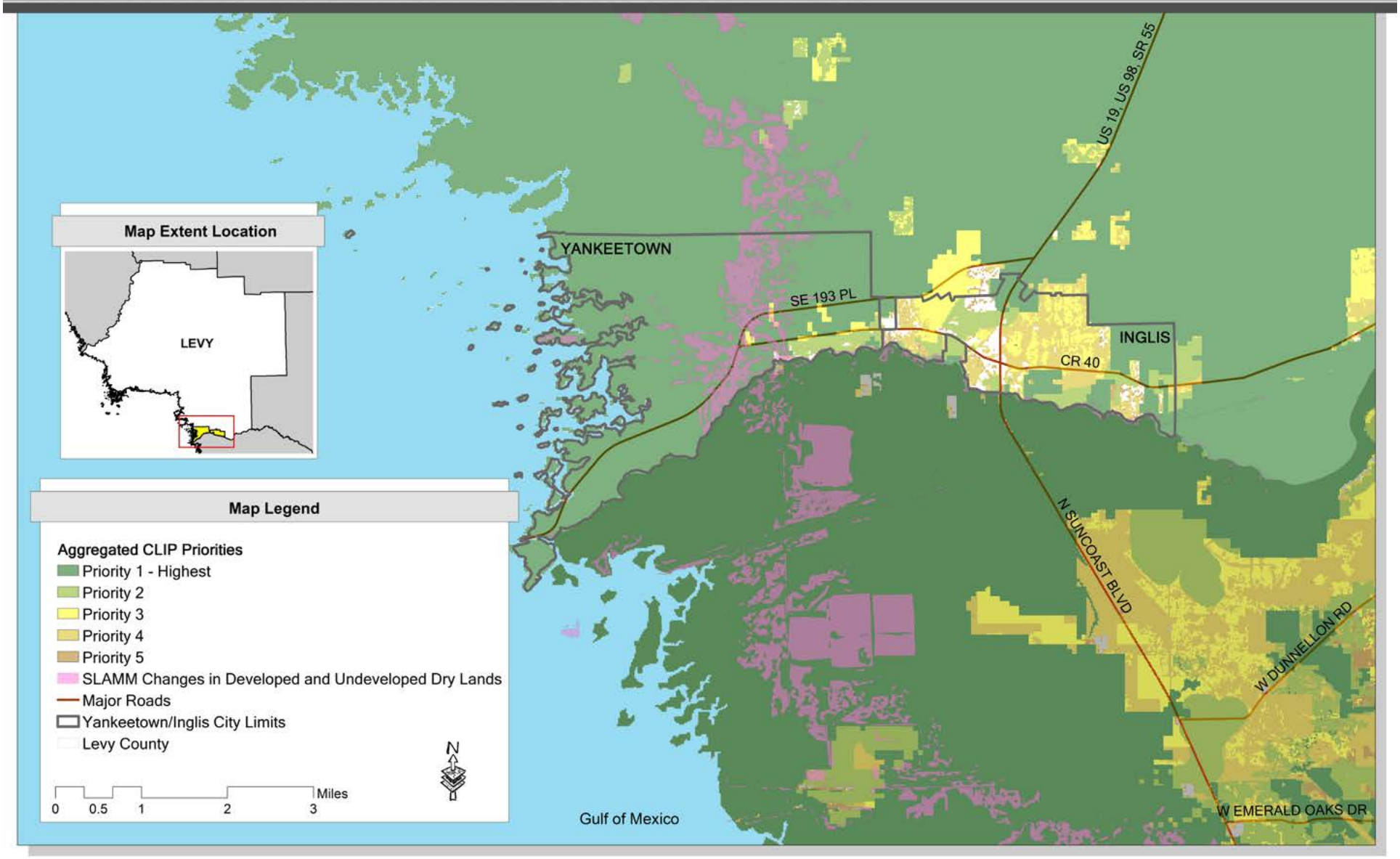
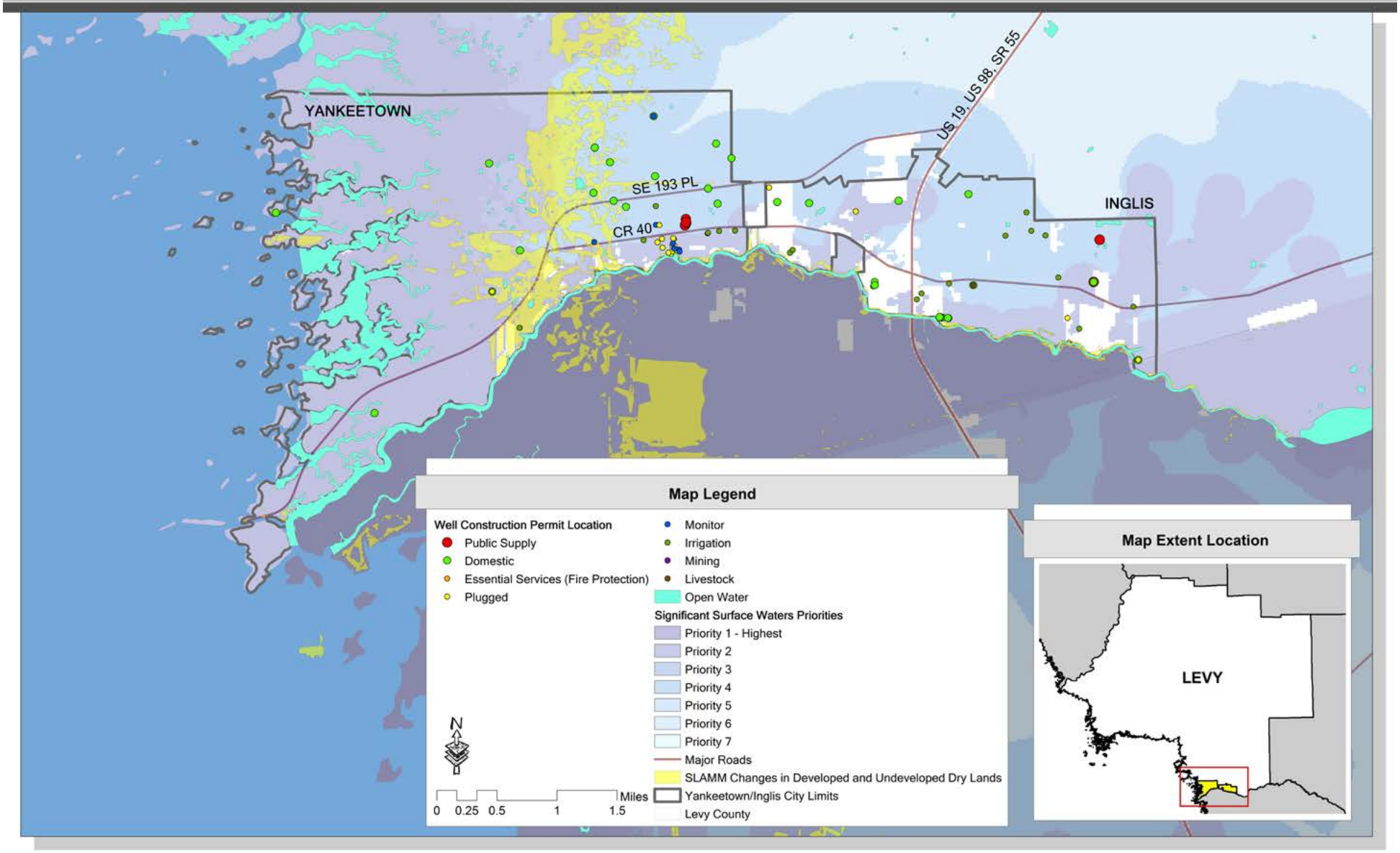
YANKEETOWN-INGLIS EXISTING LAND USE MAP



YANKEETOWN-INGLIS CONSERVATION PRIORITIES MAP



YANKEETOWN-INGLIS WATER SUPPLY MAP



Appendix B: Socio-Economic Analyses

Yankeetown and Inglis are generally categorized by the Census Bureau and other sources as low income, rural, and small in population and purchasing power. Although the area has low per capita income and low earnings per job compared to the rest of the state, the county maintains relative economic health due to its high share of earnings that come from ownership (proprietors' income) and the stability of its unemployment levels despite the recent economic downturn.

Currently, Yankeetown's largest industries include construction, manufacturing, transportation, and entertainment/recreation. Inglis' largest industries include education/healthcare, entertainment/ recreation, and construction. Job opportunities lean heavily towards occupations within these industries.

The following page includes some summary statisitics from the US Census Bureau illustrating this information- note that we have not included here all the information that was collected and reviewed for the project as a whole.

Through our proposed coastal adaptation strategies, we hope to maintain and even improve the current economic outlook. By diversifying economically and spatially, we can build value and increase activity in multiple parts of both Inglis and Yankeetown. For example, a mixed use village center style community in Inglis located outside the areas vulnerable to sea level rise would encourage job diversity; this would expand economic opportunities while giving residents more opportunities to work locally. Job opportunities may also be created through the need for restoration, redevelopment, and retrofitting of vulnerable areas.

Industry by Occupation for the Civilian Employed Population 16 Years of Age and Over					
	Inglis			Yankeetown	
Total Employed Population	405			211	
Agriculture, Forestry, Fishing/Hunting, and Mining	8	2%		9	4%
Construction	44	11%		47	22%
Manufacturing	23	6%		29	14%
Retail Trade	42	10%		18	9%
Transportation, Warehousing, and Utilities	43	11%		23	11%
Information	9	2%		0	0
Finance and Insurance, Real Estate	30	7%		16	8%
Professional, Scientific, and Management	28	7%		12	6%
Education, Health Care and Social Assistance	53	13%		17	8%
Arts, Entertainment, Recreation, and Food Services	46	11%		26	12%
Public Administration	35	9%		6	3%
Other Services	44	11%		8	3%
			Source: US Census Bureau, 2007-2011 American Community Survey		

Annual Median Worker Income				
	Inglis			Yankeetown
Worker Type				
Male	22,396			27,045
Female	15,682			20,694
Household	29,653			37,031
			Source: 2010 U.S. Census	

Appendix C: Water Resource Adaptation: Challenges and Recommendations

As more attention is given to coastal change in Levy County, the importance of water to the region becomes increasingly clear. The significance of water ranges from water quality to freshwater availability to groundwater flows that support the ecological communities in the area. Water has connections that permeate the entire system, contributing to many of the Yankeetown-Inglis area's defining characteristics and qualities of life.

As changes occur along coastal Levy County, water will play a significant role in how Yankeetown and Inglis respond and adapt, particularly with water related infrastructure. Adapting this infrastructure, such as wastewater and sewage treatment systems and water supply, will be essential to the long term vitality of Yankeetown and Inglis and lay much of the groundwork for how they adapt. Coastal change poses several challenges to water resource adaptation in the area, but this section will offer some recommendations for overcoming these challenges.

Challenges

Coastal change forces coastal communities to reevaluate their existing water related infrastructure within the context of future change and how impacts may affect public and environmental health. A key component of this is a community's wastewater and sewage treatment systems. A community's wastewater and sewage treatment infrastructure play a major role in determining a community's spatial configuration and development intensity. Communities with decentralized systems tend to be less dense and more spread out, while communities with centralized sewer systems can accommodate much higher densities and produce myriad spatial patterns. Accordingly, decentralized cluster systems and advanced treatment technology systems have given small communities the ability to accommodate higher intensity development and better sewage treatment in highly constrained areas (Nelson 2012; Joubert et al., 2005).

The current wastewater and sewage treatment systems (septic systems) may become untenable with coastal change. The Yankeetown-Inglis area septic systems are already highly constrained by poor soil suitability and a high water table. Increased flooding and higher water tables resulting from coastal change impacts could cause more frequent failures in existing onsite sewage treatment systems, resulting in potentially diminished water quality. In short, coastal change increases the likelihood of septic system failures in affected areas, which can have negative consequences for environmental and public health.

Additionally, adaptation may require increased density (cluster and infill development) and more compact development in some areas and lower densities and

limited development in others. For example, coastal change impacts in Adaptation Area One (AA-1) will likely require a spatial adjustment that results in decreased development intensities in AA-1 and increased development intensities in other Adaptation Areas to accommodate the spatial shift. Changes in the location and density of development will have significant consequences for the wastewater and sewage treatment systems in each community. The current systems are not capable of handling increases in development intensity and something will have to be done to remove infrastructure that is abandoned as a result of the this shift in AA-1.

Another challenge for the area is the risk of saltwater intrusion and contaminated drinking water wells. Wells closer to the coast are much more susceptible to saltwater intrusion than wells further inland (see Figures 1-4). Saltwater intrusion will increasingly become more of a problem as sea levels rise, and Yankeetown's water supply appears to be the most vulnerable to saltwater intrusion. There may be a day where Yankeetown is unable to provide drinking water to the public from wells within the municipality as a result of coastal change.

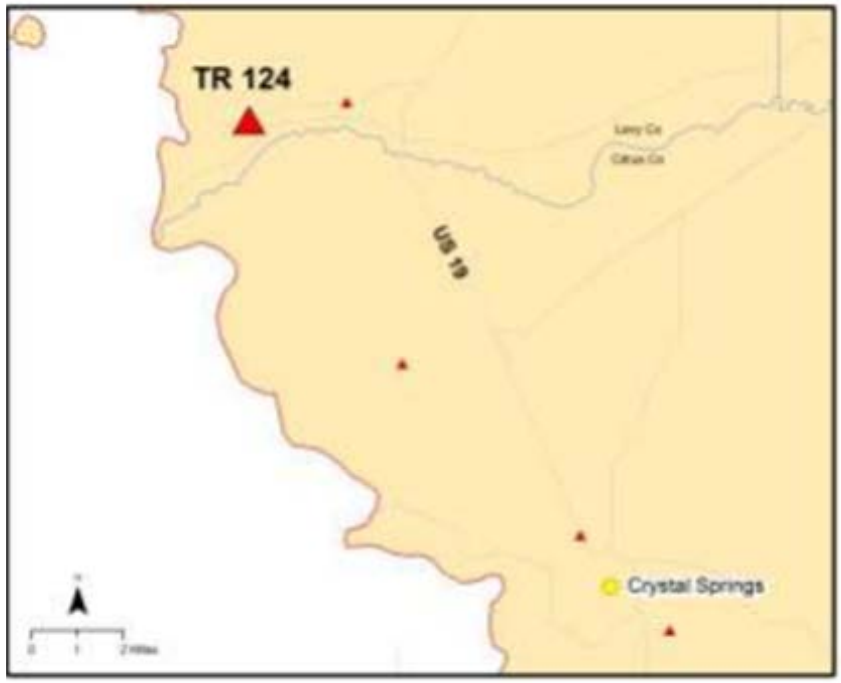


Figure 1: Southwest Florida Water Management District (SWFWMD) Monitor Well - Yankeetown (Source SWFWMD)

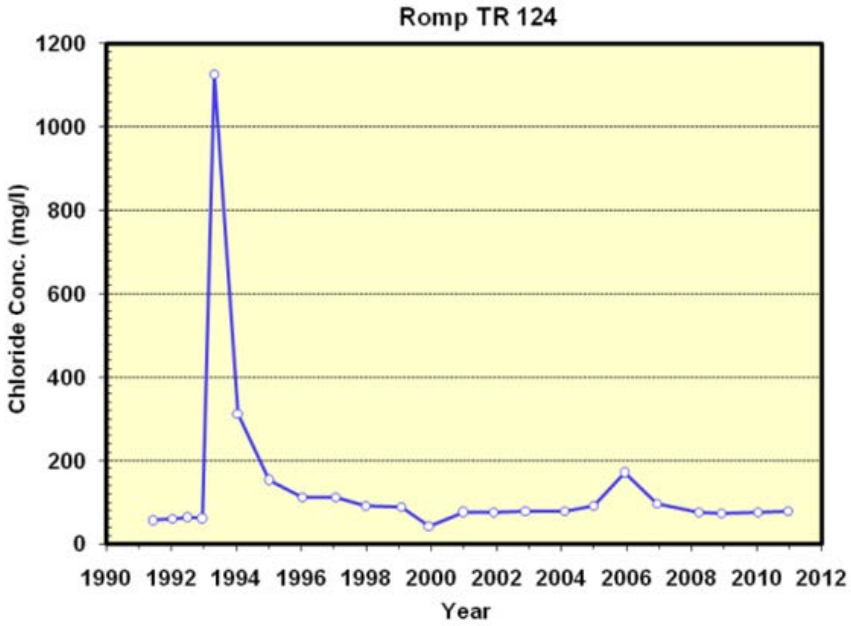


Figure 2: Chloride concentration history - Yankeetown Monitor Well, Drinking water cannot exceed 250 mg/l (Source SWFWMD)

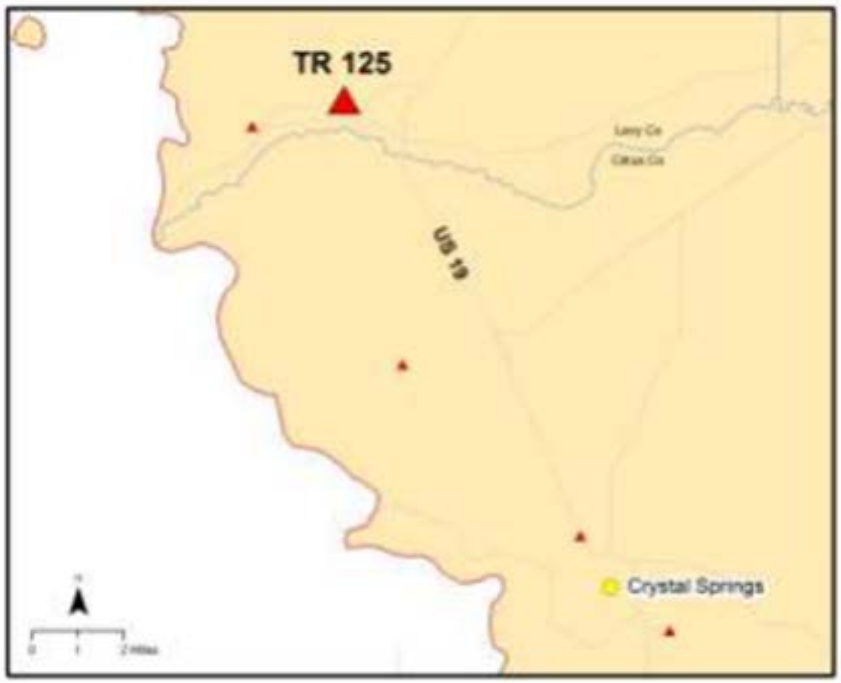


Figure 3: SWFWMD Monitor Well - Inglis (Source SWFWMD)

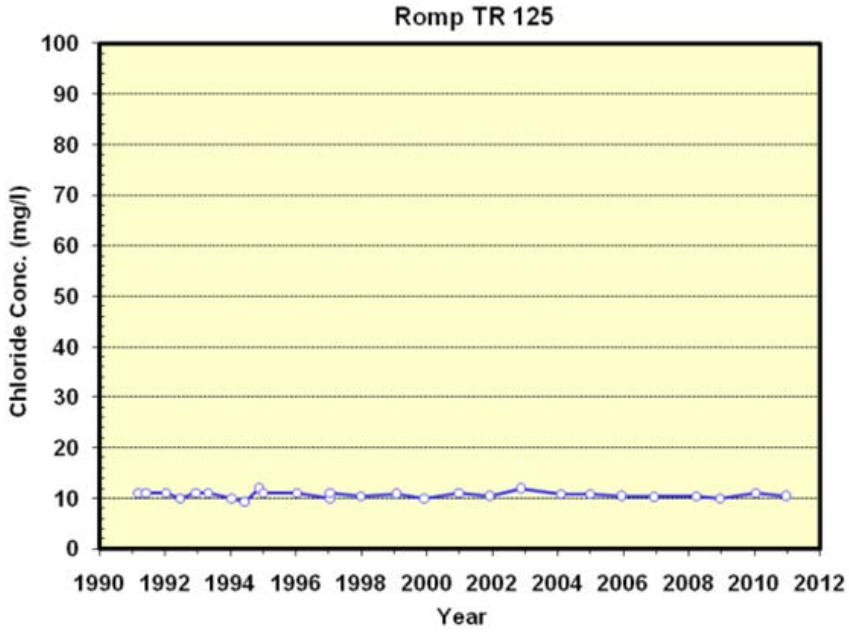


Figure 4: Chloride concentration history - Inglis Monitor Well (Source - SWFWMD)

Recommendations

These recommendations and analysis barely begin to touch the surface on the issue of coastal change, and as a result lack the expertise and depth necessary to fully understand this complex topic. It is highly recommend that Yankeetown and Inglis engage in further study on water resource adaptation, particularly in the realm of wastewater and sewage systems and water supply. Due to their limited financial resources, the municipalities should work to partner with universities, governmental agencies, and non-governmental agencies to further explore this issue. Giving attention to the issue early-on can provide the opportunity to secure funding for such research before there is increased attention on the subject.

Additionally, it is necessary to further examine alternatives to the current wastewater and sewage treatment systems and their suitability for adaptation strategies. For example, it would be wise to identify areas where cluster and infill development can be accommodated with cluster systems and advanced treatment technologies and identify areas central sewer is appropriate (such as areas with unsuitable soils or areas where increased development intensity is desired). Identifying suitable areas for each system type and adaptation scenarios based on these suitabilities can help inform future community visions for Yankeetown and Inglis.

It is also recommended that a plan/program be developed to phase in newer wastewater and sewage treatment systems and infrastructure removal (e.g., septic tanks) in the Adaptation Areas. Although Yankeetown requires all new development and repairs to have a performance based septic system, existing development may not make the transition before coastal change impacts become problematic. As a result, it may be necessary to establish a time frame in which existing development in an impacted Adaptation Area is required to install a performance based septic system (for example, a five year compliance window). Another course of action could be to levy a special assessment to improve the infrastructure in impacted areas.

Coastal change impacts to the water supply will require further study of the freshwater/saltwater interface. To minimize negative impacts to the water supply, Yankeetown and Inglis can work to maintain existing groundwater recharge and ecosystem services where

new development occurs through low impact development strategies, as well as to identify areas where groundwater recharge can be restored. Furthermore, it is recommended that future saltwater intrusion be taken into account when siting new drinking water wells.

Conclusion

Water resource adaptation poses many challenges to Yankeetown and Inglis. The current water related infrastructure needs to be modified to deal with future coastal change in order to accommodate adaptation strategies and preserve environmental and public health. Further study is recommended to provide depth to local planners' understanding of coastal change impacts, and to produce actionable adaptation strategies for Yankeetown and Inglis.

Additional Resources and References

Consortium of Institutes for Decentralized Wastewater Treatment: http://www.onsiteconsortium.org/

EPA Decentralized Wastewater Treatment Systems: http://cfpub.epa.gov/owm/septic/home.cfm

Joubert et al., 2005. Choosing a Wastewater Treatment System. University of Rhode Island Cooperative Extension Natural Resources Science Department Coastal Institute Kingston, RI. http://www.uri.edu/ce/wq/nemo/Publications/PDFs/WW.ChoosingSystem.pdf

Joubert et al., 2005. Alternative Wastewater Treatment for Individual Lots. University of Rhode Island Cooperative Extension Natural Resources Science Department Coastal Institute Kingston, RI. http://www.uri.edu/ce/wq/nemo/Publications/PDFs/WW.AlternativeTreatement.pdf

Jourbet, L. and Loomis, G. 2005. Chepachet Village Decentralized Wastewater Demonstration Project. University of Rhode Island Cooperative Extension Natural Resources Science Department Coastal Institute Kingston, RI. http://www.uri.edu/ce/wq/nemo/Publications/PDFs/WW.Chepachet.pdf

National Decentralized Water Resources Capacity Development Project: http://www.ndwrcdp.org/

National Small Flows Clearinghouse: http://www.nesc.wvu.edu/nsfc/nsfc_index.htm

Nelson, Kevin. 2012. Essential Smart Growth Fixes for Rural Planning, Zoning, and Development Codes. U.S. Environmental Protection Agency. http://www.epa.gov/smartgrowth/pdf/rural_essential_fixes_508_030612.pdf

SWFWMD Nature Coast Springs Saltwater Intrusion Monitor Well Network. http://www.swfwmd.state.fl.us/files/database/site_file_sets/1961/Coastal_Chloride_History.pdf

University of Rhode Island Cooperative Extension Water Quality Program: http://www.uri.edu/ce/wq

University of Minnesota Onsite Sewage Treatment Program: http://www.septic.umn.edu/index.htm

Appendix D: Yankeetown Planning, Land-use Policy, and Proposed Natural Resource Adaptation Action Area

Yankeetown has an extensive comprehensive plan and land development code that is driven by maintaining the existing character and qualities of life in Yankeetown. Yankeetown's comprehensive plan features the town's natural surroundings and its unique small town charm and character as points of pride. The comprehensive plan is very clear that its vision of the town is to remain a coastal village and maintain the town's lower densities. The plan highlights the town's limited capacity to handle higher intensity development because of its lack of a central sewer system and central wastewater treatment facility. The Coastal High Hazard Area (CHHA) encompasses most of the town, thus limiting public expenditures and siting of public facilities in the municipal limits.

Yankeetown has limited development in its coastal areas, except those along the river further inland. Most of the existing developed areas are located in the eastern portion of the municipality in close proximity to the river. Yankeetown established a Transfer of Development Rights (TDR) program that sends development rights along the coast and in conservation areas to the area between State Roads 40 and 40A. Development in these areas is permitted at a maximum of one dwelling unit per two acres. This program has the opportunity to be expanded to include areas that are vulnerable to coastal change impacts, like Adaptation Area One. The town also requires that all new subdivisions, planned unit developments, and commercial uses in all districts utilize low impact development practices, which will be helpful in mitigating stormwater runoff problems that may be exacerbated by coastal change.

The codes regulating residential dwelling units per acre in Yankeetown are very rigid and favor lower densities. This could prove problematic for adaptation strategies that favor cluster and infill development. The maximum allowed residential densities in the areas with existing development is two units per acre, but all lawfully established parcels are entitled to one dwelling unit regardless of parcel size. Density increases greater than 4 or more units an acre are illegal in Yankeetown without a central sewer system. This rigid framework in Yankeetown's allowed dwelling units per acre could become problematic in light of coastal change.

The future will be much different from the past, so preserving the present is not a likely possibility. Adaptation strategies may call for spatial shifts that marginally increase residential densities in the town. Yankeetown needs policies that are more flexible to accommodate redevelopment in areas suitable for relocation, a greater variety of housing types (e.g., not just single family detached housing) to accommodate redevelopment, and the option to employ alternative wastewater and sewage systems, such as cluster or advanced treatment

technology systems, to facilitate redevelopment in suitable areas. Thoughtfully designed redevelopment can accommodate relatively small increases in dwelling units per acre that allow for adaptation, while preserving the quality of life the people of Yankeetown desire.

Additionally, the town of Yankeetown's proposed Natural Resource Adaptation Action Area (NRAAA) is a great step towards addressing adaptation to coastal change. Many of the goals, objectives, and policies mentioned in the proposed NRAAA have applications that could be employed in the areas of existing development that are not within the proposed boundaries, such as those dealing with structural adaptation. The NRAAA can both inform and compliment an adaptation action area and/ or adaptation strategies within the areas of existing development.

Overall, Yankeetown has begun to address the issue of coastal change with their proposed NRAAA. Their existing plans and policies seek to maintain the current character and qualities of life in the town and contain many progressive planning practices that could be tweaked to address coastal change (e.g., the TDR program). Although well intentioned, the lack of flexibility in densities could prove problematic to certain adaptation strategies that focus on infill or cluster development. Regardless, Yankeetown has a great opportunity to address an uncertain future and develop adaptation strategies and policies that help them address future coastal change.

Appendix E: GIS Adaptation Strategy Examples

The following are strategies for coastal change adaptation taken from the Sea Level Rise Adaptation Strategy for San Diego Bay report published in 2012. While this is not our work, we believe that it is the most complete and informative reference guide to different adaptation strategies currently available. Each of the approaches has merit and this guide is a practical and concise overview of many different options for adapting to coastal change that may be applicable in any coastal area.

5. MANAGEMENT PRACTICES TOOLBOX

This section presents a toolbox of options for managing sea level rise that are generally more aggressive than the strategies recommended in previous sections. The comprehensive and targeted strategies presented in previous sections are mostly "no-regrets" approaches that can be implemented at relatively low cost, that can be integrated into existing work programs, and that have co-benefits for reaching other community goals. However, in the long run, no-regrets strategies will not be sufficient to ensure resiliency in the region's coastal zone. Successful implementation of the management practices described in this section will require significant technical and management capabilities, regional collaboration, financial investment, and political commitment.

Generally, sea level rise management practices can be classified into four categories: hard defense; soft defense; accommodation; and withdrawal. This toolbox illustrates specific practices in each of these categories through section diagrams and photographs. It also documents the opportunities and constraints of these four approaches, as determined in a map-based exercise in the second Stakeholder Working Group workshop. Each approach presents significant opportunities and constraints, and decision-making around these practices will require careful deliberation around the tradeoffs. Ultimately, a mix of hard defenses, soft defenses, accommodation, and withdrawal will likely emerge as the most optimal management approach, but existing frameworks for making these difficult decisions need to be enhanced, as recommended in Comprehensive Strategy #10.

strategy: HARD STRUCTURE

Hard defenses are designed to be impermeable structures intended to protect land, structures and investments along the water edge. Examples includes hard, impermeable defenses such as seawalls, revetments, dikes, and storm surge barriers that armor or "draw the line" between water and development and prevent flooding or erosion of edges.

Seawall at Lake Michigan, Chicago

opportunities:

- Stabilizes upland areas
- Protects existing development and infrastructure
- Maintains property values for bayfront and low-lying development
- Setbacks can be used for recreation, infrastructure and non-habitable structures.

constraints:

- Expensive to construct, with annual maintenance required
- Areas outside of protective zone are often more subject to erosion and ecological degradation
- Shoreline habitats will be lost as space to migrate is eliminated

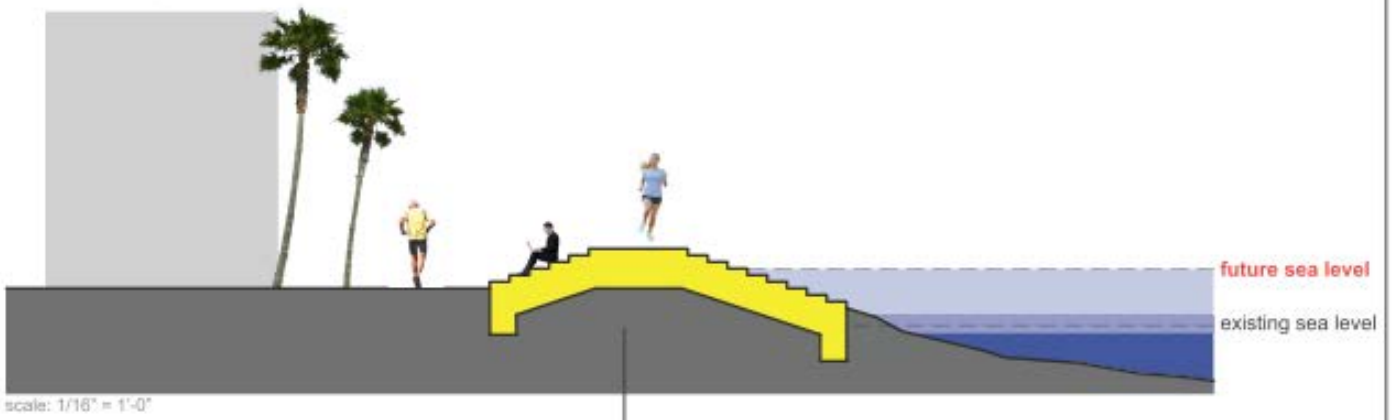
unknowns:

- Potential loss of public access and aesthetic link to waterfront

option A - Seawall - retaining

Seawalls are engineered, permanent barriers built parallel to shoreline to protect land and structures from flooding and erosion caused by wave action. Seawalls may be vertical or sloping, and massive gravity concrete walls or constructed of steel or timber.

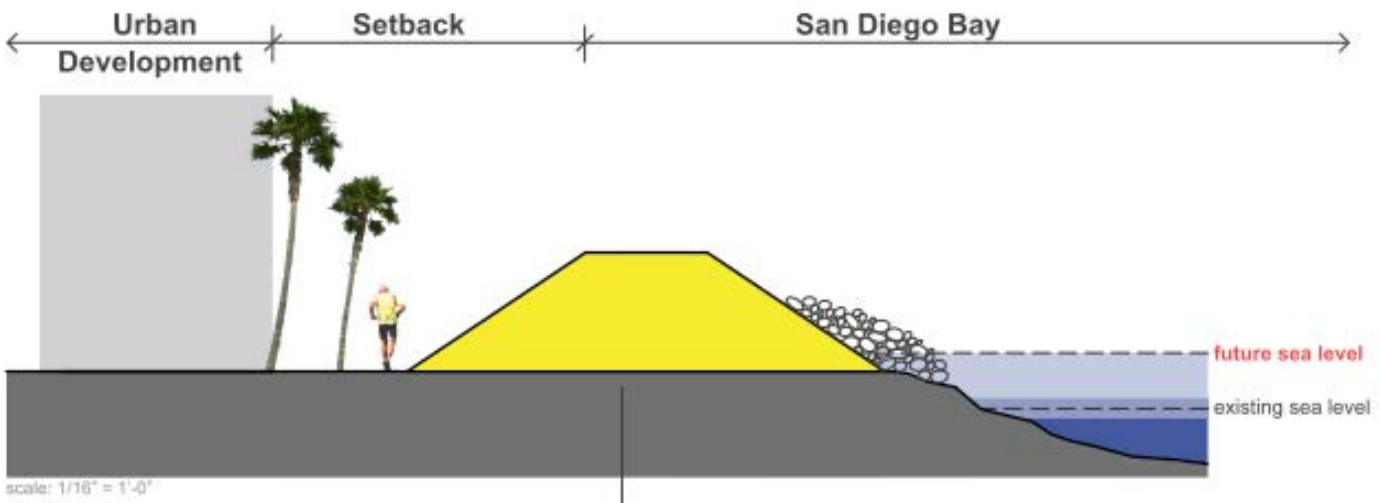
option B - Seawall - widened/stepped



Seawalls may be stepped on both the bay and city sides, allowing for easier access and greater public uses while working to dissipate wave and tidal energy. More land would be required for this option, and construction expenses would increase

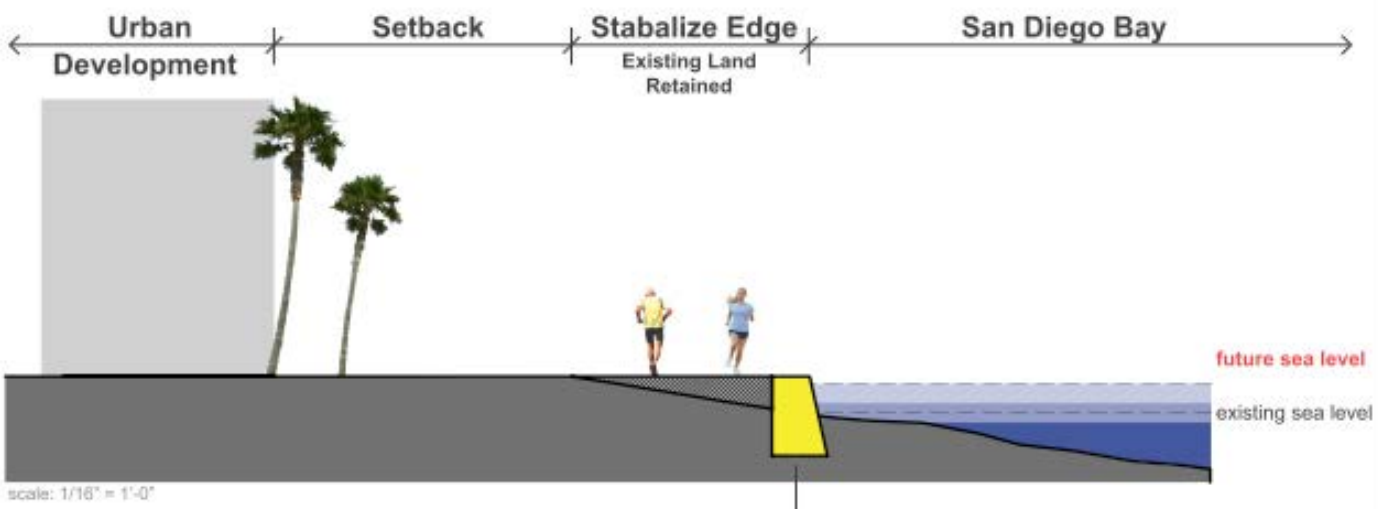
HARD STRUCTURE STRATEGIES

option C - Levee



Levees are engineered, permanent, impermeable barriers constructed to protect low-lying inland areas from flooding. The mounds are constructed of earth, sand and clay; the sloped sides are stabilized and protected from erosion and wave action by rip-rap or concrete armor units.

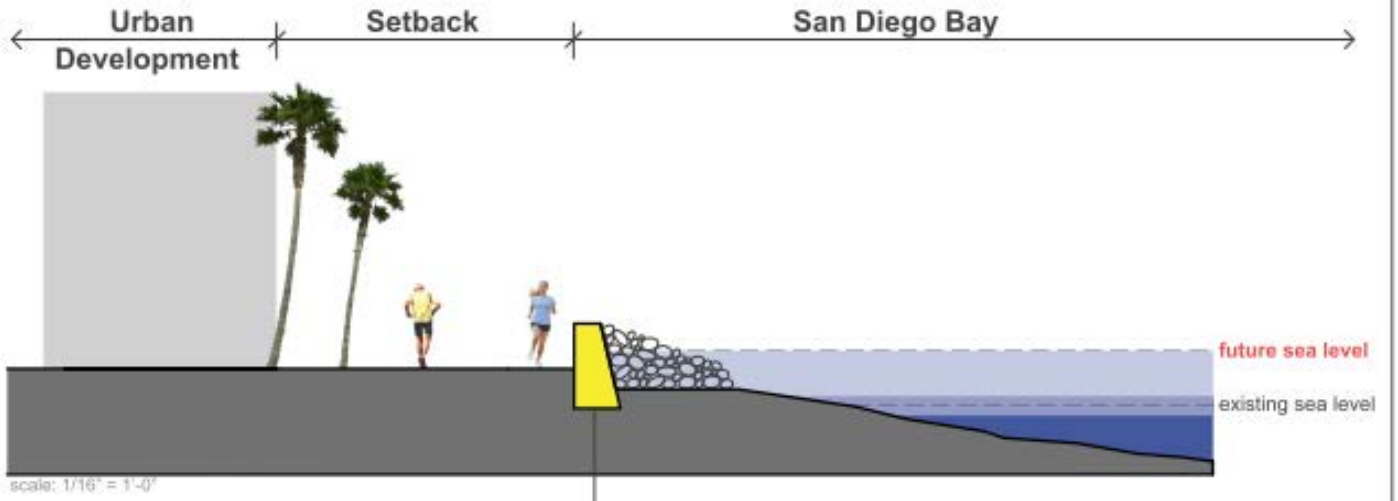
option D - Bulkhead



Bulkheads are engineered, permanent walls that retain land and provide erosion-protection. Secondary use to stabilize and protect upland areas from flooding. Bulkheads are soil retaining structures that may be constructed of concrete, rip-rap, or pilings with steel or timber.

HARD STRUCTURE STRATEGIES

option E - Rip-rap



Rip-rap is large, angular stone placed on existing beach, embankment, cliff or other shore edge to prevent erosion and help dissipate wave energy. Concrete armor units, such as tetrapods and cubes, perform similar functions.

strategy: SOFT STRUCTURE

Soft structures use natural systems and ecosystem services to protect development, investments, and ecosystem well-being. Soft defenses typically protect development through increasing the distance between the water and structures or through requiring space for percolation and retention of flood waters and runoff. Examples include wetland preservation and enhancement, and stormwater management with bioswales and detention basins to hold floodwaters.

Tijuana Estuary

opportunities:

- Reduction of intensity and frequency of flooding, correspondingly reducing size and cost of any required seawalls or hard structures
- Preserves or increases valuable habitat
- Provides recreation and open space areas
- Reduces water pollution in bay and enhances groundwater recharge

constraints:

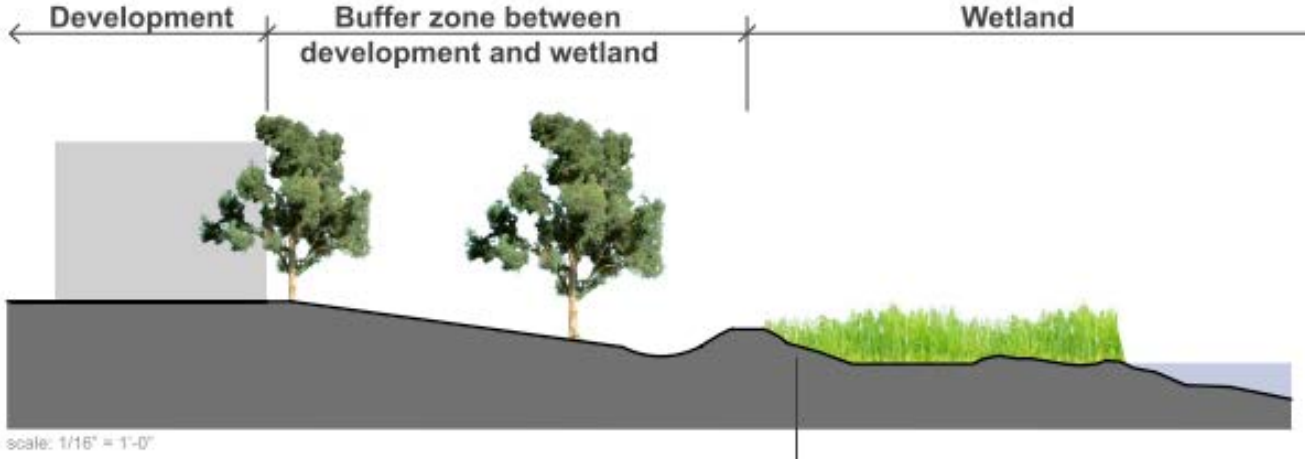
- More extensive land required to provide benefits
- Continued maintenance required
- Green infrastructure is typically cost effective

unknowns:

- Time to establish new habitat

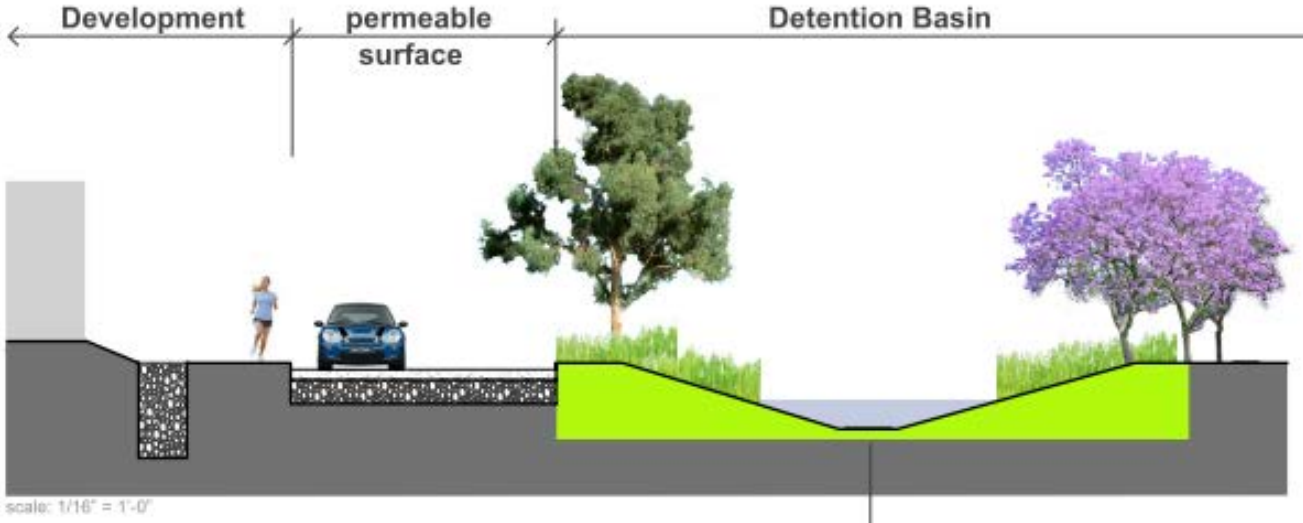
SOFT STRUCTURE

option A - Wetland Restoration / Enhancement



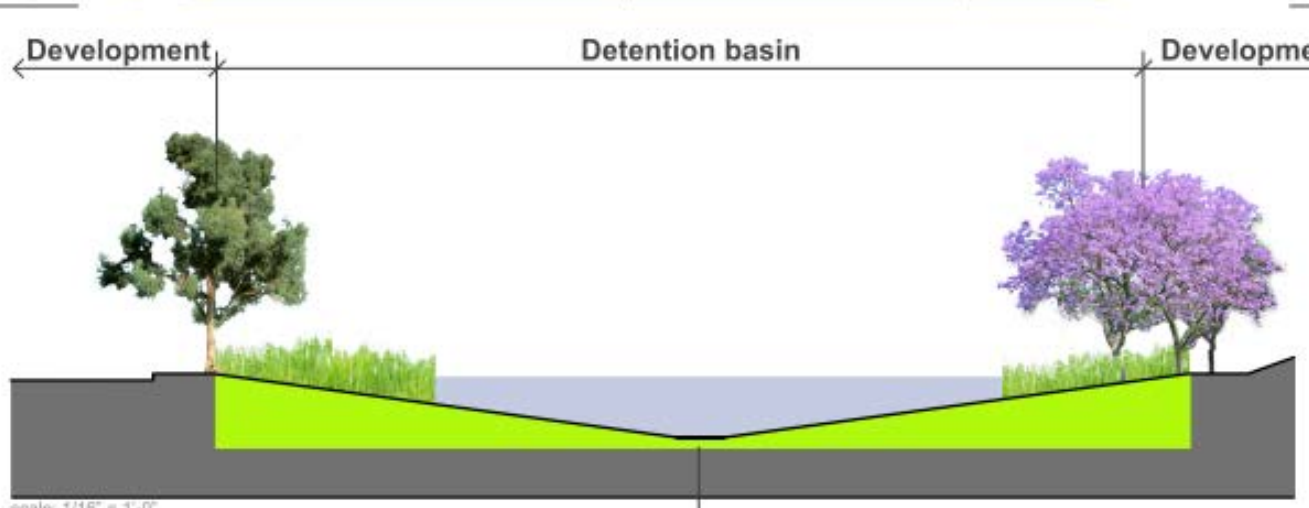
Wetland restoration/enhancement and their natural filtration and absorptive qualities provide flood water storage, buffers from wave and tidal energy, and shoreline stabilization. Wetlands are also particularly sensitive and will "naturally" shift upland with the increasing salinity and water depth that results from sea level rises. Wetlands provide ecosystem services to local communities in the form of improved water quality, support for fisheries, and recreation.

option B - Low Impact Development (LID) and Green Infrastructure



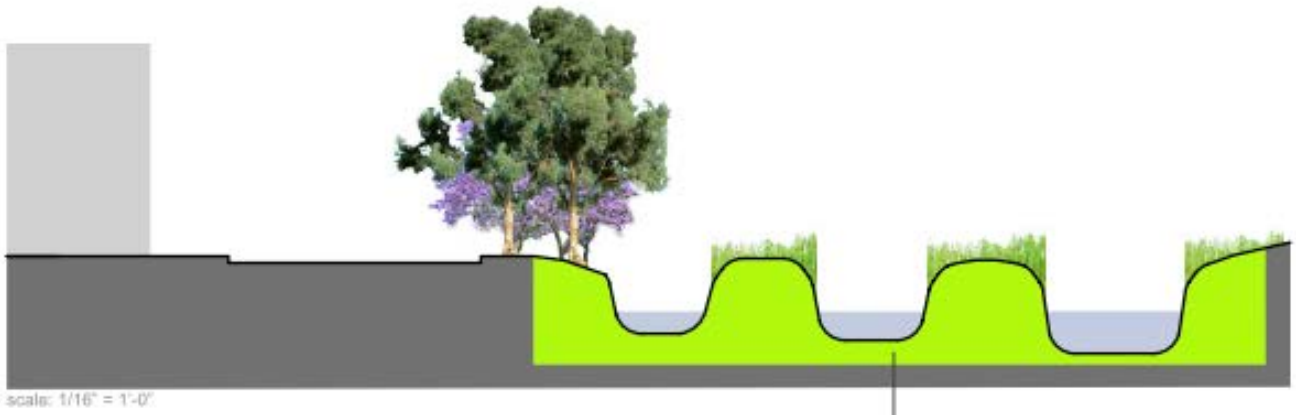
Low impact Development (LID) and Green Infrastructure work with natural systems to maximize the retention and percolation of stormwater. Green infrastructure includes the open, permeable spaces within a community, and seeks to adapt traditional "gray" infrastructure to allow for infiltration of stormwater and provide potential habitat.

option C - Detention basins or upland "mini-floodplains"



Detention Basins or Constructed Wetlands are engineered basins that collect stormwater, either allowing it to percolate on-site or releasing it after the major storm event has passed. Upstream basins help to prevent flooding by capturing it before it reaches the bay.

option D - Bioinfiltration / Stormwater Park



Bioinfiltration uses plants and topography to capture and filter stormwater, and create habitat areas. Examples are stormwater parks, rain gardens and small "pocket" wetlands that allow for "managed flooding".



option E - Bioswales and other vegetated drain channels

scale: 1/16" = 1'-0"

Bioswales and other vegetated drain channels direct flood waters away from development, slow runoff, and allow for percolation of storm or flood waters.

strategy: ACCOMMODATION

Accommodation realigns traditional methods of planning and building with changing conditions of high water and tidal fluctuations. New building methods accommodate new flood plains and various degrees of flooding.

Loblolly House, Kieran Timberlake Architects

opportunities:

- Removes development from immediate threat of flooding
- May reduce flood insurance premiums• text here
- Property owner can control elevation of structure

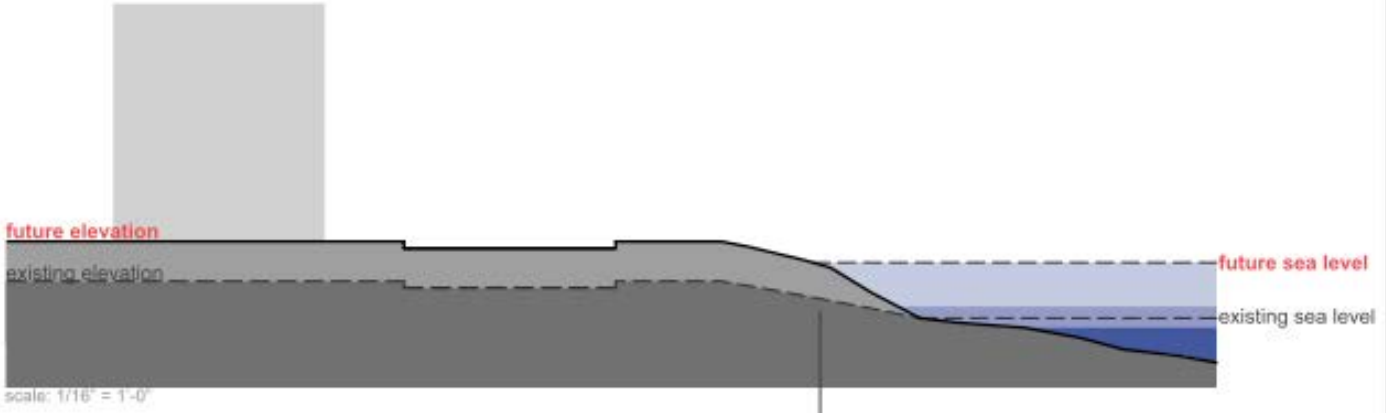
constraints:

- Expensive to retrofit existing development
- Not useful in areas with permanent flooding
- Adding fill and raising grades may impact wetlands and other habitat

unknowns:

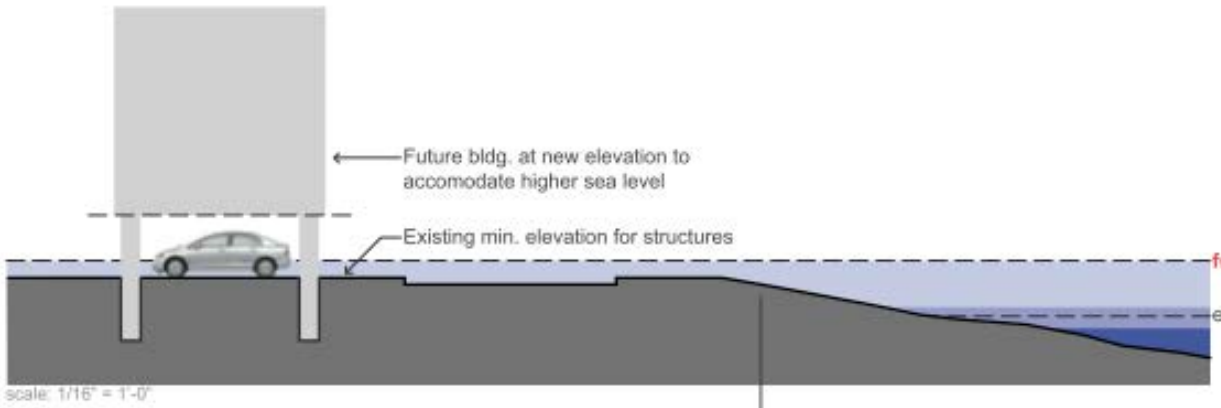
- Accessibility
- Costs of allowing flooding of development, even if temporary

option A - Elevated Grade Surface



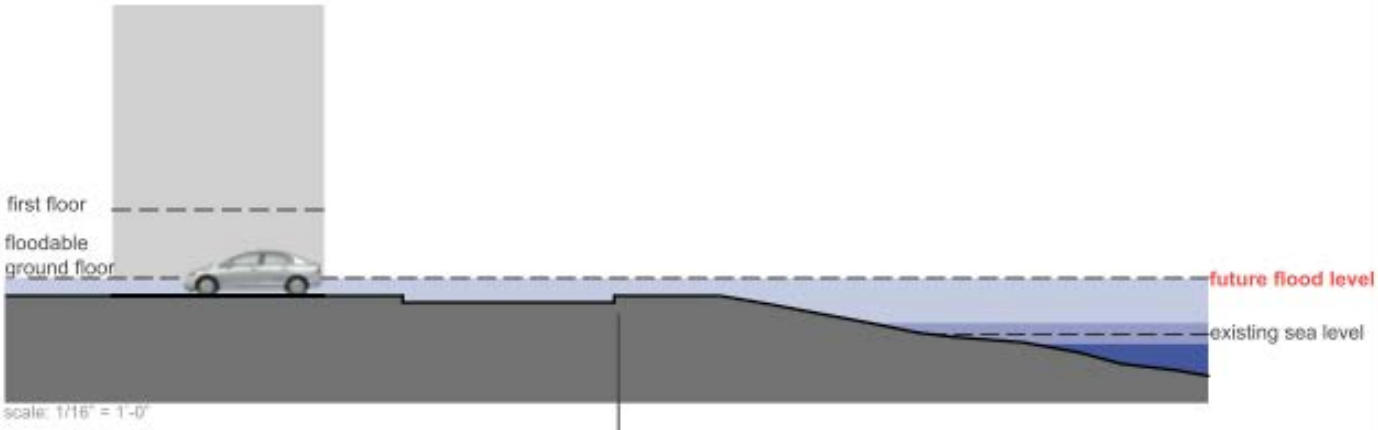
Elevated grade surfaces raise elevations of pads for new structures, infrastructure, and other land uses. Earth or gravel, or raised foundation walls, can be used to raise building pads and infrastructure up out of low-lying areas that might be expected to flood. Depending on edge conditions, elevated grades may require rip-rap and other armoring for protection. It may be possible to raise the land surface of wetlands.

option B - Elevated Structure



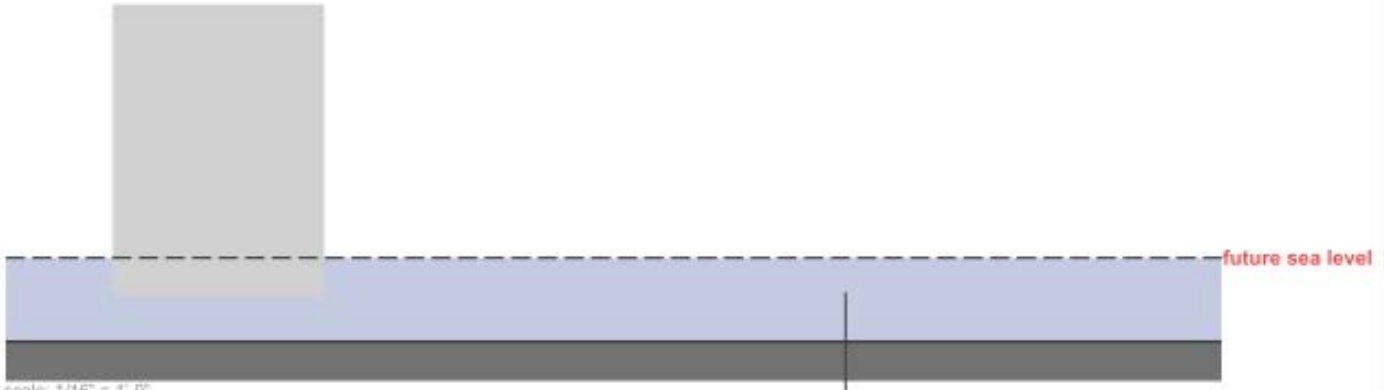
Elevated structures built in known flood plains are often constructed on pilings to allow for flood waters to flow under the structure.

option C - Floodable Development



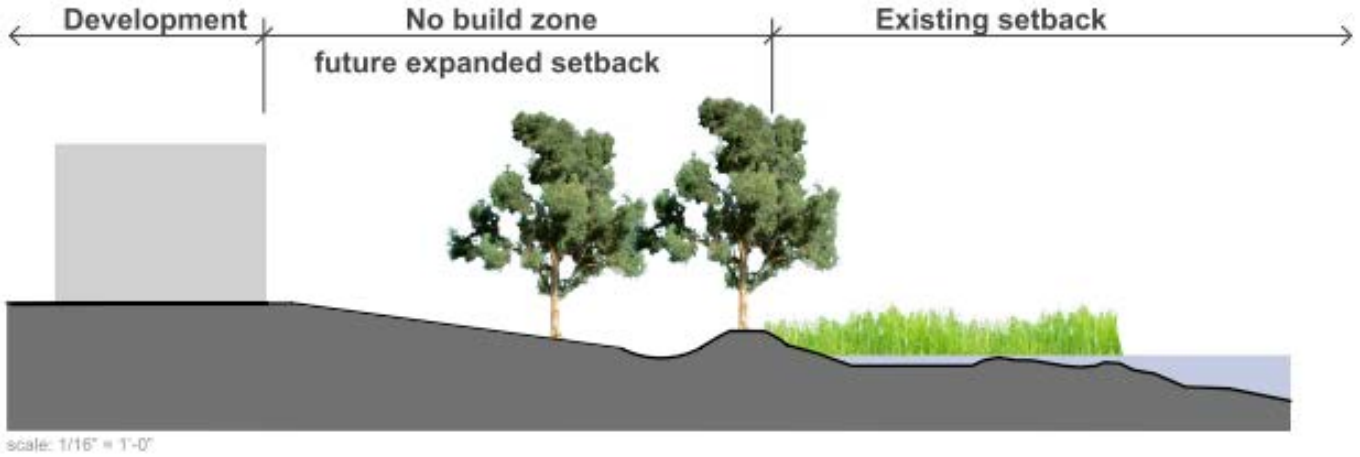
Floodable development allows for flooding of either built structures or open spaces. In built structures, the floodable area is designated as uninhabitable, and while habitable space is restricted to upper levels of development. Shore edge parks and plazas can also be flooded intermittently.

option D - Floating Structure



Floating structures range from houseboats to floating roadways and other infrastructure. The mooring or anchoring of the structure is critical to the success of this strategy.

option E - Buffers and Setbacks



Buffers and setbacks are land permanently dedicated to remain undeveloped and vegetated to protect adjacent land from flooding or other impacts. Setbacks from the water's edges are achieved through zoning, overlay zones, and land use restrictions. Buffers and setbacks are most effective when they are determined in conjunction with specific conditions, such as susceptibility to erosion or wave action, or capacity to provide valuable habitat. They may be established through regulation or land acquisition.

strategy: Withdrawal

Withdrawal from rising sea levels, or managed retreat, is a viable strategy when the economic and ecological costs of protecting development is prohibitive. The objective is to allow for flooding and rising sea levels through restricting development or moving structures out of the path of the water. New development would be prevented in vulnerable areas. Reducing federal or other subsidies for shore protection may help property owners manage the risk of bayfront development.

Shoreline in Dare County, North Carolina

opportunities:
- New space for tidal habitats
- New recreation and open space areas
- Increased or maintained public access to shoreline areas

constraints:
- Property owner opposition
- More expensive than hard structure strategies in urban areas

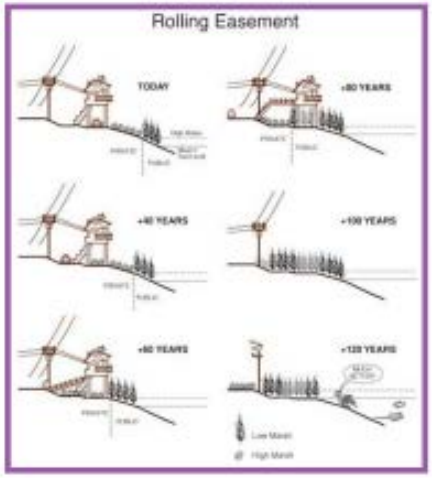
unknowns:
- Legal and insurance issues
- Public perception

option A - Zoning and Overlay Zone

option B - Rolling Easements

Zoning and overlay zones guide the design and planning process for development and habitat areas through restricting land uses to avoid risks associated with flooding.

Rolling easements are a type of easement that prevents hard structures and armoring of the coastal edge, but otherwise doesn't prohibit land uses. The easement "rolls" or moves inland as the sea level rises, maintaining the area of public tidal lands, and allowing for shoreline habitats to also migrate inland. Structures may be moved elsewhere on the property, or elevated to allow for water flow.

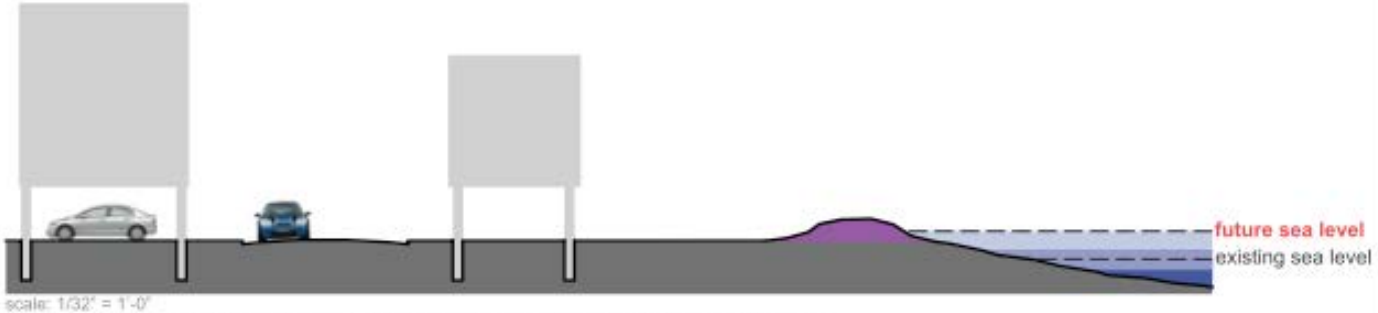


option C - Design for Disassembly

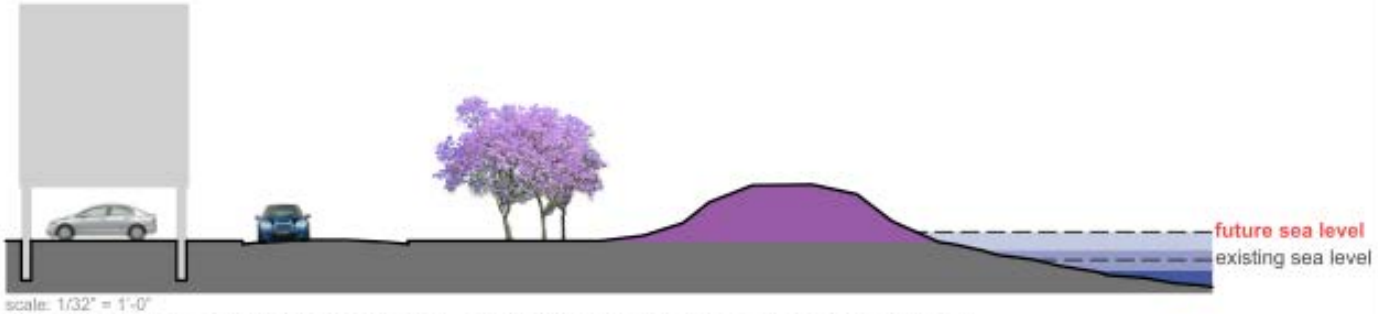
Design for Disassembly is a building process that plans for the future disassembly and reuse of building materials.

option D - Managed Retreat

Existing development exposed to coastal storms and flooding



Phase 1: Shorefront homes removed and housing elevated for flooding.



Phase 2: Shoreline buildings removed, dune built up with vegetative coastal buffer

Managed retreat moves human settlement away from the fluctuations of the water-land interface. Structures may be removed or relocated inland as sea level rises and the existing shoreline erodes. Plans for withdrawal from the water's edge can be incorporated in long-range plans and visions, and include the planned relocation and/or disassembly of valuable existing structures and land uses as well as planned abandonment of less essential structures.

University of Florida Department of Urban and Regional Planning
PO Box 115706
Gainesville, FL 32611
Phone: 352-392-0997