Vignettes from the Trenches

Sea Level Rise Planning Across the Southeast Atlantic Coast

Jason M. Evans, Ph.D.

April 13, 2016

SE Atlantic Climate Community of Practice
Tybee Island, GA

Sea Grant

STETSON UNIVERSITY

My Past Few Years

Outreach > Hyde County, NC Adaptation Plan

GREENKEYS!

A PLAN TO CREATE A SUSTAINABLE FLORIDA KEYS

Vulnerability, Consequences and Adaptation Planning Scenarios, or VCAPS, with Georgia's expertise in benefit/cost modeling.

Islamorada Matters

A Plan to Enhance, Preserve and Protect Our Quality of Life

community in the form of tailored resilience and adaptation plans.

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Outreach

Coastal Hazards

- Climate Community of Practice
- Crisis Response
- Flood Insurance
- Shoreline Change
- Sea Level Rise
- Tybee Island Sea Level Rise Plan
  - About the Project
  - Public Input and Outreach
  - Plan Outline
  - Planning Team
  - Media Coverage
  - Tybee Resources
- St. Marys Flood Resiliency Plan
- Hyde County, NC Adaptation Plan

Communicating Science

Healthy Coastal Ecosystems

Safe and Sustainable Seafood

Sustainable Development

Outreach

Research

Outreach > Coastal H Plan

Tybee Is Adaptati

On the front li barrier island

Georgia Sea Grant, Government, and UG communities prepare storm surge.

The Tybee Island Se project that studies h would impact low-lyi early 2014, the Tybe outline adaptation ac planning horizon.

Tybee's proximity to surges and tidal effe is being given to infrastructure anc Sea Level Rise A the problems sea

Navigate the

About the Proje Gain insight and management anc

Public Input anc View meeting su Rise Planning on

Plan Outline Learn more abou

Planning Team Get to know the t

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SEA GRANT

UCATION OUTREACH GEORGIA COAST

GALLERY

Go Fish...

Resiliency

Carolina Sea Grant lan for the future

a Grant, the University of ernment and UGA Marine St. Marys, Ga. to develop a lan.

gh a nationwide grant the United States to undergo lanning. Funded through a grant eric Administration's National e shared with other coastal a and nationwide through the partners include the Lamar Dodd onment and Design, both housed

end to tailor the plan with nergency Management ram, focusing on the ons that may provide local

t procedures, timeline

used to shape the plan.

the project.

Jason Evans, Charles Hopkinson, Roger Weaver and Mayor John Morrissey meet to launch the St. Marys Flood Resiliency planning project.

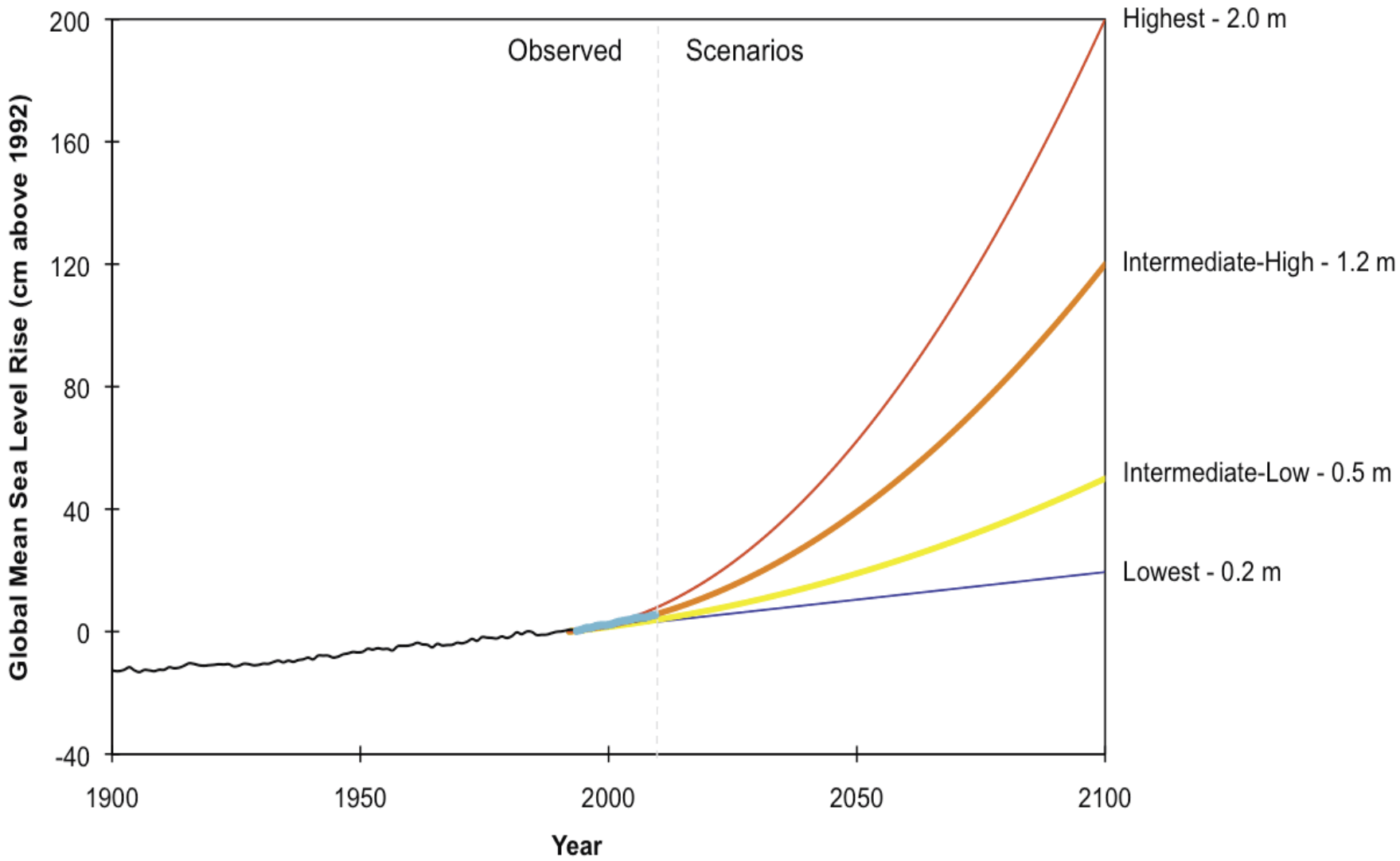
Established in 1787, St. Marys is a historic city that is vulnerable to anticipated coastal changes, such as increased coastal flooding, rising seas and intensified storm surges.

Assertion #1

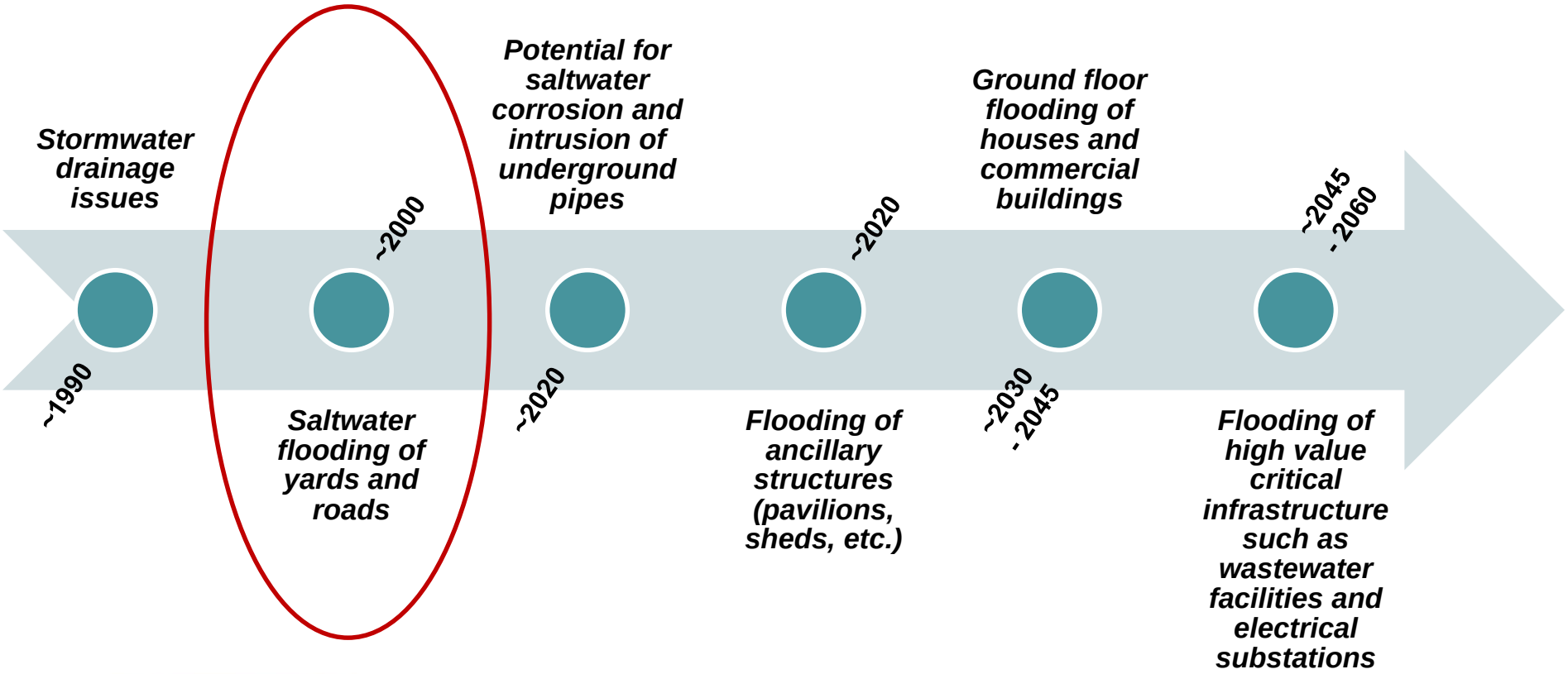
Climate change adaptation is one of the most complex and daunting challenges ever faced by human civilization.

Sea Level Rise Scenarios

National Climate Assessment (2012)



General Timeline of Sea Level Rise Impacts on the Built Environment



Miami Beach

http://s13.therealdeal.com/trd/m/up/2013/07/Miami-flooding-4-13-13.jpg.jpg

Flooding Solutions
#MBRisingAbove
MIAMIBEACH
MBRisingAbove.com

citibike

DETOUR

Tybee Island, GA

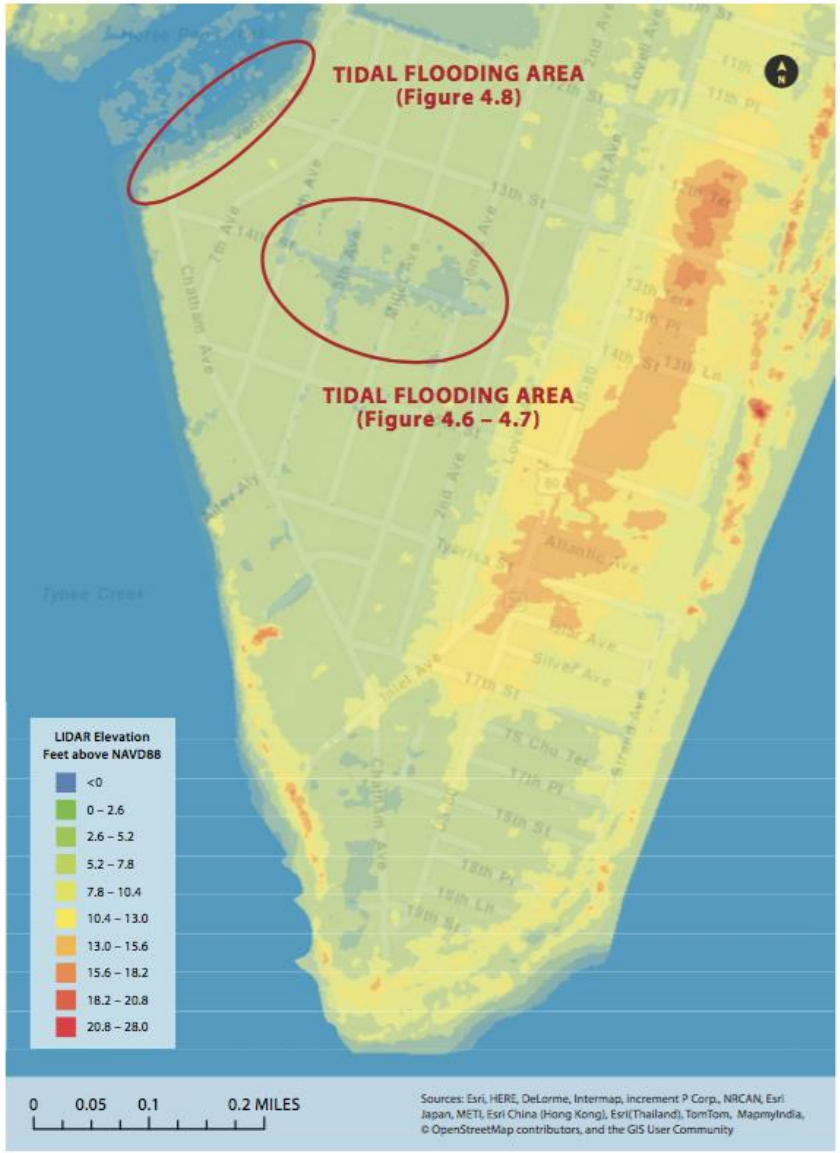


FIGURE 4.6: STORMWATER DRAIN WITH SALTWATER DISCHARGE DURING KING TIDE, NOVEMBER 14, 2012

FIGURE 4.7: SALTWATER FLOODING OF YARDS AND STREETS FROM STORMWATER DRAIN DISCHARGE DURING KING TIDE, NOVEMBER 14, 2012

Tybee Island, GA

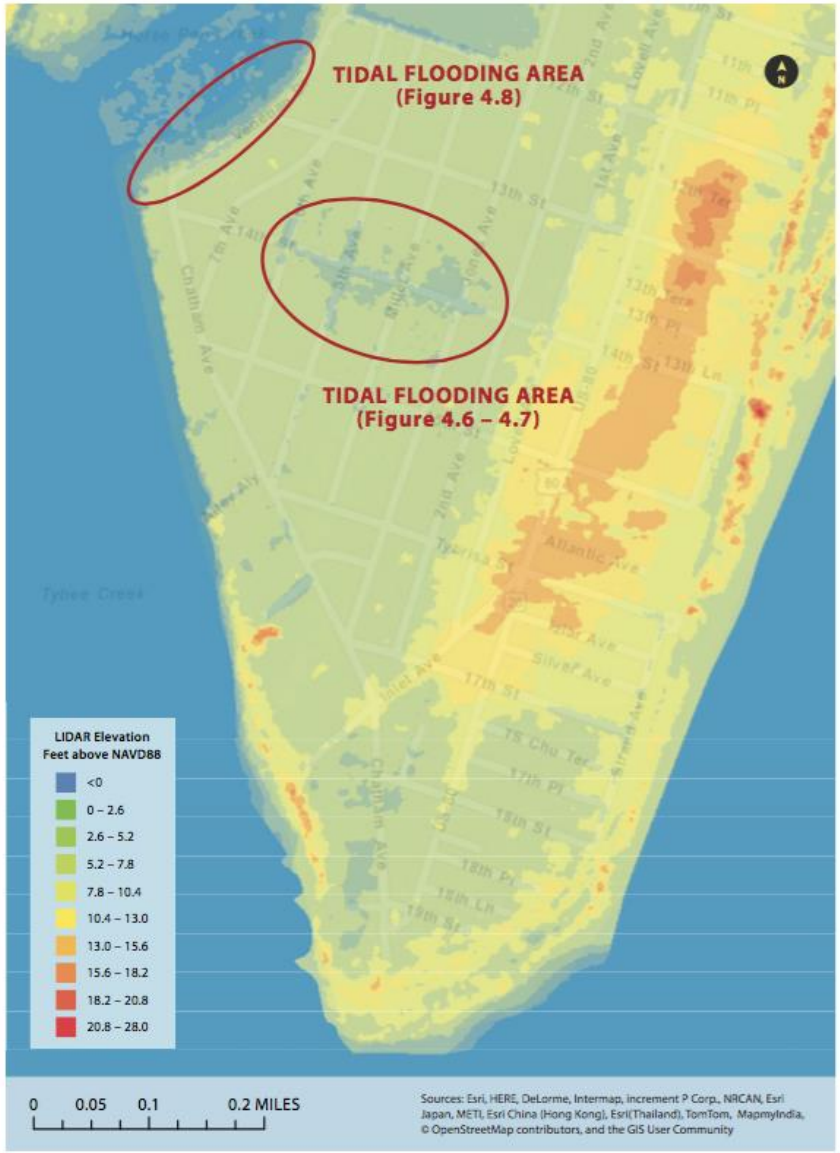


FIGURE 4.8: SALTWATER FLOODING OF YARDS AND STREETS FROM BANK OVERFLOW DURING KING TIDE, NOVEMBER 14, 2012

Tybee Island, GA

Action: Stormwater backflow preventers

FIGURE 4.9: STORMWATER TIDAL BACKFLOW PREVENTERS, NEAR INTERSECTION OF 14TH ST. AND VENETIAN DR.

Sea Level Rise Adaptation Options

- Accommodate, or "Buy Some Time"
  - Elevate property and infrastructure
- Protect, or "Stand and Defend"
  - Sea walls, levees, storm surge gates
- Relocate, or "Get Out of the Way
  - Rolling easements, buy outs, wetland restoration
- Avoid, or "Stay Out of the Way"
  - Build outside of hazard zones
- Do nothing, or "Wait and see"

Assertion #2

Very few development decisions being made today in vulnerable coastal communities are fully considering the consequences of future sea-level rise.

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nature climate change

LETTERS

PUBLISHED ONLINE: 14 MARCH 2016 | DOI: 10.1038/NCLIMATE2961

Millions projected to be at risk from sea-level rise in the continental United States

Mathew E. Hauer[1]*, Jason M. Evans[2] and Deepak R. Mishra[3]

Sea-level rise (SLR) is one of the most apparent climate change stressors facing human society[1]. Although it is known that many people at present inhabit areas vulnerable to SLR[2,3], few studies have accounted for ongoing population growth when assessing the potential magnitude of future impacts[4]. Here we address this issue by coupling a small-area population projection with a SLR vulnerability assessment across all United States coastal counties. We find that a 2100 SLR of 0.9 m places a land area projected to house 4.2 million people at risk of inundation, whereas 1.8 m affects 13.1 million people—approximately three times larger than indicated by current populations. These results suggest that the absence of protective measures could lead to US population movements of a magnitude similar to the twentieth century Great Migration of southern African-Americans[5]. Furthermore, our population projection approach can be readily adapted to assess other hazards or to model future per capita economic impacts.

Sea-level rise is widely recognized as one of the most likely and socially disruptive consequences of future climate change[2]. Scenarios of future SLR at the year 2100 range from a low of 0.3 m to a high scenario of 2.0 m associated with collapse of polar ice sheets[3]. Understanding the specific locations at risk of SLR impacts is a high priority in climate change research[6] and adaptation planning[7,8].

Although there is growing worry and debate that climate change could cause widespread human migration over the next century[2,9,10], relatively few studies have attempted to merge climate change scenarios with population growth trends and projections in high-risk areas (however, see ref. 11). Notably, several previous studies have estimated the populations at risk of future SLR inundation through the use of current population data[12]. Given the rapid growth of population in coastal areas[13], such temporal mismatch of data sets (that is, present population and future SLR) seems likely to underestimate the impacts SLR will have on future populations. Other research has tied small-area flood inundation risk to populations at a county scale[14]. Such spatial mismatch is likely to overestimate the future populations at risk of SLR, as populations located on higher ground within a coastal county may

data (that is, elevation and associated flood risk) with small-area population projections developed with a modified version of the Hammer method[17,18] in a dynamic flood hazard model. By spatially and temporally aligning small-area population projections from coastal states in the continental United States (US) to 2100, we are able to assess who could be at risk from future SLR.

This approach addresses two fundamental questions concerning the vulnerability of future coastal populations in the United States: How many people are potentially at risk of impact from SLR? and What areas in the US are likely to experience the greatest population exposure to SLR? Accordingly, our results can be used to inform local adaptation infrastructure and growth management strategies, alerting officials to the areas where interventions and policies are most needed.

We assess the populations at risk of SLR by using the National Oceanic and Atmospheric Administration's (NOAA) 0 m through 1.8 m (6 feet) SLR data sets for twenty-two coastal states and the District of Columbia[19]. These data sets simulate expected changes in the mean higher high water (MHHW) mark on areas that are hydrologically connected to coastal areas, without taking into account additional land loss caused by other natural factors such as erosion. Notably, the state of Louisiana was not included in the data set at the time of analysis owing to local hydrologic complexities associated with coastal levees and accelerated land subsidence; however, we have recreated NOAA's hydrologic connectedness approach for Louisiana using USGS's National Elevation Dataset (NED) (Methods).

We used a linear/exponential extrapolation approach for projecting Census Block Groups (CBGs) from 2010 to 2100. We included only CBGs ($n = 72{,}664$) located in counties ($n = 319$) expected to experience impact under the 1.8 m scenario. A detailed technical description is available in Methods. Detailed projections of exposure for all 319 coastal counties are also found in Supplementary Fig. 1 and Supplementary Tables 1 and 2. The population at risk of SLR is dynamically assessed as the proportion of the CBG underwater when SLR is expected to exceed 0.3 m intervals under the 0.9 m and 1.8 m scenarios. With a recreation

Coastal population growth = Underestimation of problem

4.2 million people impacted nationally with 0.9 meters of SLR at 2100

13.1 million with 1.8 m

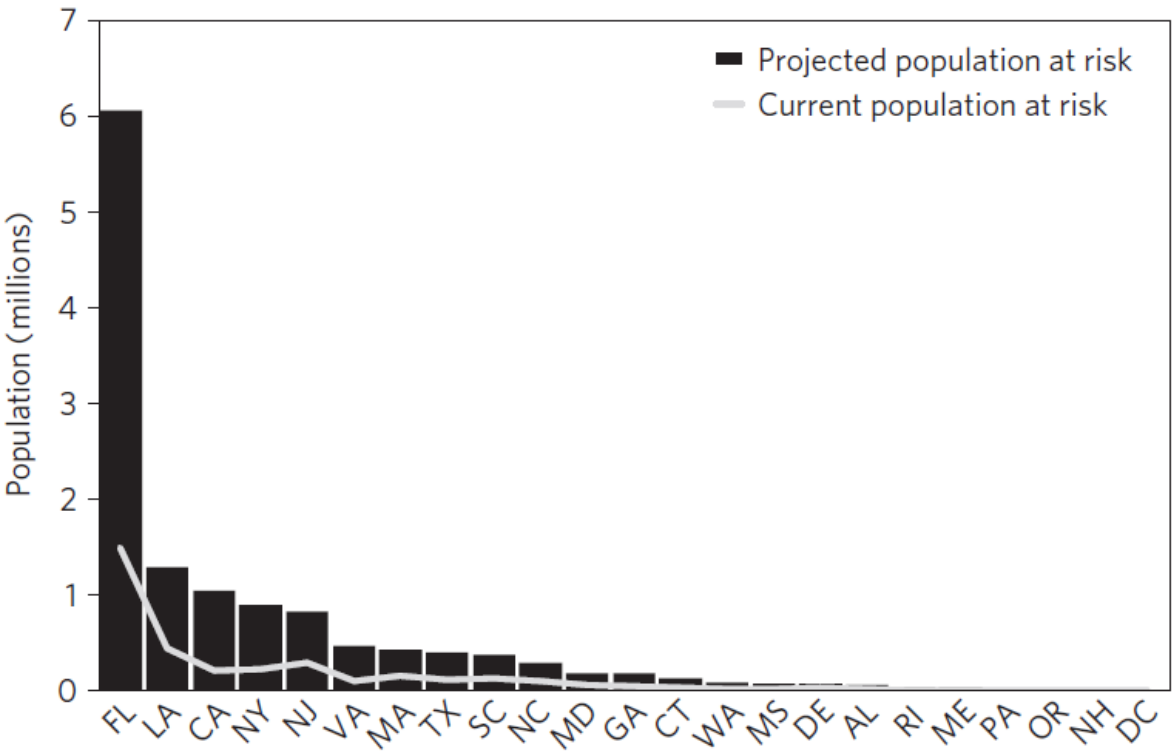
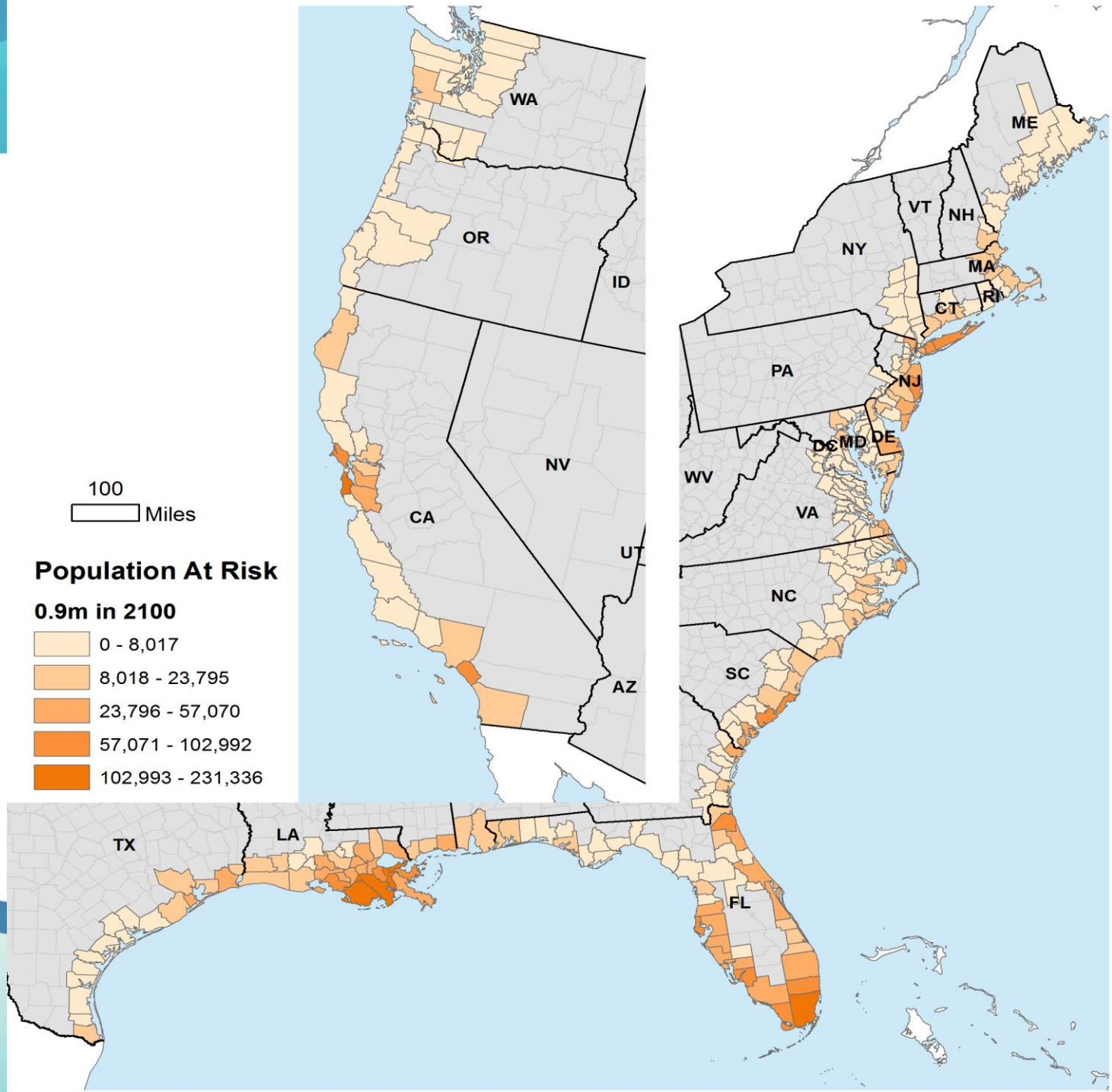
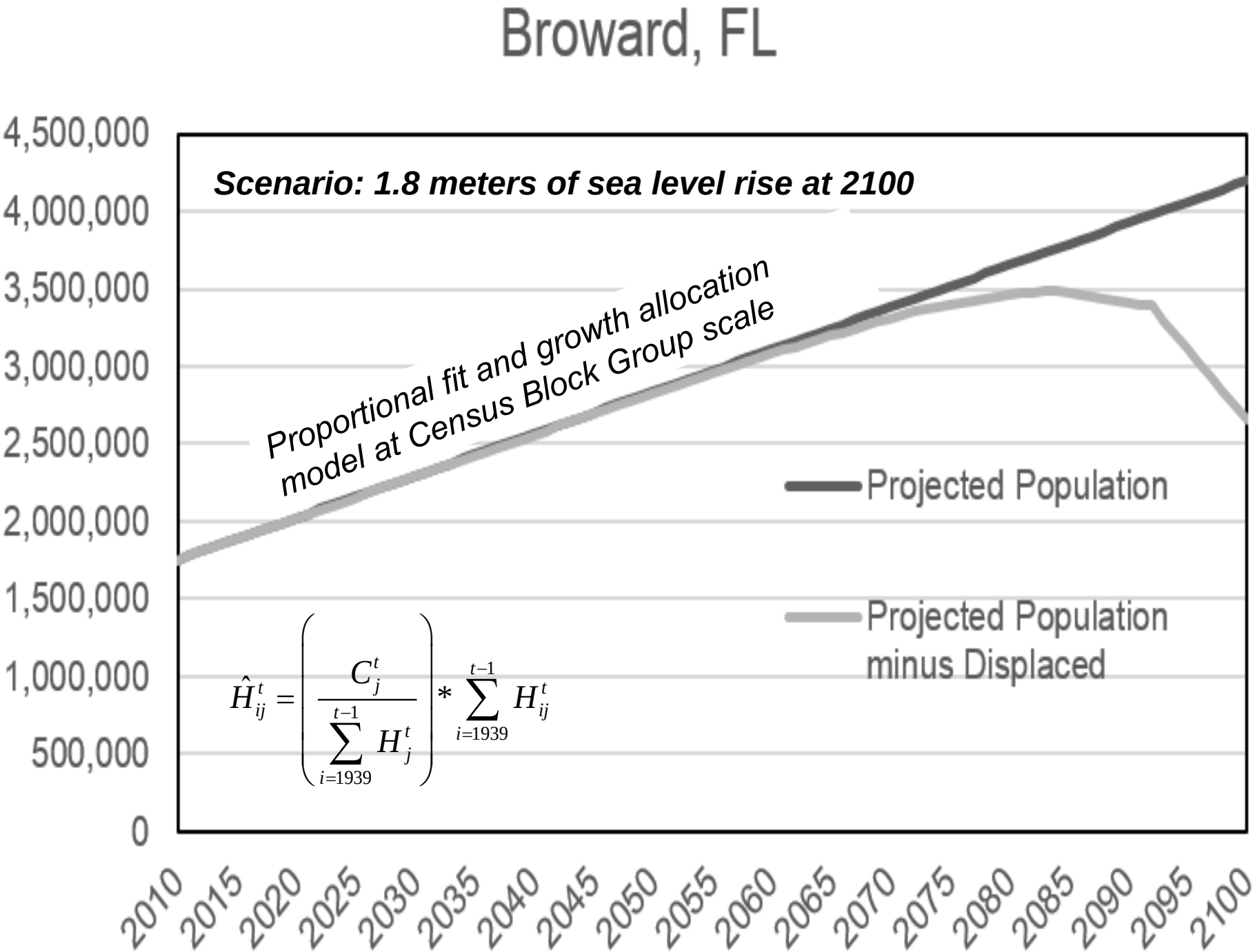


Figure 2: Projected vs. current population under 2100 MHHW, 1.8m of sea level rise

Hauer, Evans, & Mishrak 2016

Credit: M.J. Hauer, J.M. Evans and D. Mishra




Broward, FL
Scenario: 1.8 meters of sea level rise at 2100
Proportional fit and growth allocation model at Census Block Group scale
Projected Population
Projected Population minus Displaced
$\hat{H}_{ij}^{t} = \left(\frac{C_j^t}{\sum_{i=1939}^{t-1} H_j^t} \right) * \sum_{i=1939}^{t-1} H_{ij}^t$
4,500,000
4,000,000
3,500,000
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
2010
2015
2020
2025
2030
2035
2040
2045
2050
2055
2060
2065
2070
2075
2080
2085
2090
2095
2100

Population impacted with 1.8 meters of sea level rise at 2100

County	2100 Projected Population at Risk	US Rank	% 2100 Projected Population At Risk	US Rank
Tyrell, NC	6,046	*184*	91.8%	*1*
Monroe, FL	138,886	*23*	83.1%	*2*
Hyde, NC	7,598	*164*	80.2%	*3*
Cameron, LA	10,457	*145*	72.9%	*4*
Nassau, FL	21,230	*108*	13.5%	*69*

U.S. national-scale analysis of 318 coastal counties

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Camden, GA	13,155	*132*	12.1%	*79*

U.S. national-scale analysis of 318 coastal counties

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Outreach > Hyde County, NC Adaptation Plan

Hyde County, NC Adaptation Plan

Georgia Sea Grant, North Carolina Sea Grant and UGA help Hyde County plan for rising seas

Georgia Sea Grant, North Carolina Sea Grant, the University of Georgia's Carl Vinson Institute of Government and UGA Marine Extension Service are partnering with Hyde County, NC to develop a community resilience and adaptation plan. The project is funded by a grant from the national NOAA Sea Grant Program.

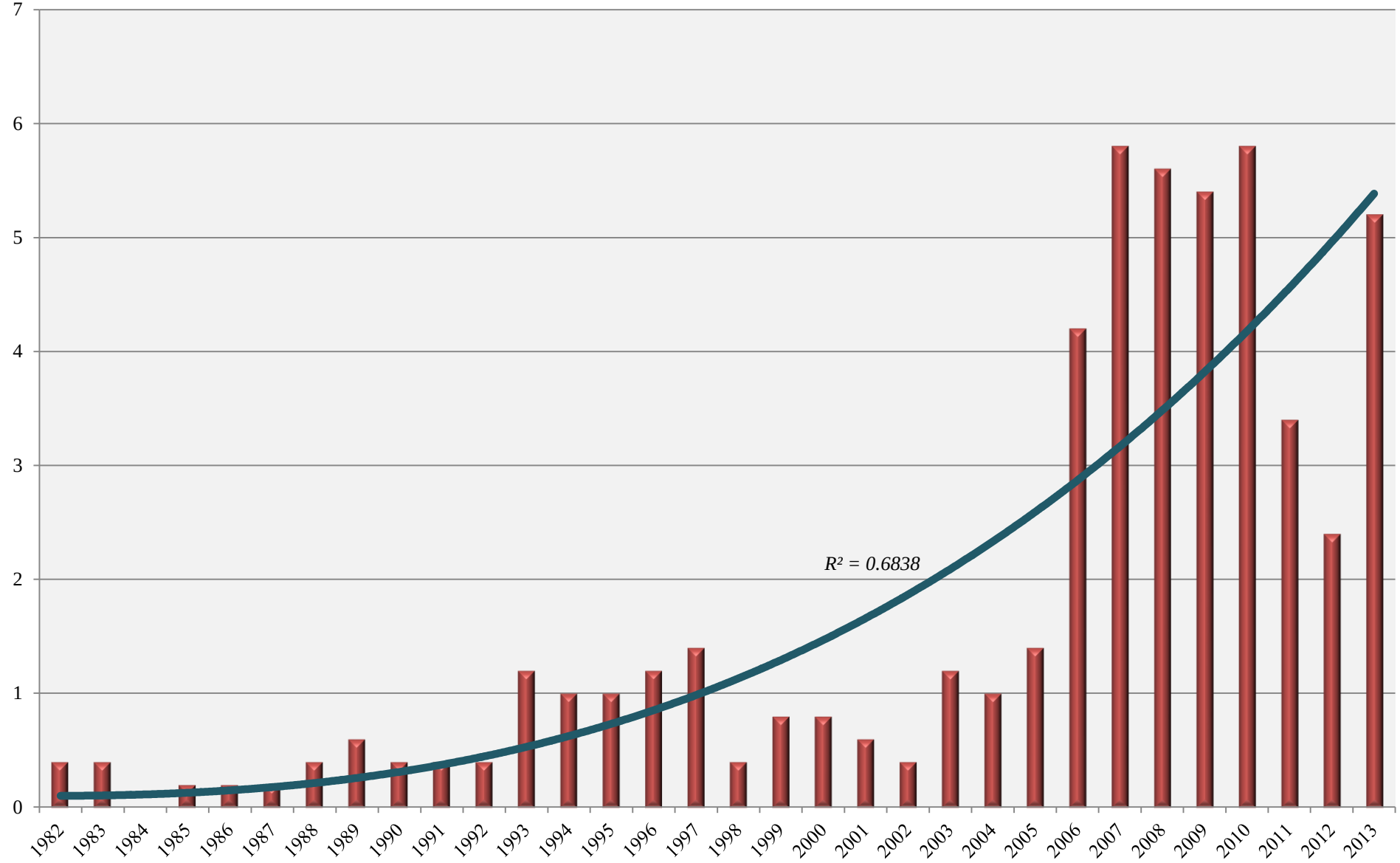
Hyde County has sought Sea Grant expertise on topics such as coastal flooding, which is expected to be exacerbated by extreme rainfall events and future sea-level rise.

The effort will blend North Carolina's expertise in facilitating the Vulnerability, Consequences and Adaptation Planning Scenarios, or VCAPS, with Georgia's expertise in benefit/cost modeling.

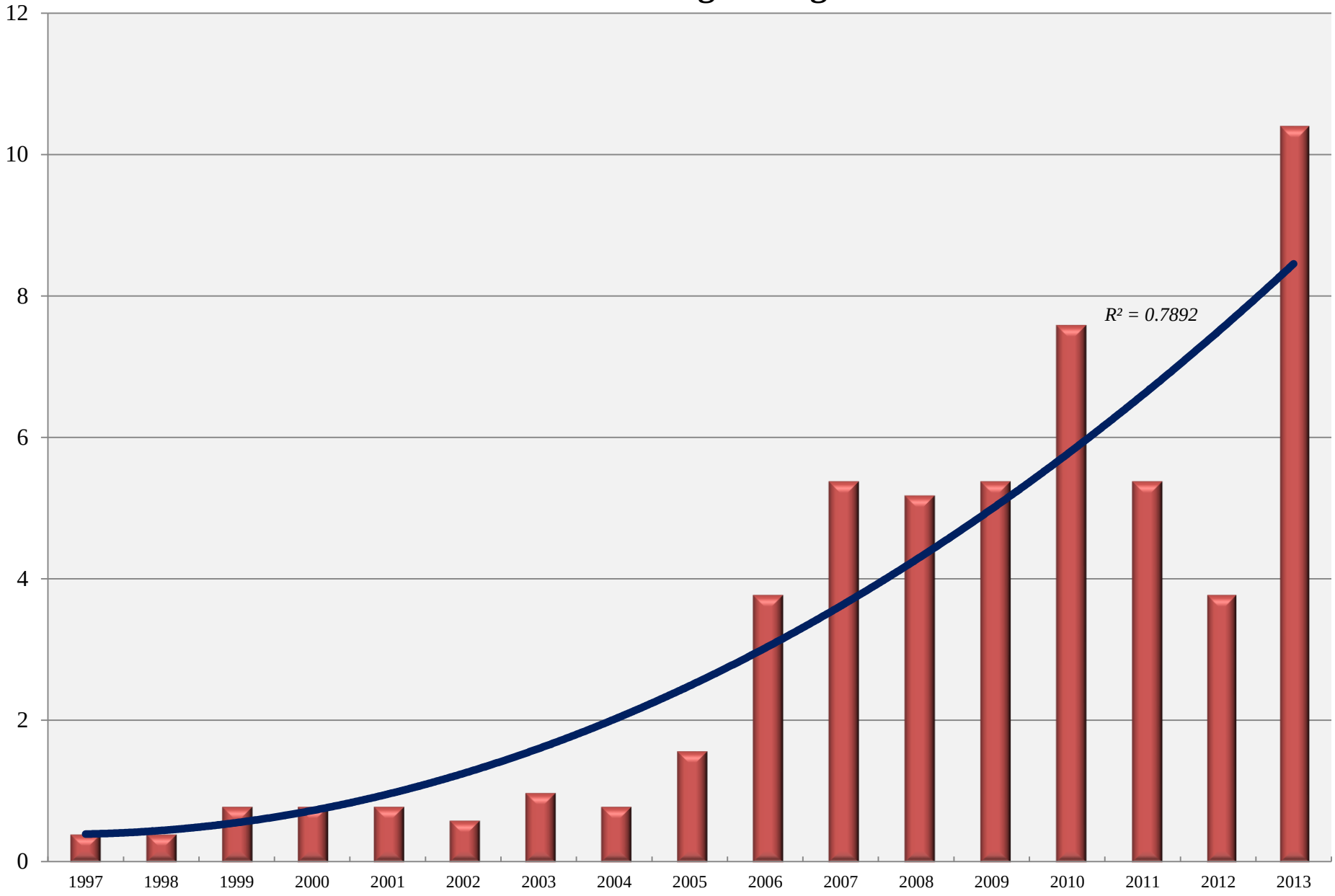
VCAPS involves developing, through a series of public workshops, detailed assessments of communities' current and future ulnerabilities. These could include potential for flooding, damage to ıfrastructure and private property and threats to local water supply om drought or saltwater intrusion. Recently, this technique was uccessfully applied in Plymouth, NC to untangle factors that contribute › the town's problems with flooding.

he benefit/cost analysis method developed by UGA's Carl Vinson ıstitute of Government and Georgia Sea Grant has been used to look t various pathways for adaptation in Tybee Island, Ga. The analyses ill provide the basis for developing policy recommendations for each ommunity in the form of tailored resilience and adaptation plans.

Nuisance Tidal Floods Per Year at Key West Tide Gauge
5-Year Running Average



Nuisance Tidal Floods Per Year at Vaca Key Tide Gauge
5-Year Running Average



Switching Gears – A Tour of What's Happening Now

Stillwright Way/Sexton Way, Key Largo 10/28/15
Photo Source: Jon Glista

North Blackwater Lane, Key Largo 10/9/15
Photo Source: Emilie Stewart

Grassy Way, Key Largo 9/29/15
Photo Source: Unknown

Adams Drive, Key Largo 9/29/15
Photo Source: Kim Weatherly

Waters Edge Colony, Stock Island 9/30/15
Photo Source: A. Higgins

Father Tony's Way, Big Pine Key 9/29/15
Photo Source: Greg Corning

Bernstein Park, Stock Island 9/29/15
Photo Source: A. Higgins

Kmart Plaza, Key West 9/29/15
Photo Source: Bob Shillinger

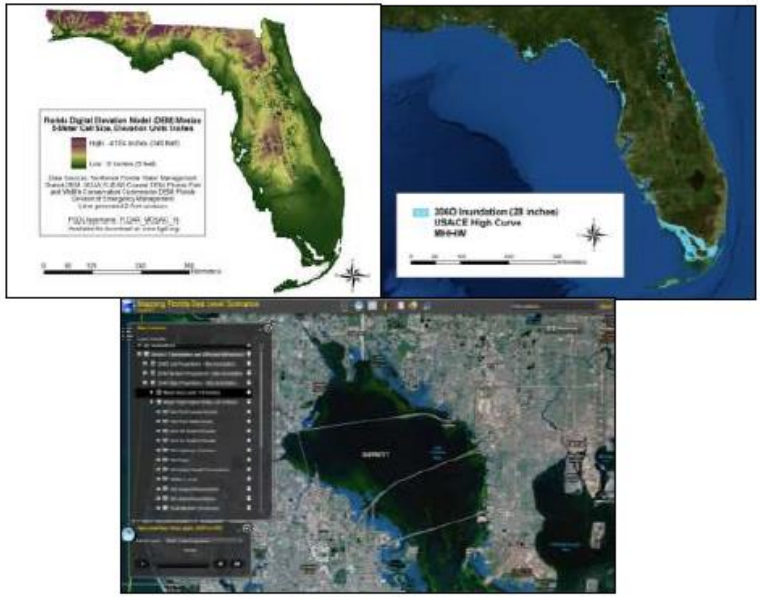
Bat Tower Road, Sugarloaf
10/9/15
Photo Source: Will Thompson

Roads Analysis

Based on FDOT Sea Level Rise Sketch Tool *

Developed by University of Florida

DEVELOPMENT OF A GEOGRAPHIC INFORMATION SYSTEM (GIS) TOOL FOR THE PRELIMINARY ASSESSMENT OF THE EFFECTS OF PREDICTED SEA LEVEL AND TIDAL CHANGE ON TRANSPORTATION INFRASTRUCTURE



FDOT Contract# BDK75 977-63
September 2013
Final Report

UF UNIVERSITY of FLORIDA

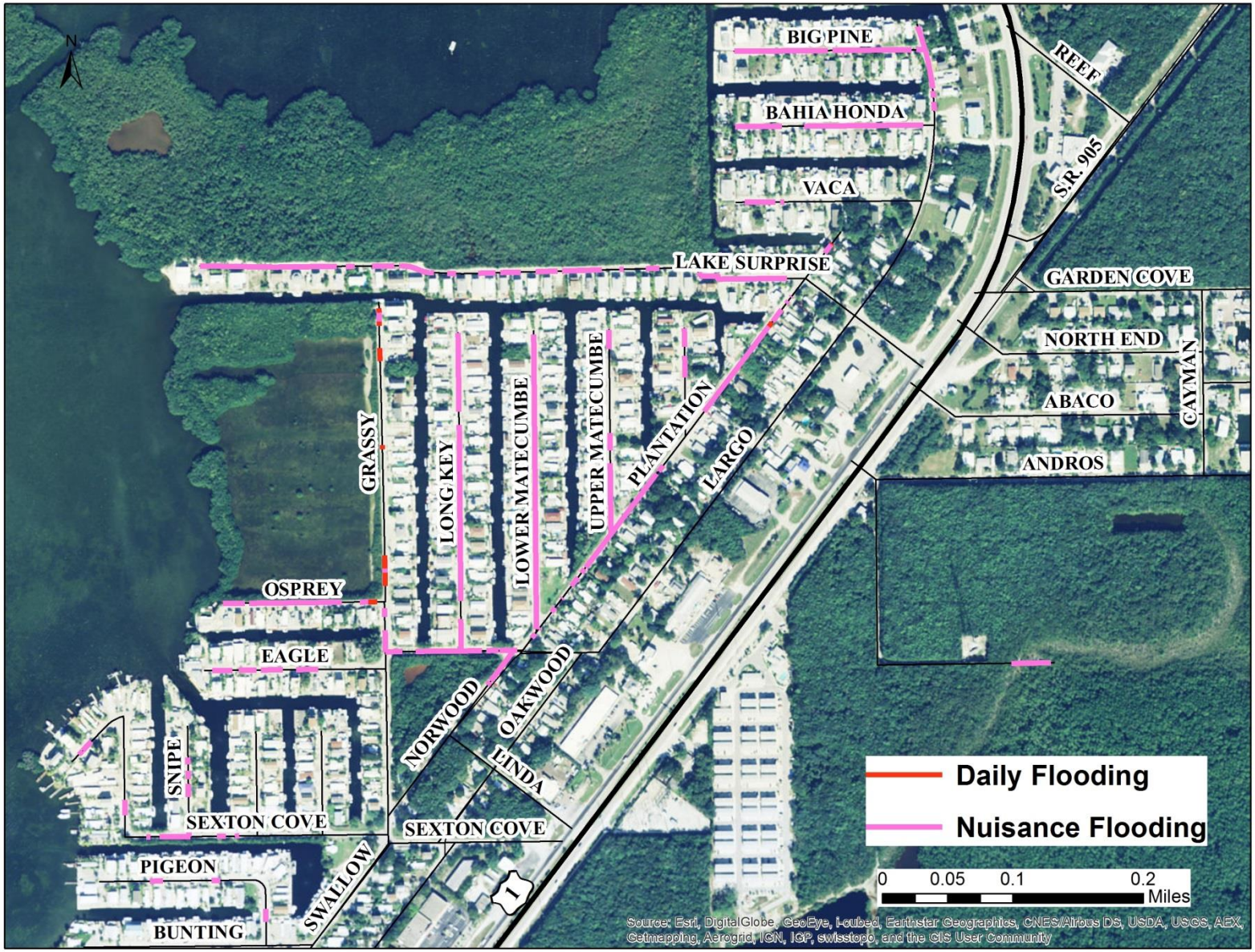
Prepared by
Alexis Thomas
Dr. Russell Watkins
The GeoPlan Center
Department of Urban & Regional Planning
University of Florida

Funded by
Florida Department of Transportation

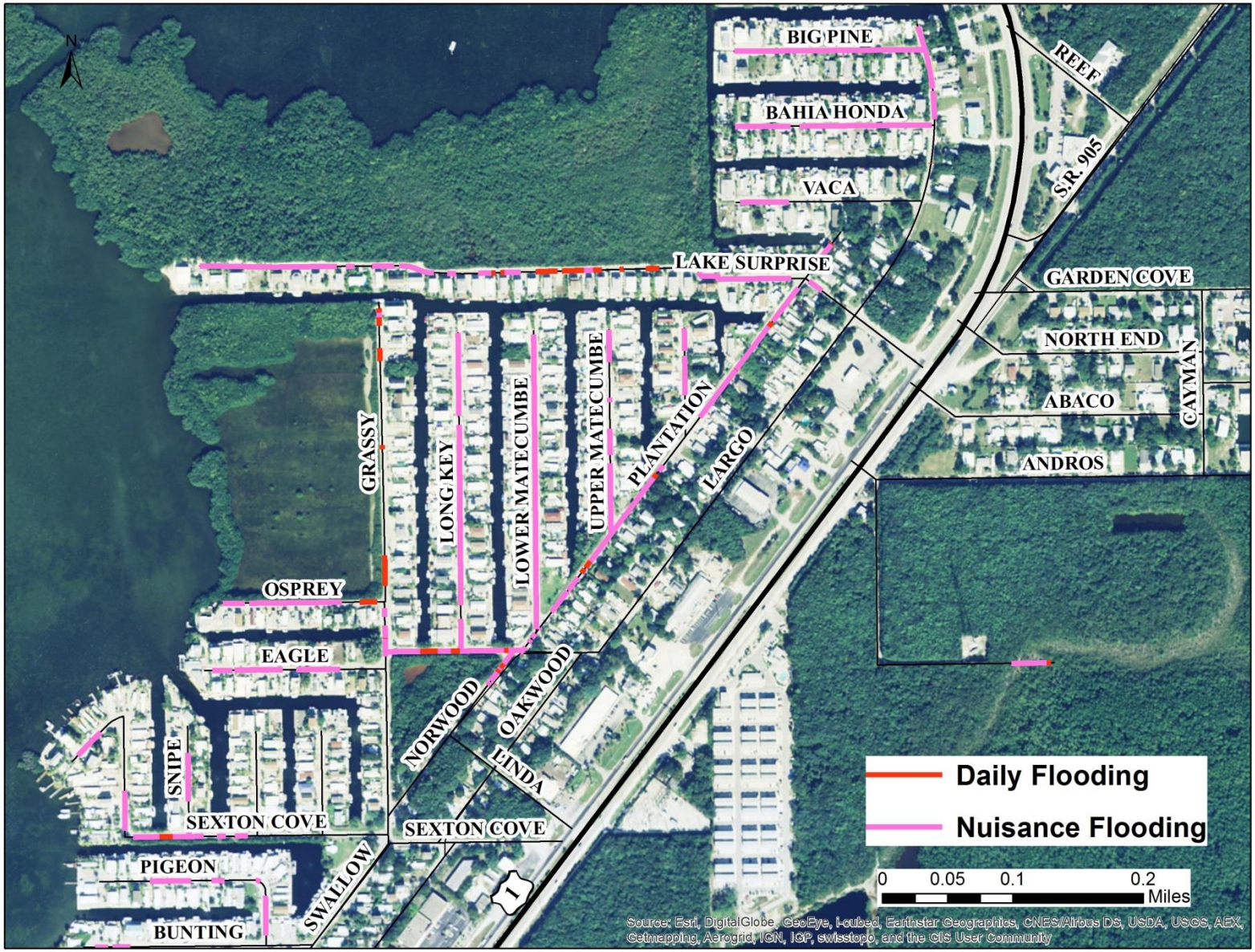
http://sls.geoplan.ufl.edu/documents-links/

**General planning assessment tool requires additional data for use in site-level decisions*

Key Largo: Lake Surprise/Sexton Cove
3” of Sea Level Rise (2030 Low Scenario)



Key Largo: Lake Surprise/Sexton Cove
7” of Sea Level Rise (2030 High Scenario)



Monroe County (Florida Keys)

Engineering assessments of sea-level rise for road improvement budgets

Some discussion of sea-level rise as a planning overlay with wildlife habitat

Bi-partisan support and advocacy for federal and state funds

Hyde County, North Carolina

1:577,791

0 5 10 20 mi

0 5 10 20 km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the

North Carolina Coastal Atlas
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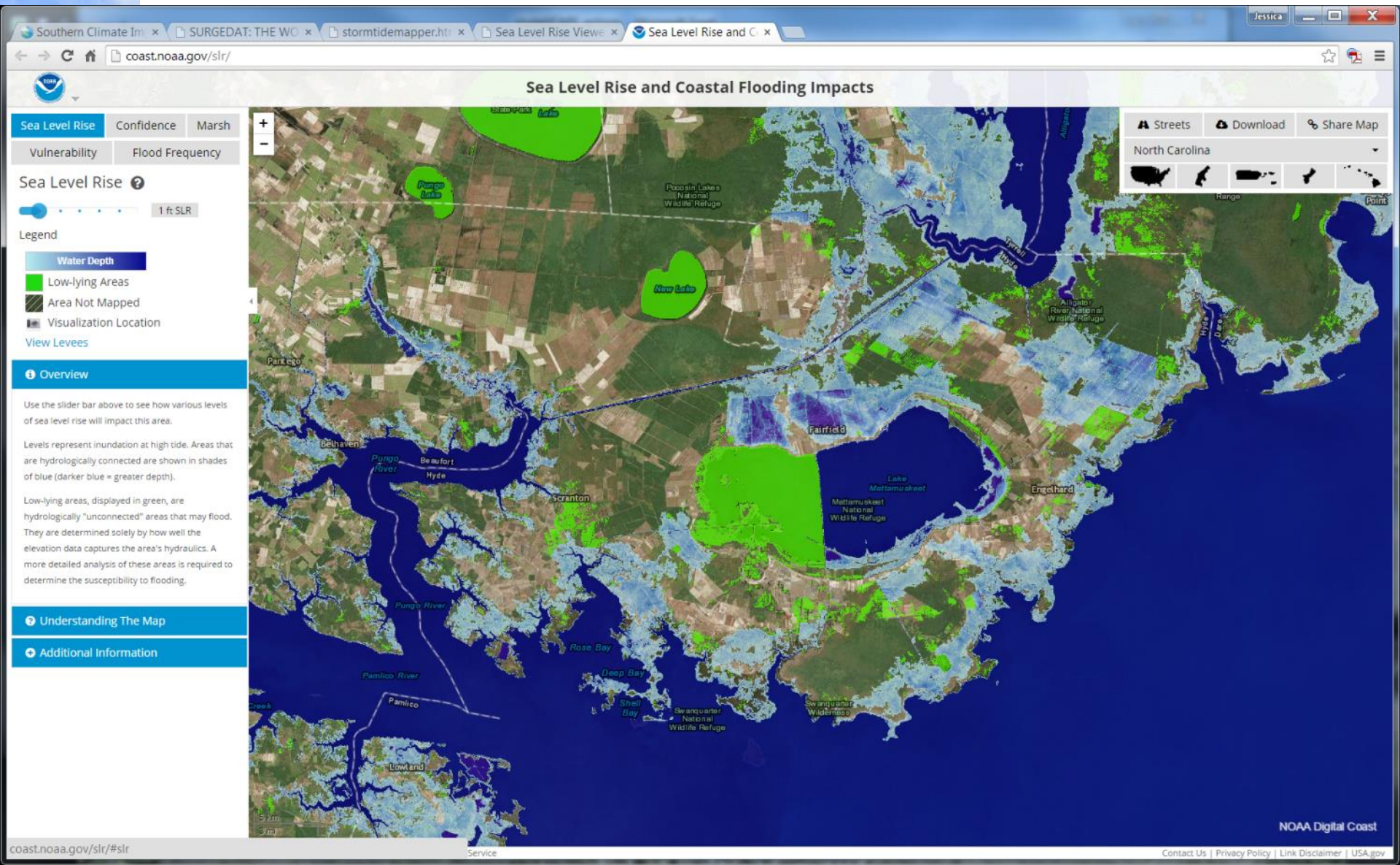
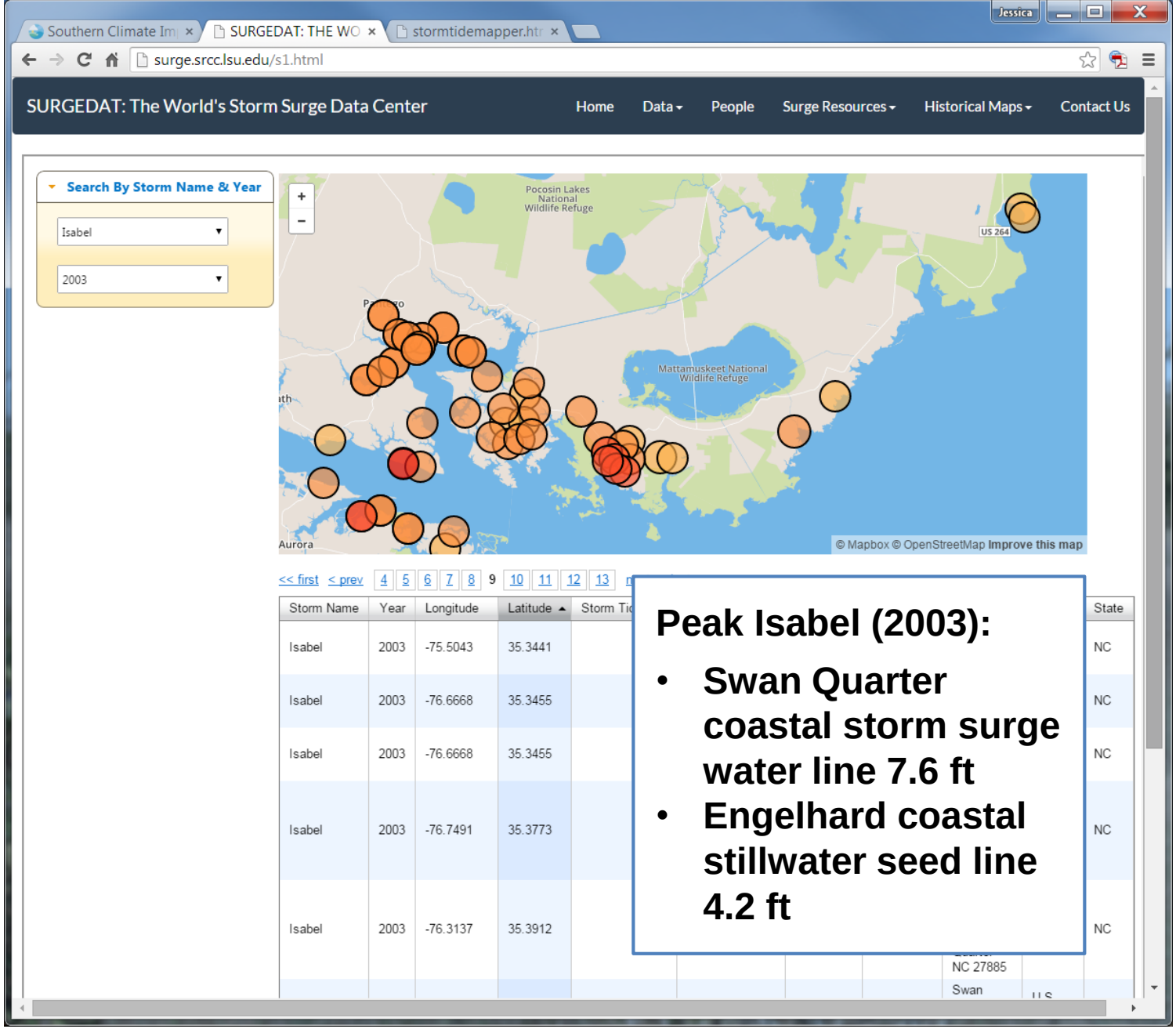
NOAA Sea Level Rise – 1 foot





Peak Isabel (2003):

- **Swan Quarter coastal storm surge water line 7.6 ft**
- **Engelhard coastal stillwater seed line 4.2 ft**

STETSON UNIVERSITY Sea Grant North Carolina

(GA SG 2013)

(GA SG 2013)

Spencer Heritage Farms Statewide DOQQs (1993)

July 23, 2015

1:9,322

0 0.075 0.15 0.3 mi

0 0.125 0.25 0.5 km

North Carolina Coastal Atlas
Copyright © North Carolina Coastal Atlas

Spencer Heritage Farms NAIP Imagery (2006)

July 23, 2015

1:9,322

0 0.075 0.15 0.3 mi

0 0.125 0.25 0.5 km

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Spencer Heritage Farms NAIP Imagery (2012)

July 23, 2015

1:9,322

0 0.075 0.15 0.3 mi

0 0.125 0.25 0.5 km

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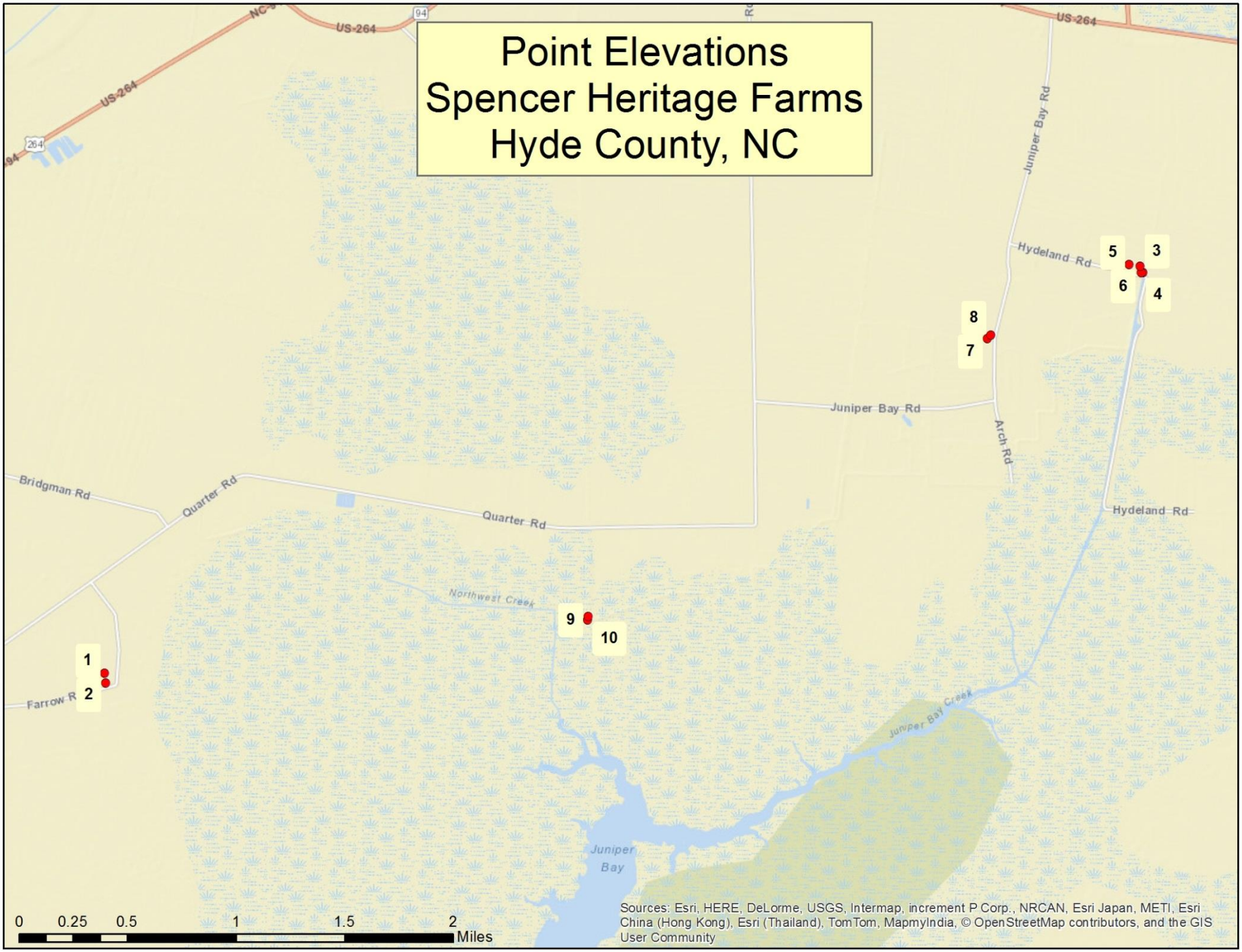
Point Elevations
Spencer Heritage Farms
Hyde County, NC
US-264
NC-94
Juniper Bay Rd
Hydeland Rd
Arch Rd
Quarter Rd
Bridgman Rd
Farrow R
Northwest Creek
Juniper Bay Creek
Juniper Bay
1
2
3
4
5
6
7
8
9
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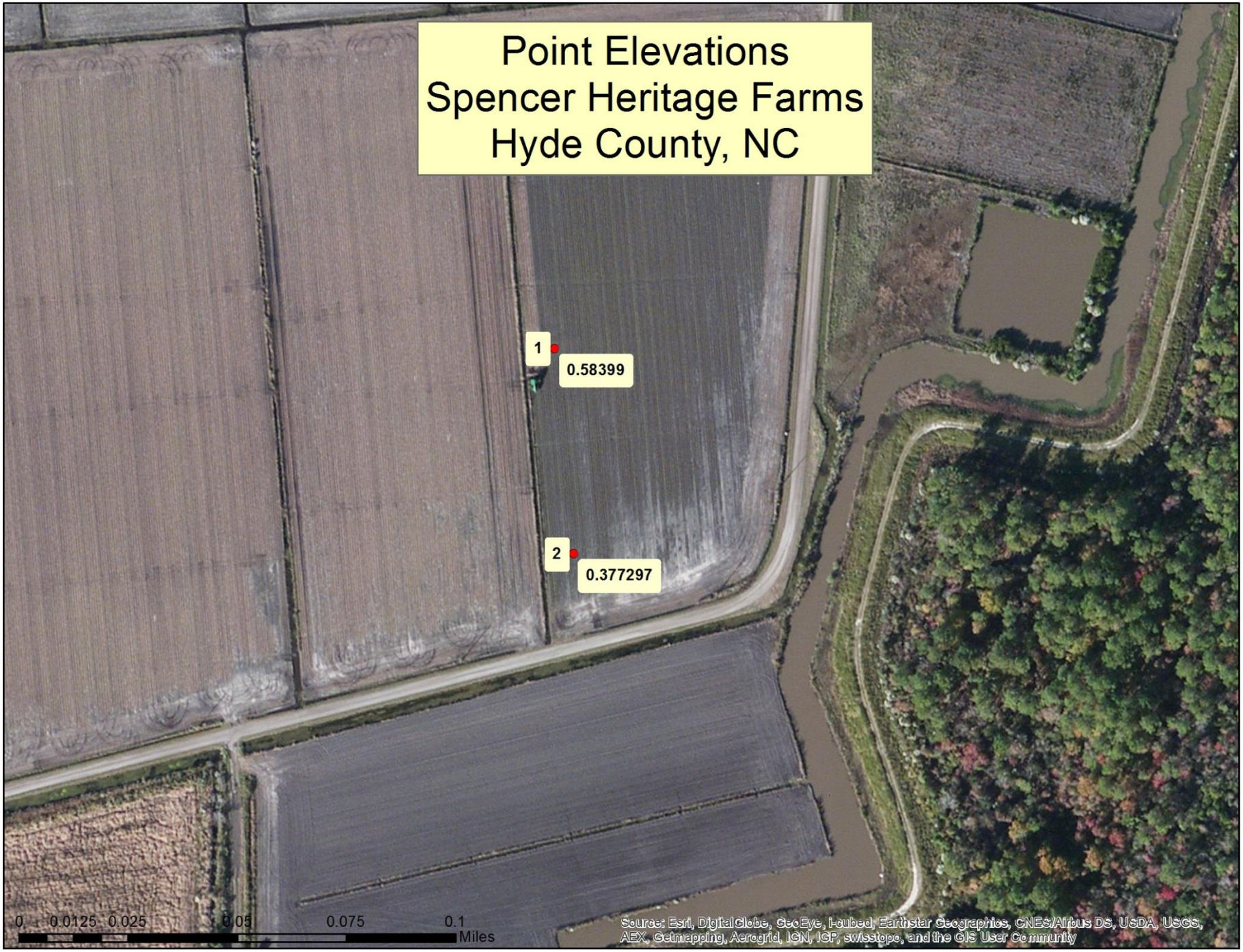
0 0.25 0.5 1 1.5 2 Miles
Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community


Point Elevations
Spencer Heritage Farms
Hyde County, NC
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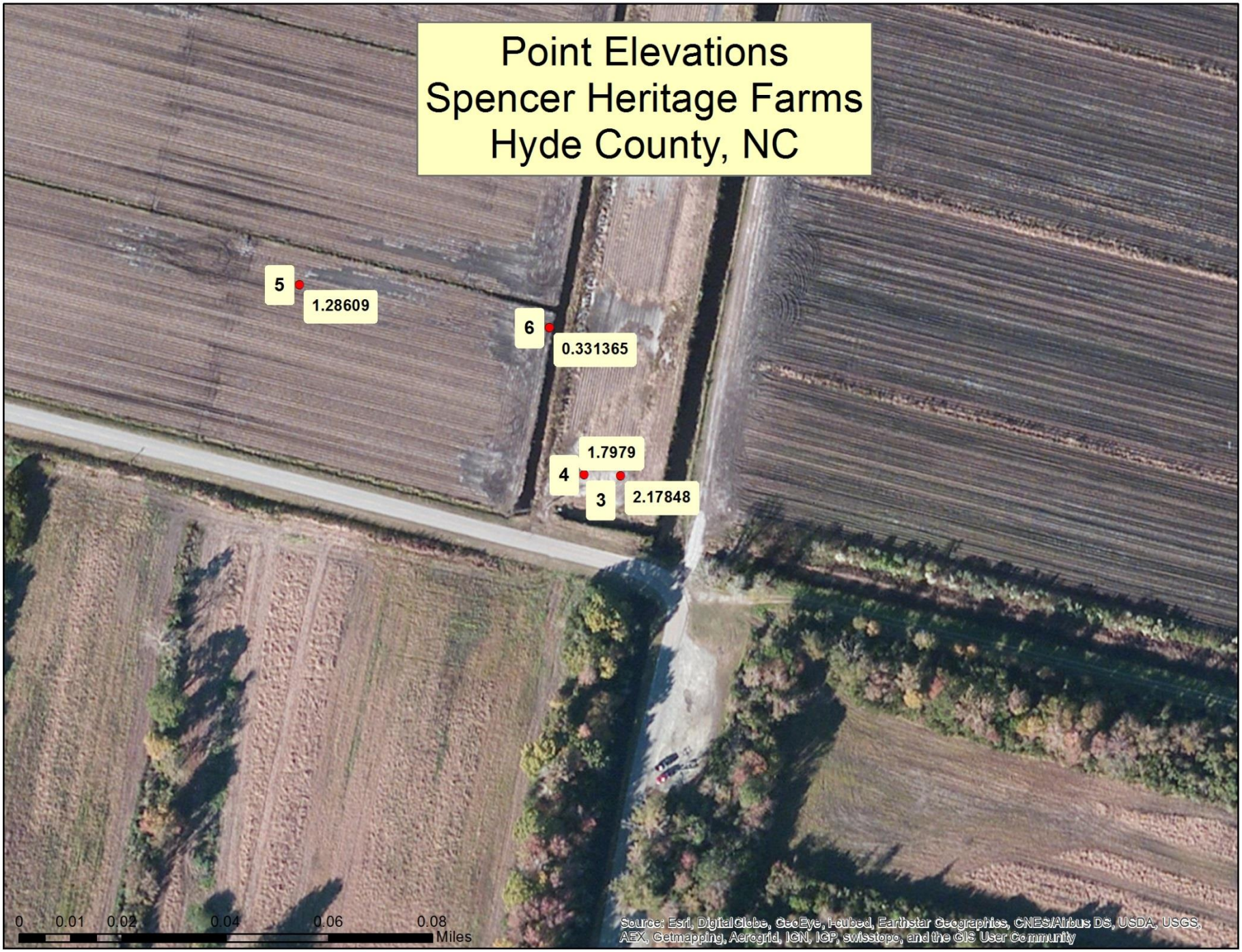
Miles
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community


Point Elevations
Spencer Heritage Farms
Hyde County, NC
5
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1.7979
4
3
2.17848
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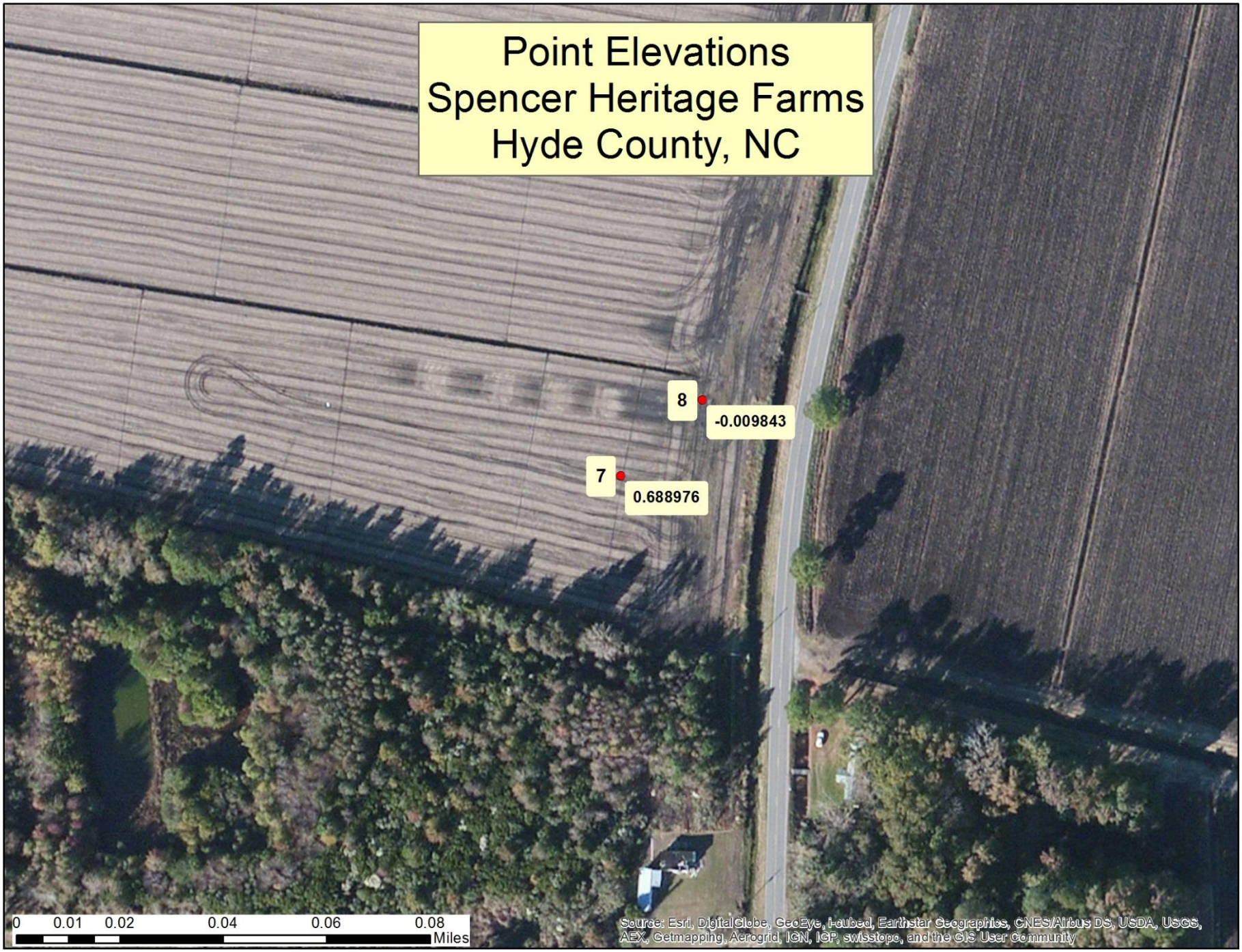
Miles
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community


Point Elevations
Spencer Heritage Farms
Hyde County, NC
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7
0.688976
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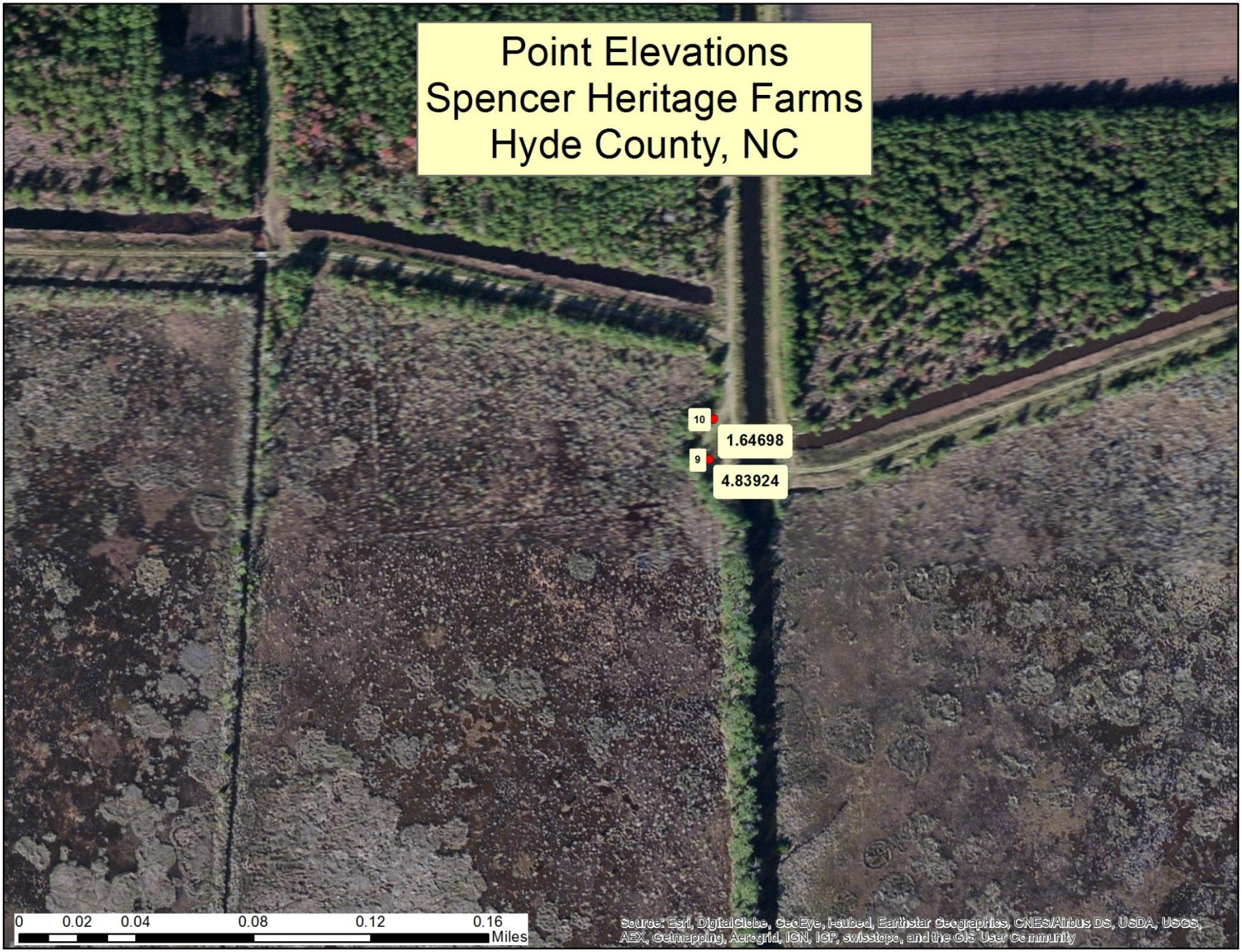
Miles
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community


Point Elevations
Spencer Heritage Farms
Hyde County, NC
10
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9
4.83924
0 0.02 0.04 0.08 0.12 0.16
Miles
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

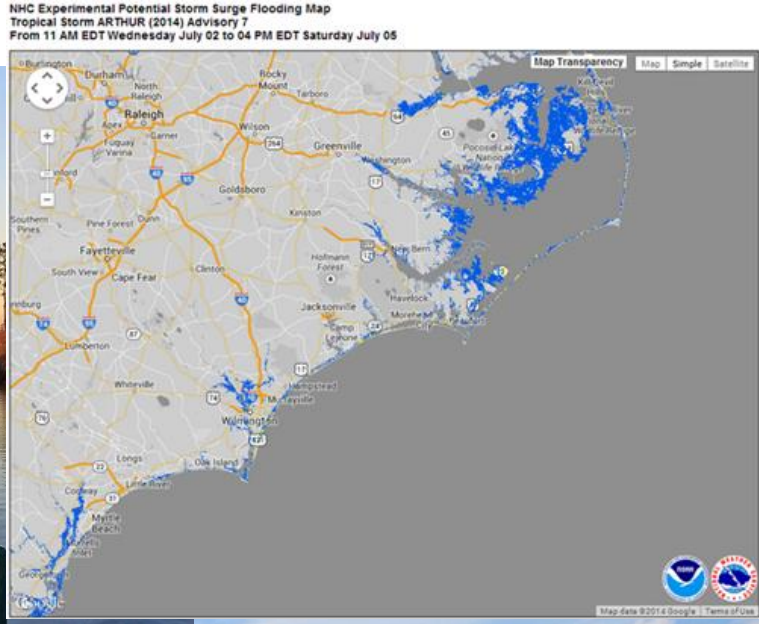
Hyde County Flood Resilience Planning Process

- Vulnerability, Consequences, and Adaptation Planning Scenario (VCAPS) Process
  - Interviews
  - Group diagramming
- GIS-based cost-benefit analysis
  - Additional public meetings
  - Investigations of options as needed (ex. elevation data collection)

STETSON UNIVERSITY Sea Grant North Carolina

July 1, 2014 Public Meeting

- Mainly focused on structures
- Agriculture and salinity intrusion
  - Seafood industry
- Adaptations require transformation
  - Agriculture tailwater recovery
  - Regulatory flexibility and coordination



(NC Dept. of Agriculture & Consumer Services 2014)

Final Report

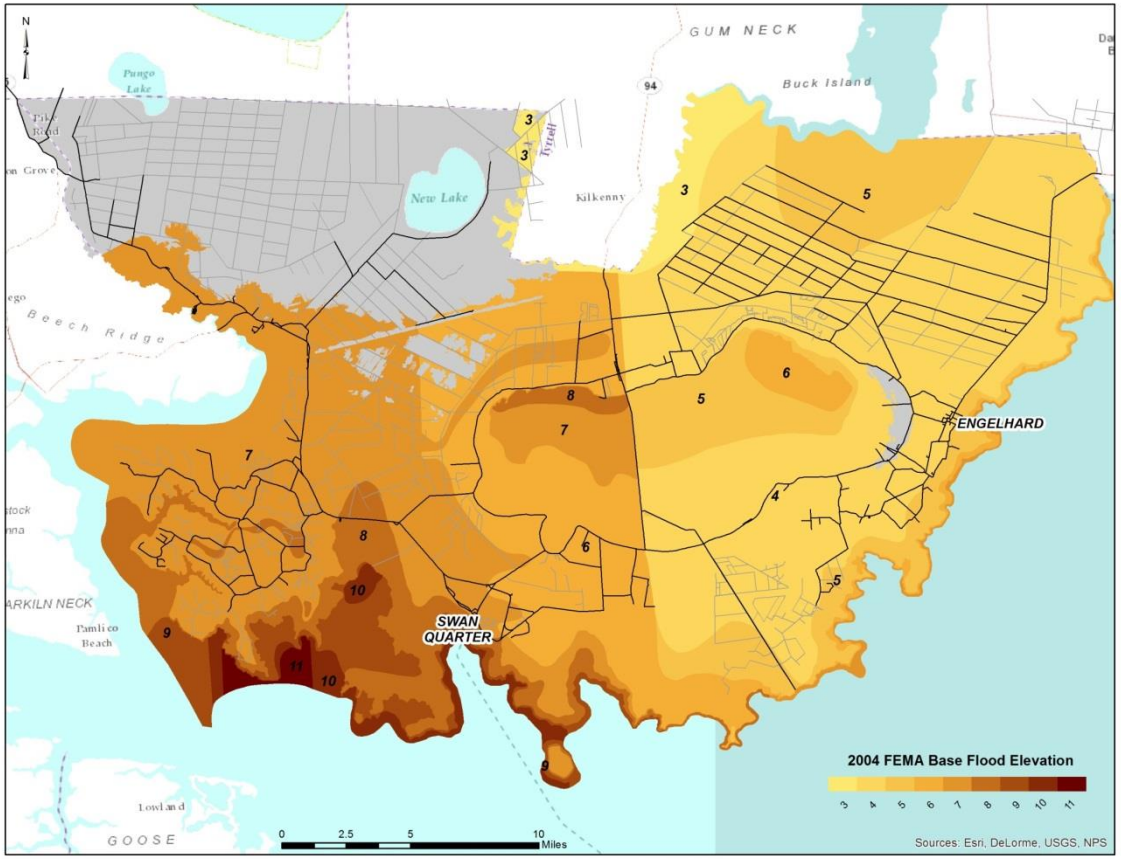
GIS-based cost-benefit analysis

What Will Adaptation Cost? An Economic Framework for Coastal Community Infrastructure

June 2013

Eastern Research Group, Inc.

Written under contract for the
National Oceanic and Atmospheric Administration (NOAA)
Coastal Services Center



NOAA Coastal Services Center
(843) 740-1200
www.csc.noaa.gov

NOAA Coastal Services Center
LINKING PEOPLE, INFORMATION, AND TECHNOLOGY

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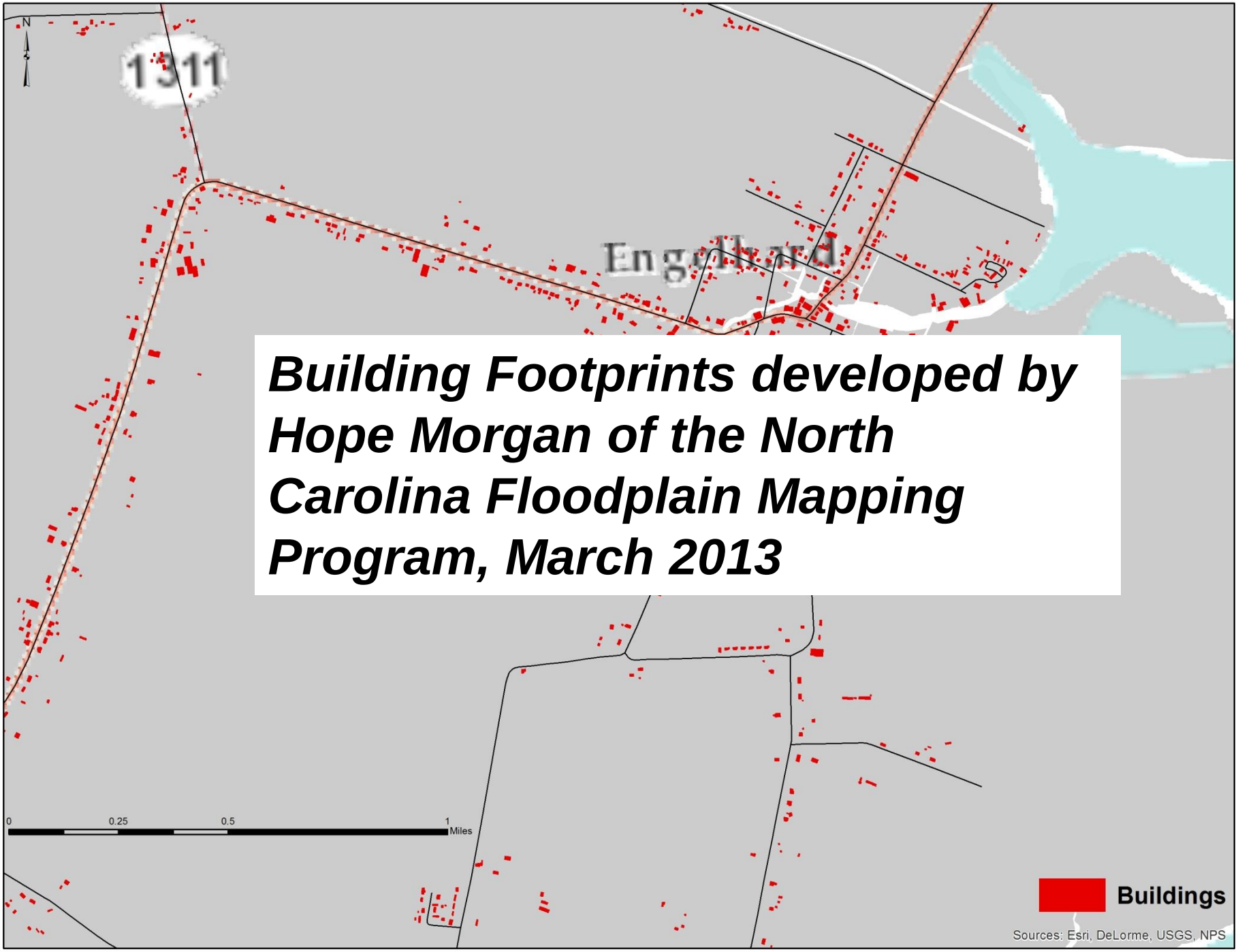
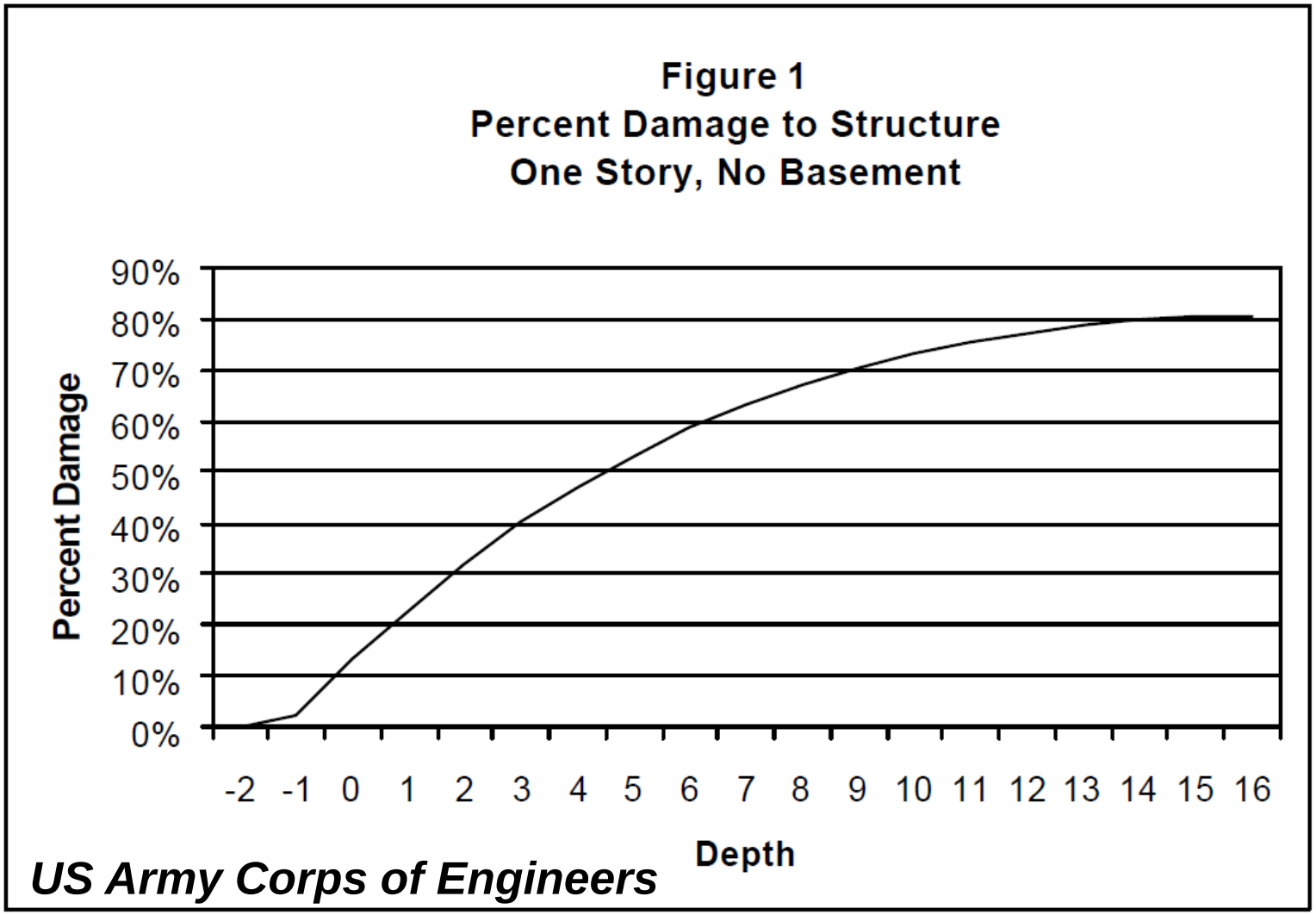
Sea Grant North Carolina



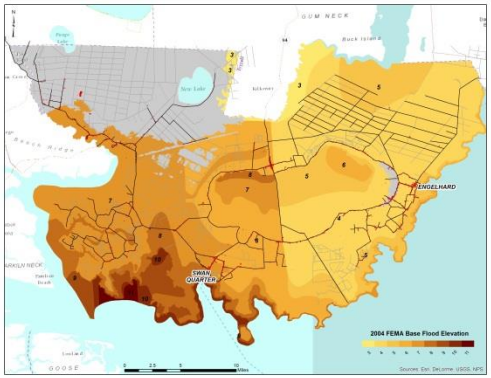
Building Footprints developed by Hope Morgan of the North Carolina Floodplain Mapping Program, March 2013

Flood-damage curve



US Army Corps of Engineers (2000)

County-wide Totals (Including Ocracoke) 5,884 Buildings



Flood Height	Finished Floors	Total Building	50 Yr Flood Risk	50 Yr Flood Risk	Total Elevation
10 Year					
50 Year					
100 Year					
500 Year	3,664	$126.0 M	$39.0 M	$41.2 M	$174.5 M

Average elevation cost in Hyde County is ~$47,000 - $48,000 per structure

Stand and defend

Preliminary dike analysis for Engelhard area

Swan Quarter Dike

http://images.topix.com/gallery/up-RDNRMDU18DSR892L.jpg

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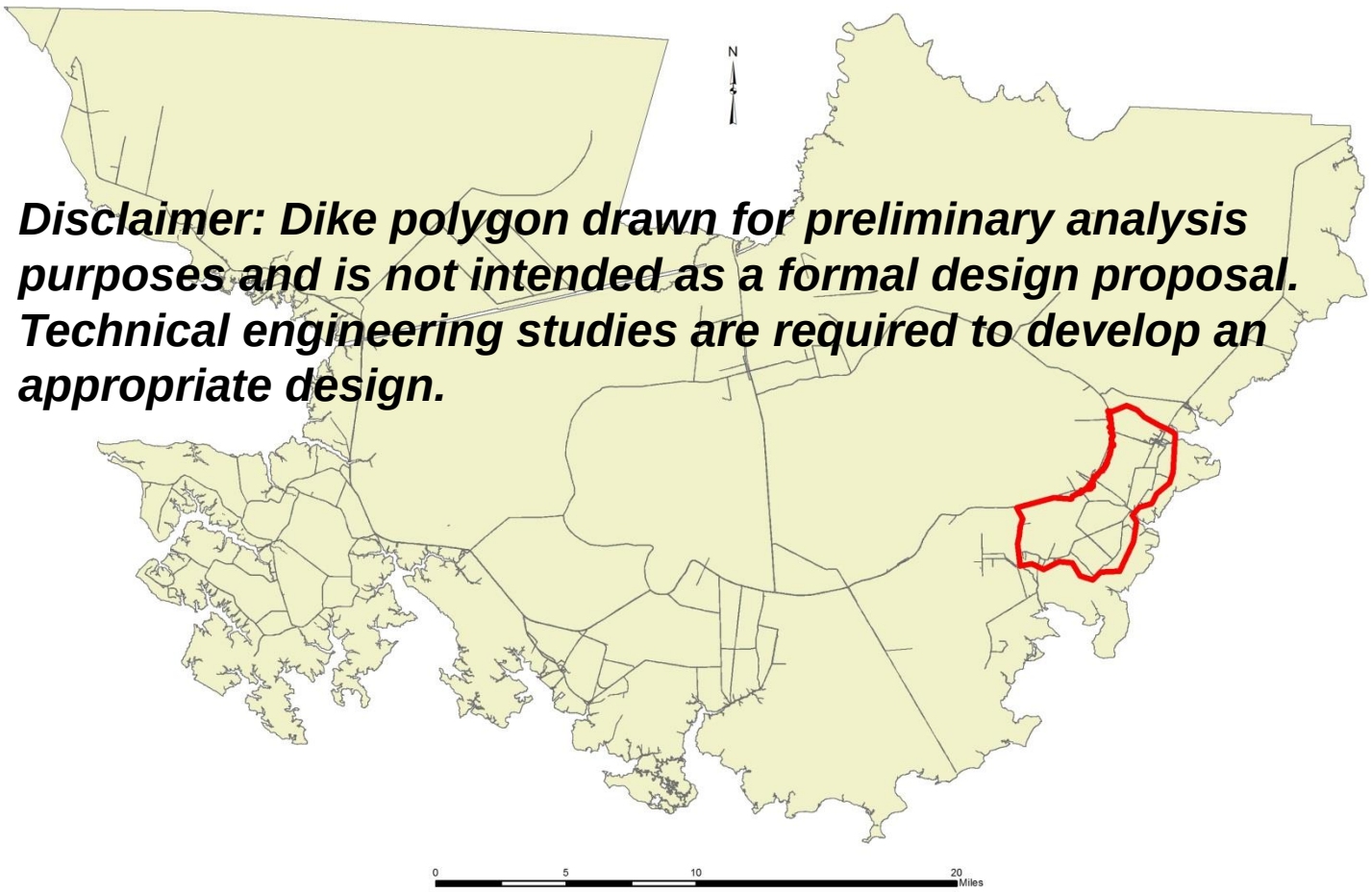
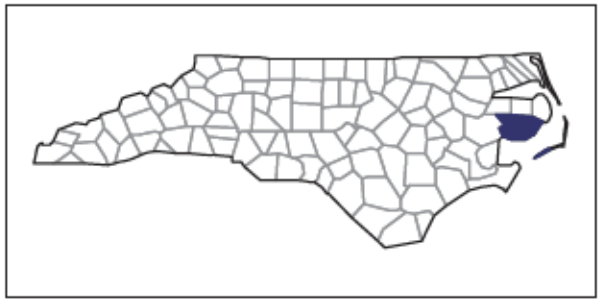
Dike Polygon



Disclaimer: Dike polygon drawn for preliminary analysis purposes and is not intended as a formal design proposal. Technical engineering studies are required to develop an appropriate design.

2012 CENSUS OF AGRICULTURE

COUNTY PROFILE



Hyde County
North Carolina

	2012	2007	% change
Number of Farms	158	176	- 10
Land in Farms	107,559 acres	82,680 acres	+ 30
Average Size of Farm	681 acres	470 acres	+ 45
Market Value of Products Sold	$133,411,000	$68,173,000	+ 96
Crop Sales (D)			
Livestock Sales (D)			
Average Per Farm	$844,375	$387,347	+ 118

2012 USDA Data indicate $1,240 of annual market value for every acre of Hyde County farmland

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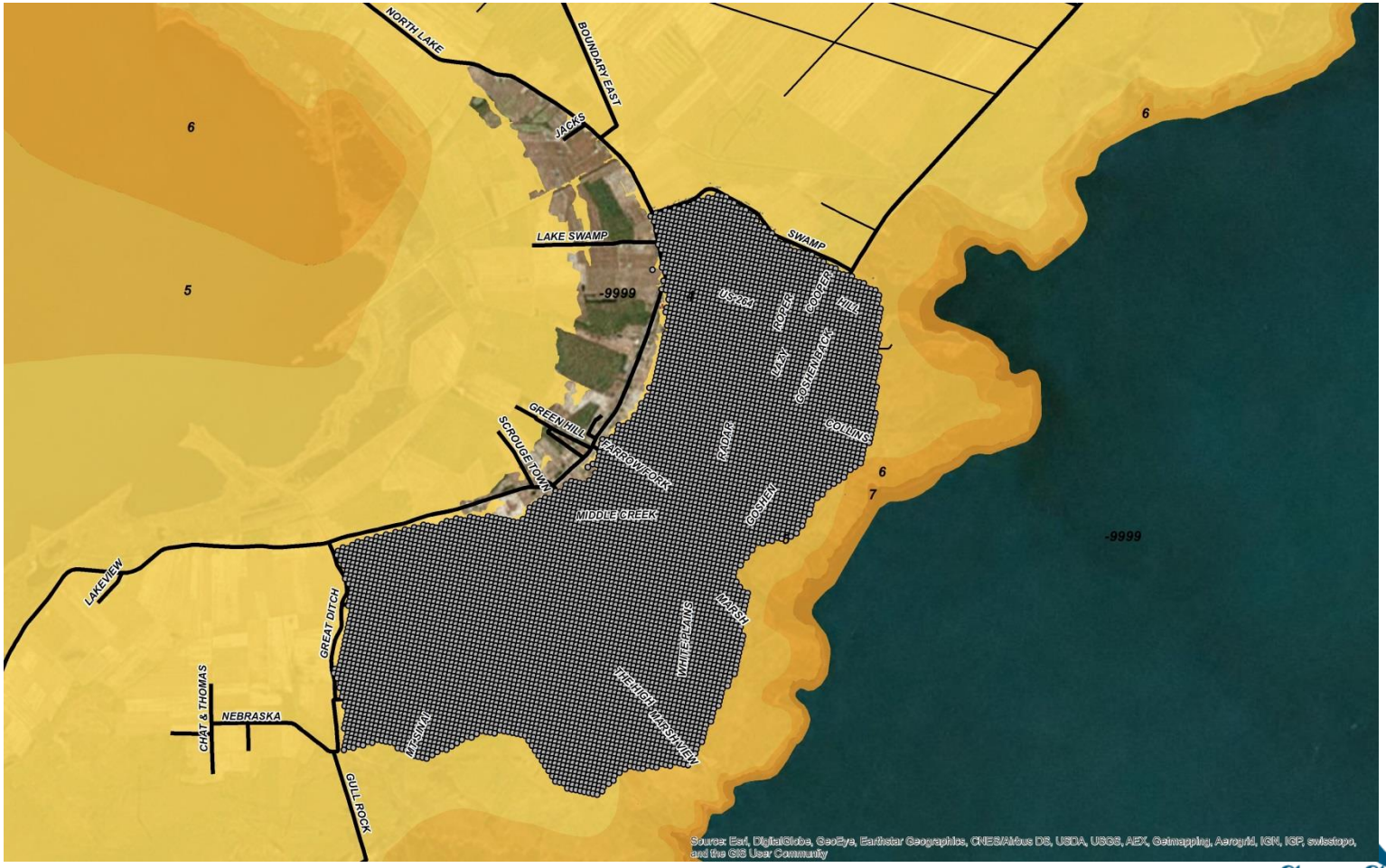
Modeling Approach



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Elevation extracted for each acre of land

Assumed a 100% crop loss from a saltwater flood event of a height greater than the land elevation

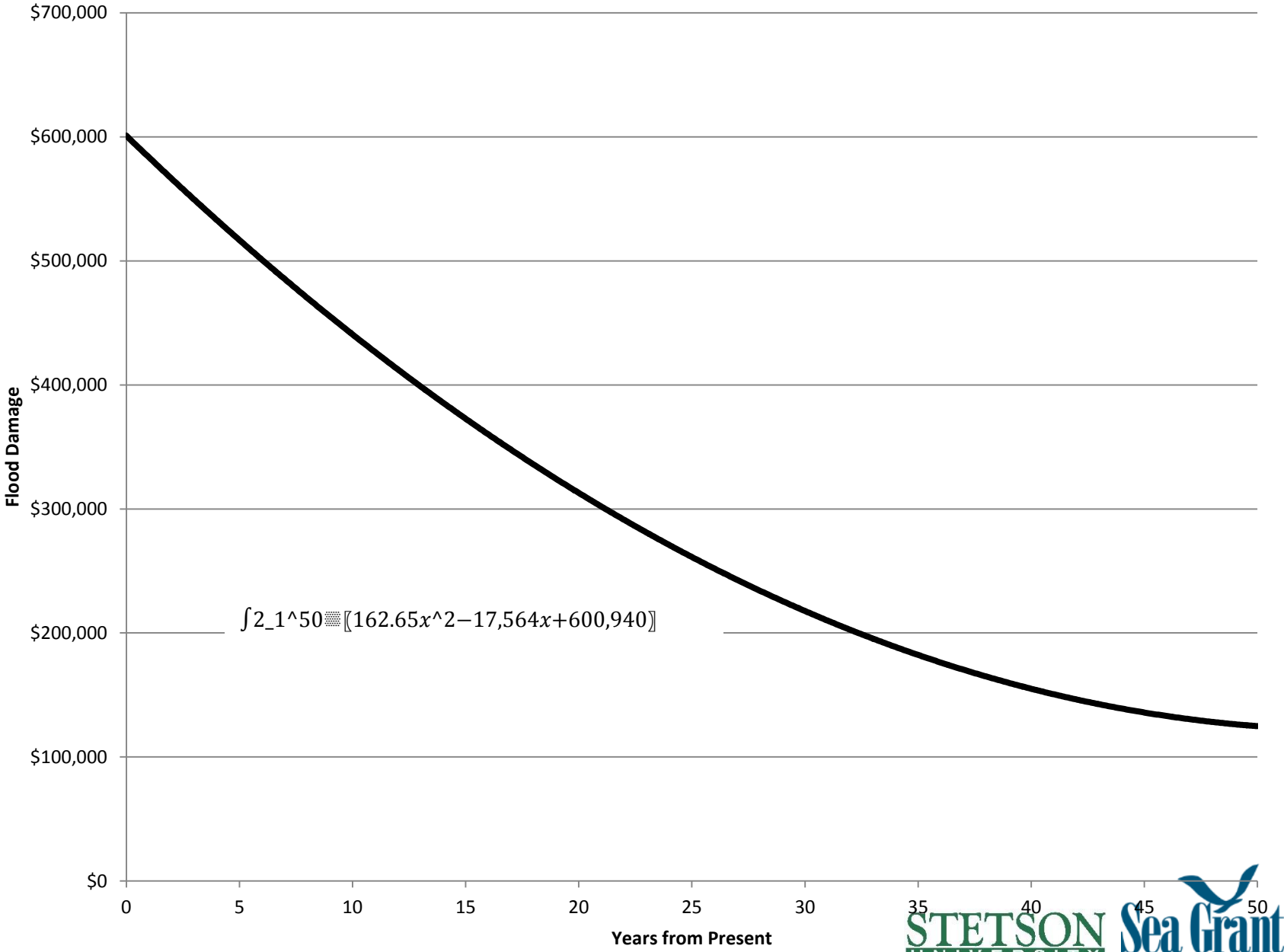
Future losses discounted at 3.3% per year

Table

elevations_BFE_Engelhard_LandCover

FID	Shape *	GRID_CODE	Land Cover	ELEVATION	100 Year Flood
0	Point	11	Herbaceous Agricultural Vegetation	1.665	4
1	Point	11	Herbaceous Agricultural Vegetation	1.793	4
2	Point	11	Herbaceous Agricultural Vegetation	1.798	4
3	Point	11	Herbaceous Agricultural Vegetation	1.58	4
4	Point	11	Herbaceous Agricultural Vegetation	1.336	4
5	Point	11	Herbaceous Agricultural Vegetation	1.519	4
6	Point	11	Herbaceous Agricultural Vegetation	1.767	4
7	Point	11	Herbaceous Agricultural Vegetation	1.743	4
8	Point	11	Herbaceous Agricultural Vegetation	1.767	4
9	Point	11	Herbaceous Agricultural Vegetation	1.23	4
10	Point	11	Herbaceous Agricultural Vegetation	1.472	4
11	Point	11	Herbaceous Agricultural Vegetation	1.44	4
12	Point	11	Herbaceous Agricultural Vegetation	1.585	4
13	Point	11	Herbaceous Agricultural Vegetation	1.287	4
14	Point	11	Herbaceous Agricultural Vegetation	1.887	4
15	Point	11	Herbaceous Agricultural Vegetation	1.517	4
16	Point	11	Herbaceous Agricultural Vegetation	1.774	4
17	Point	11	Herbaceous Agricultural Vegetation	2.197	4
18	Point	11	Herbaceous Agricultural Vegetation	2.068	4
19	Point	11	Herbaceous Agricultural Vegetation	1.763	4
20	Point	11	Herbaceous Agricultural Vegetation	2.068	4
21	Point	11	Herbaceous Agricultural Vegetation	1.524	4
22	Point	11	Herbaceous Agricultural Vegetation	1.602	4
23	Point	11	Herbaceous Agricultural Vegetation	1.594	4
24	Point	11	Herbaceous Agricultural Vegetation	1.167	4
25	Point	11	Herbaceous Agricultural Vegetation	1.592	4
26	Point	11	Herbaceous Agricultural Vegetation	1.489	4
27	Point	11	Herbaceous Agricultural Vegetation	1.609	4
28	Point	11	Herbaceous Agricultural Vegetation	1.469	4
29	Point	11	Herbaceous Agricultural Vegetation	2.117	4
30	Point	11	Herbaceous Agricultural Vegetation	2.111	4
31	Point	11	Herbaceous Agricultural Vegetation	2.214	4
32	Point	11	Herbaceous Agricultural Vegetation	1.952	4
33	Point	11	Herbaceous Agricultural Vegetation	1.663	4
34	Point	11	Herbaceous Agricultural Vegetation	1.911	4
35	Point	11	Herbaceous Agricultural Vegetation	1.952	4
36	Point	11	Herbaceous Agricultural Vegetation	2.126	4
37	Point	12	Recently Disturbed or Modified	3.216	4
38	Point	14	Developed & Urban	1.633	4
39	Point	11	Herbaceous Agricultural Vegetation	1.309	4
40	Point	11	Herbaceous Agricultural Vegetation	1.648	4
41	Point	11	Herbaceous Agricultural Vegetation	1.663	4
42	Point	11	Herbaceous Agricultural Vegetation	0.993	4
43	Point	11	Herbaceous Agricultural Vegetation	1.341	4
44	Point	11	Herbaceous Agricultural Vegetation	1.707	4
45	Point	11	Herbaceous Agricultural Vegetation	1.459	4
46	Point	11	Herbaceous Agricultural Vegetation	1.88	4
47	Point	11	Herbaceous Agricultural Vegetation	2.056	4
48	Point	11	Herbaceous Agricultural Vegetation	2.088	4
49	Point	11	Herbaceous Agricultural Vegetation	1.523	4
50	Point	11	Herbaceous Agricultural Vegetation	1.672	4
51	Point	11	Herbaceous Agricultural Vegetation	1.973	4

Agricultural Flood Damage Curve, Engelhard, NC
High Sea Level Rise



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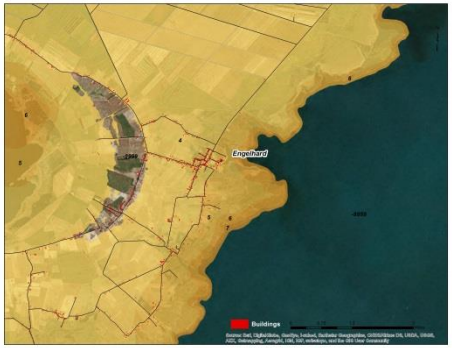
Protective Dike
(~18 linear miles)



Comparable Swan Quarter dyke cost ~$17 million (2010 dollars) over 46 years

Completed in 2011

Ag
Acres

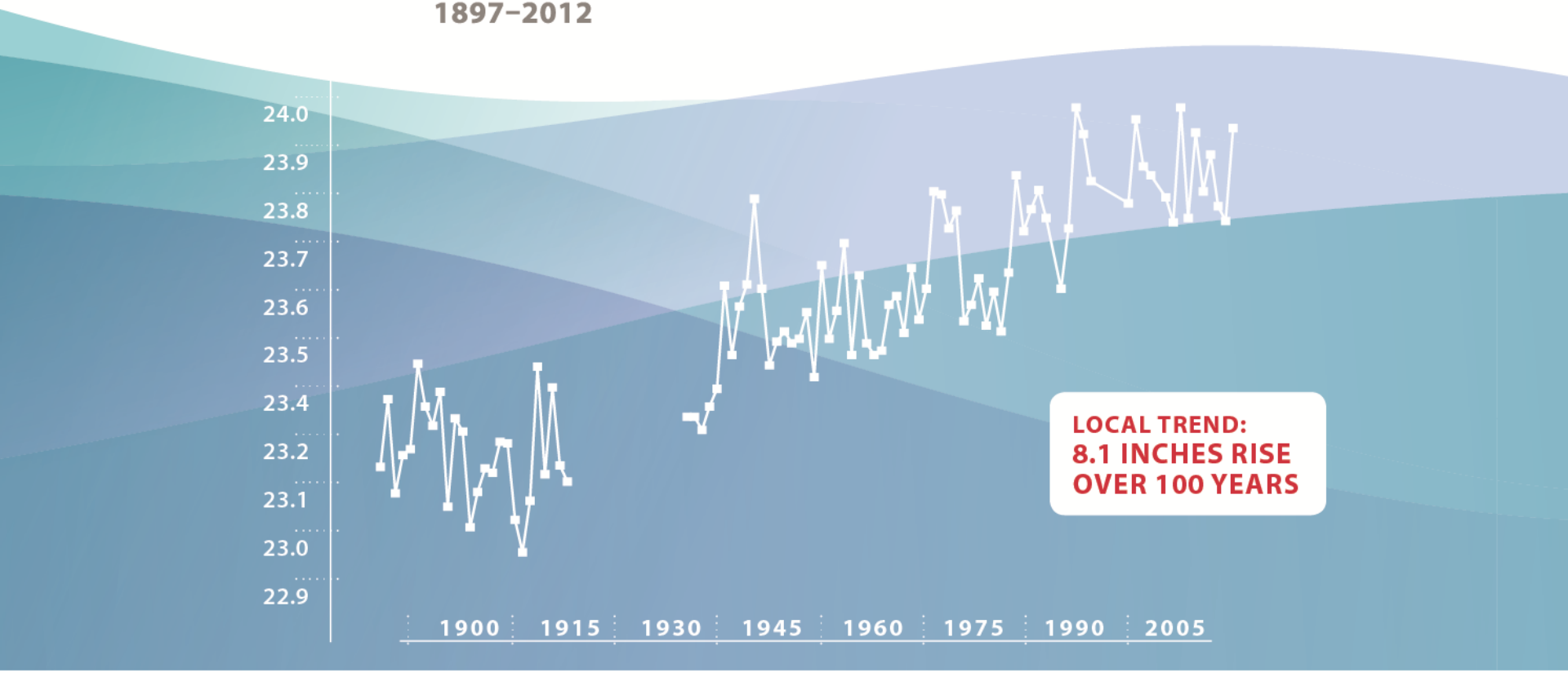
l
s
ed

~6,60

400

Sea Level Rise at Fernandina Beach, FL

TIDE GAUGE DATA
1897–2012



Outreach
Coastal Hazards
> Climate Community of Practice
> Crisis Response
> Flood Insurance
> Shoreline Change
> Sea Level Rise
> Tybee Island Sea Level Rise Plan
> St. Marys Flood Resiliency Plan
> About the Project
> Project Schedule
> Public Input and Outreach
> Planning Team
> Media Coverage
> Hyde County, NC Adaptation Plan
Communicating Science
Healthy Coastal Ecosystems
Safe and Sustainable Seafood
Sustainable Development

Research

Education

Outreach > St. Marys Flood Resiliency Plan

St. Marys Flood Resiliency Plan

Georgia Sea Grant, North Carolina Sea Grant and UGA help St. Marys plan for the future

Georgia Sea Grant, North Carolina Sea Grant, the University of Georgia's Carl Vinson Institute of Government and UGA Marine Extension Service are partnering with St. Marys, Ga. to develop a community resilience and adaptation plan.

In 2013, St. Marys was selected through a nationwide grant competition as one of five locations in the United States to undergo community resilience and adaptation planning. Funded through a grant by the National Oceanic and Atmospheric Administration's National Sea Grant Program, the findings will be shared with other coastal communities in Georgia, North Carolina and nationwide through the Sea Grant network. Additional project partners include the Lamar Dodd School of Art and the College of Environment and Design, both housed at the University of Georgia.

Researchers and extension specialists intend to tailor the plan with recommendations linked to the Federal Emergency Management Agency's Community Rating System program, focusing on the implementation of effective adaptation actions that may provide local residents flood insurance rate reductions.

About the Project
Gain insight and understanding into project procedures, timeline management and areas of focus.

Project Schedule
Learn about key milestones in the project.

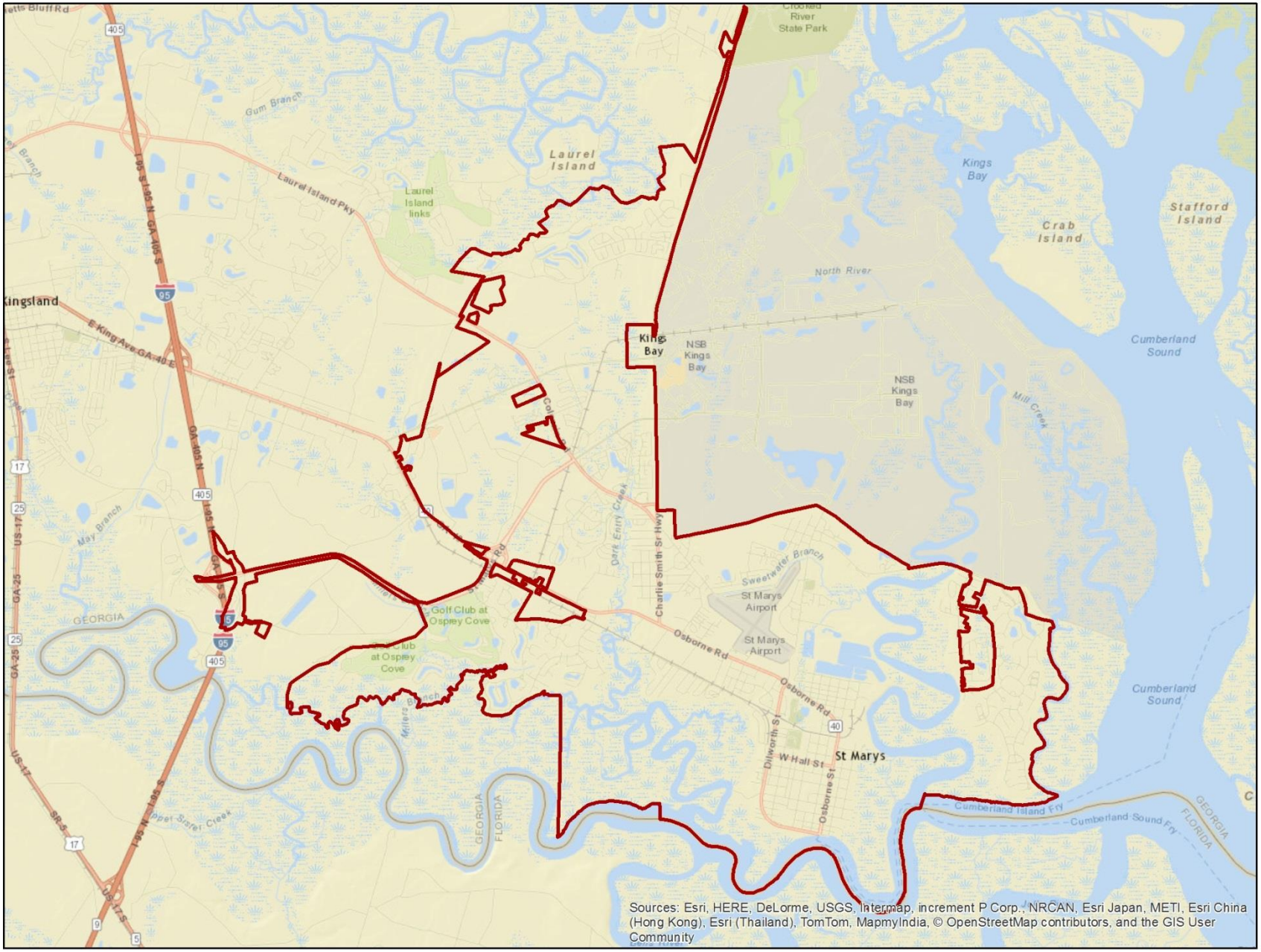
Public Input and Outreach
Learn about how local knowledge is being used to shape the plan.

Meet the Planning Team
Get to know the team behind the project.

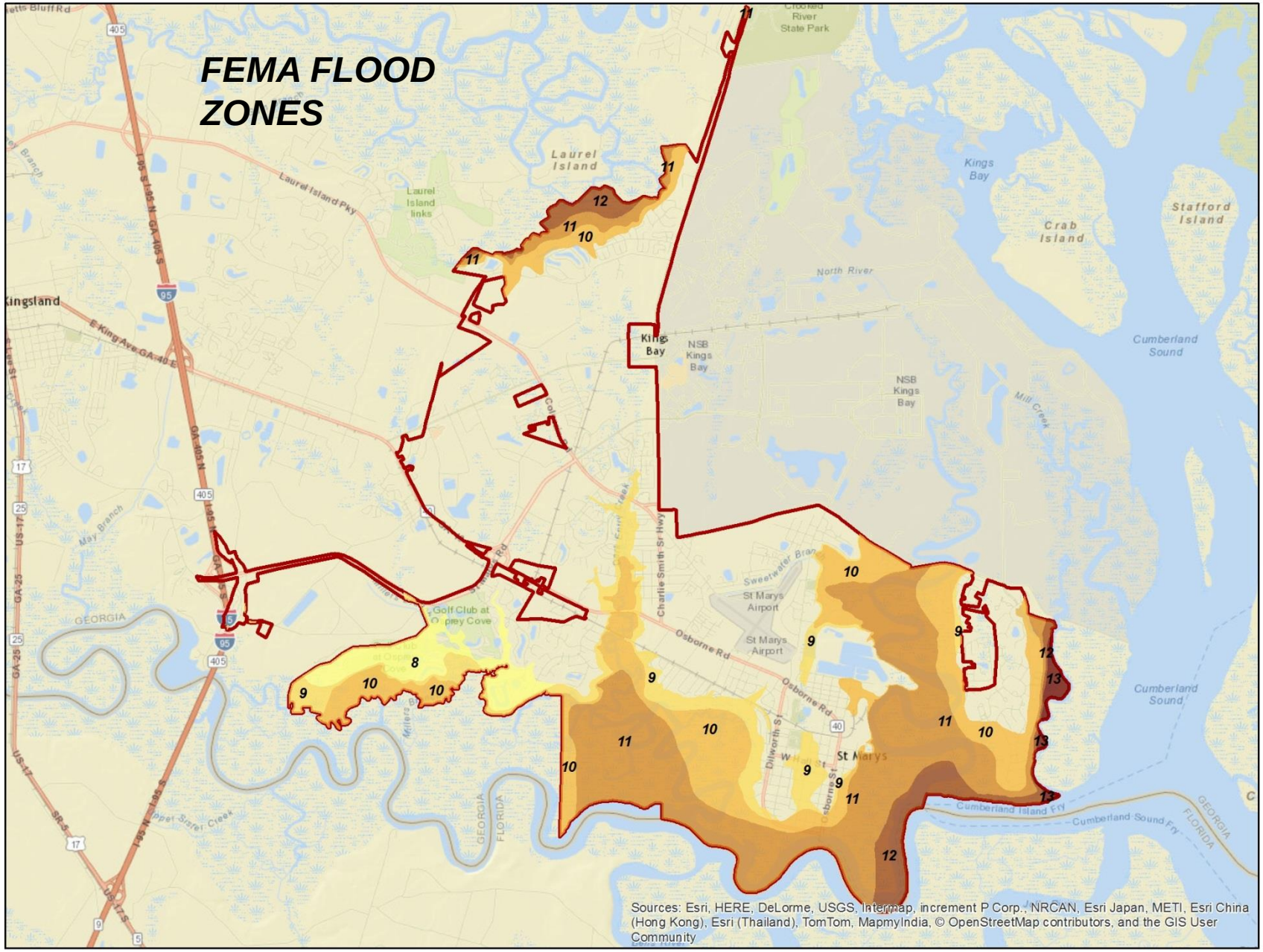
Media Coverage
Access press releases and articles on the project.

Jason Evans, Charles Hopkinson, Roger Weaver and Mayor John Morrissey meet to launch the St. Marys Flood Resiliency planning project.

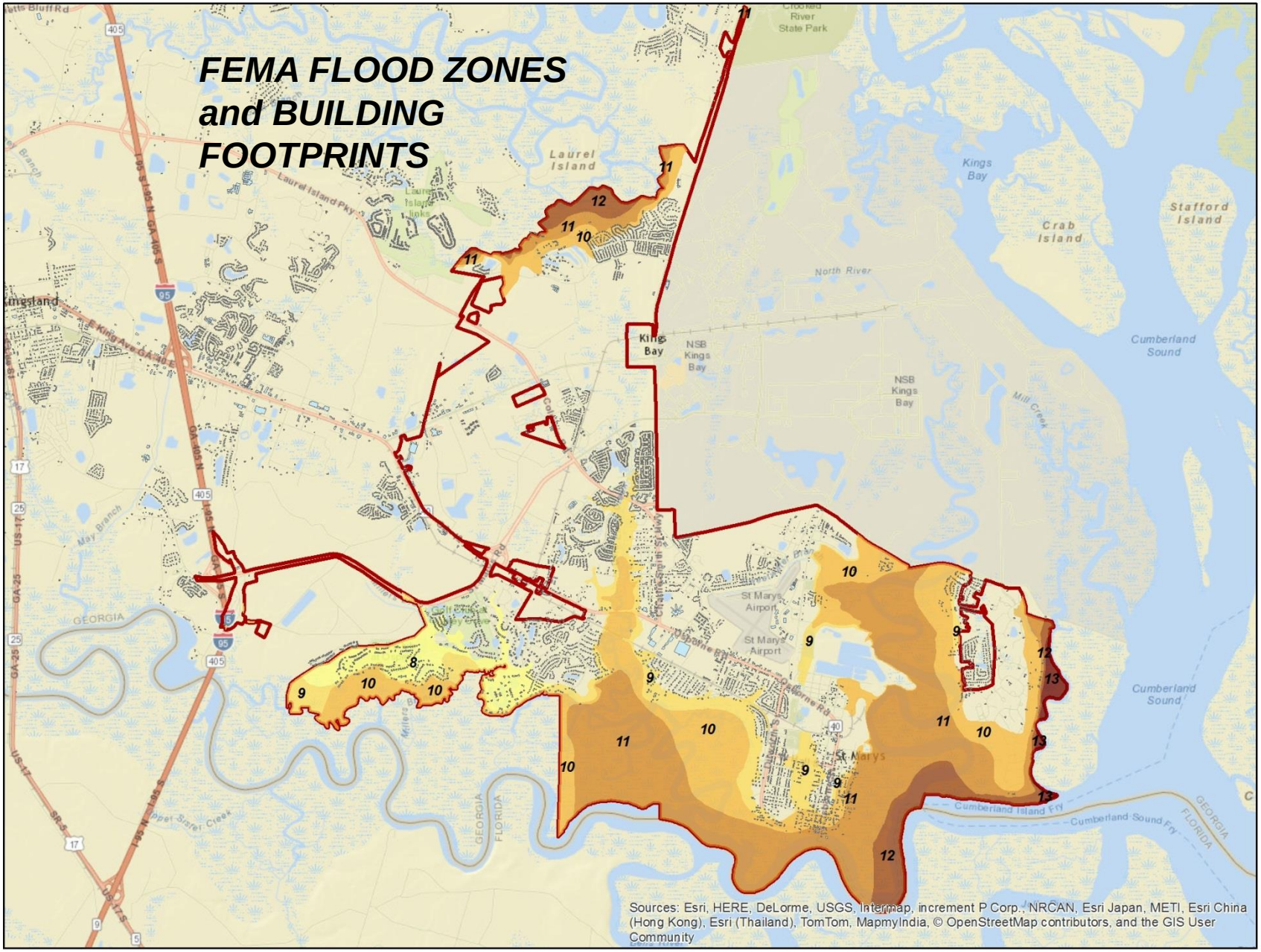
Established in 1787, St. Marys is a historic city that is vulnerable to anticipated coastal changes, such as increased coastal flooding, rising seas and intensified storm surges.

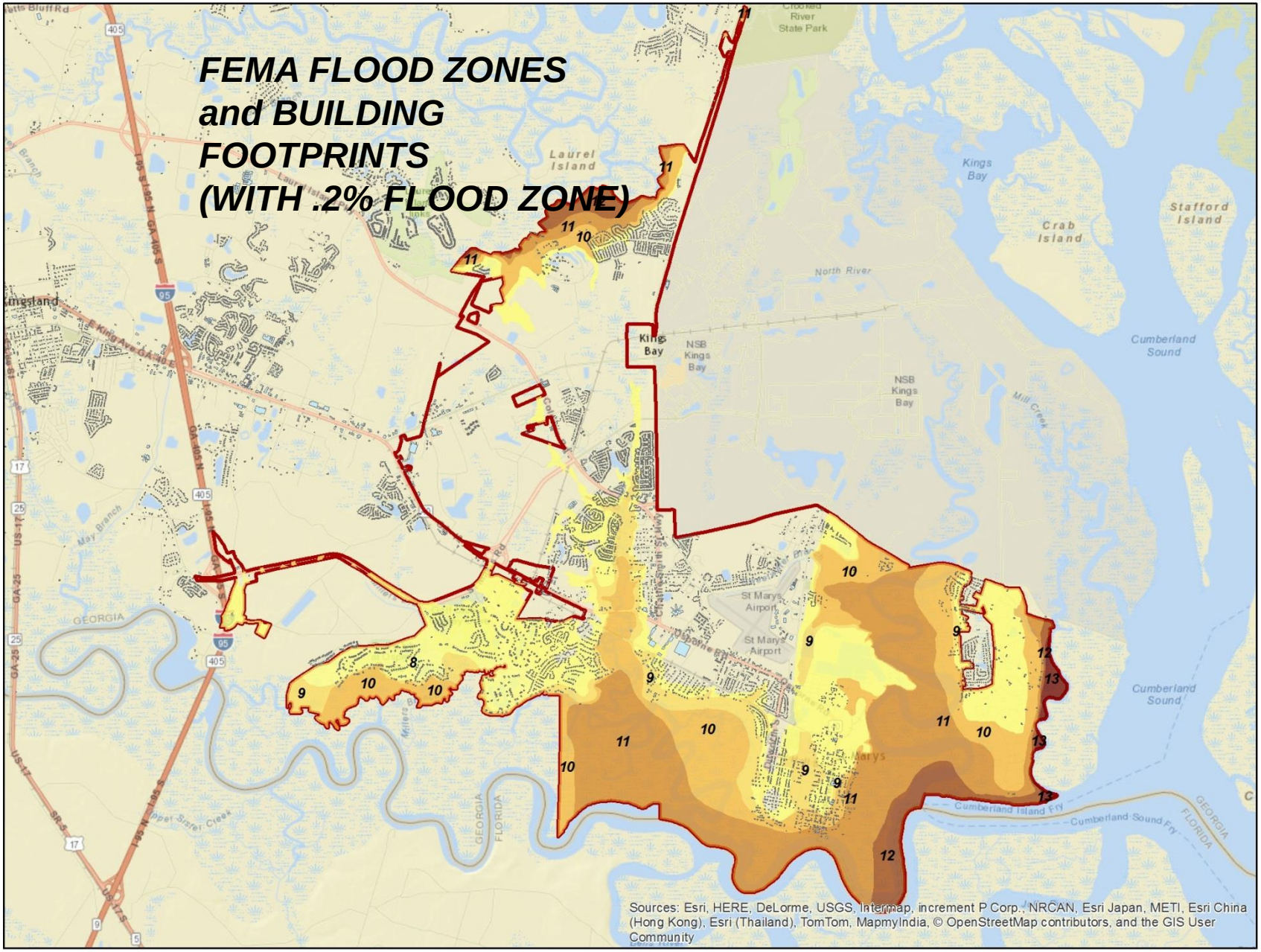

Crooked River State Park
Gum Branch
Laurel Island
Laurel Island links
Laurel Island Pky
Kingsland
E King Ave
Kings Bay
NSB Kings Bay
North River
Kings Bay
Crab Island
Stafford Island
Cumberland Sound
Mill Creek
May Branch
GEORGIA
Golf Club at Osprey Cove
Charlie Smith Sr Hwy
Dark Entry Creek
Sweetwater Branch
St Marys Airport
Osborne Rd
Dilworth St
W Hall St
St Marys
Osborne St
Millers Branch
Cumberland Island Fry
Cumberland Sound Fry
FLORIDA
Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

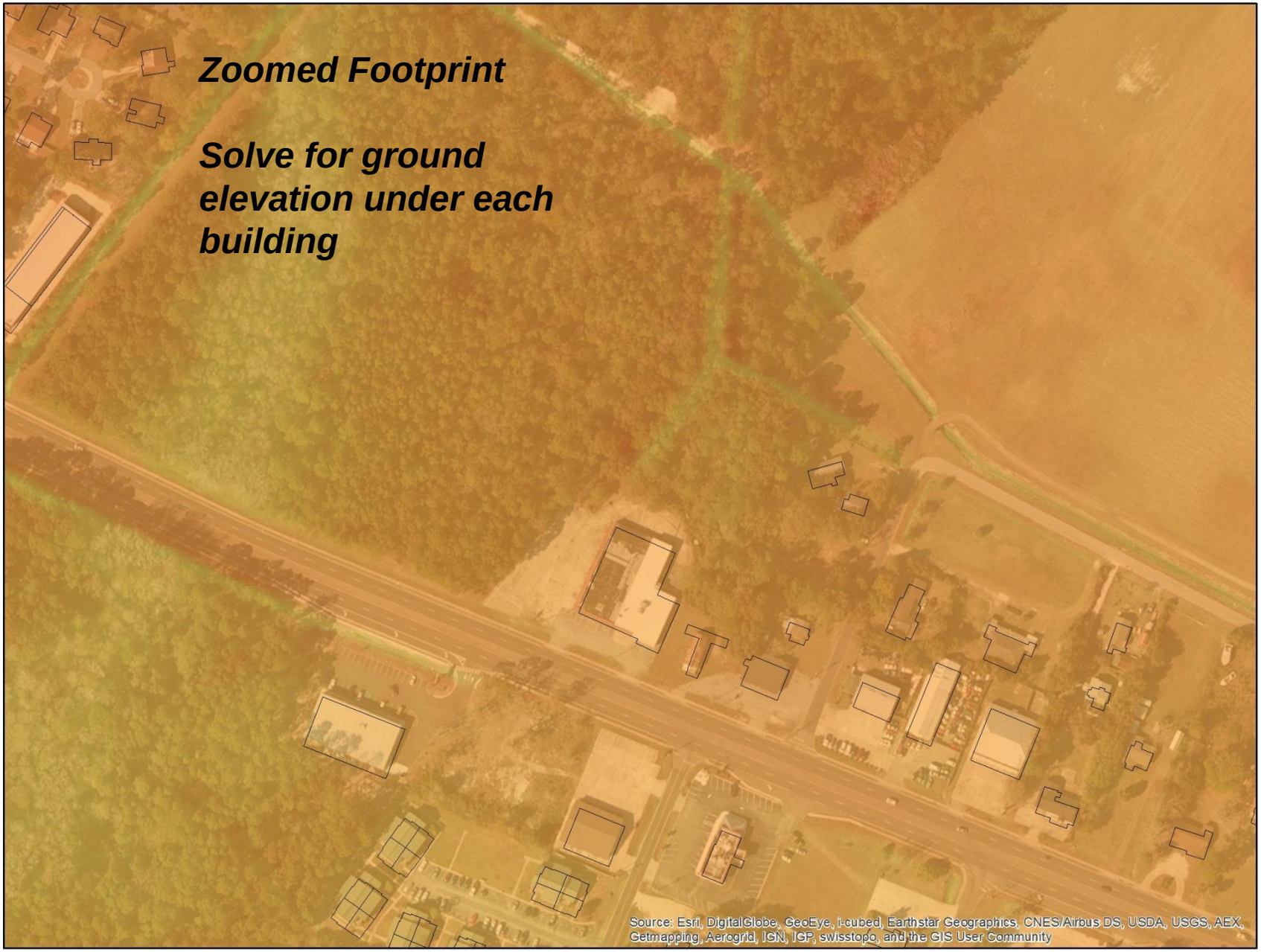
FEMA FLOOD ZONES

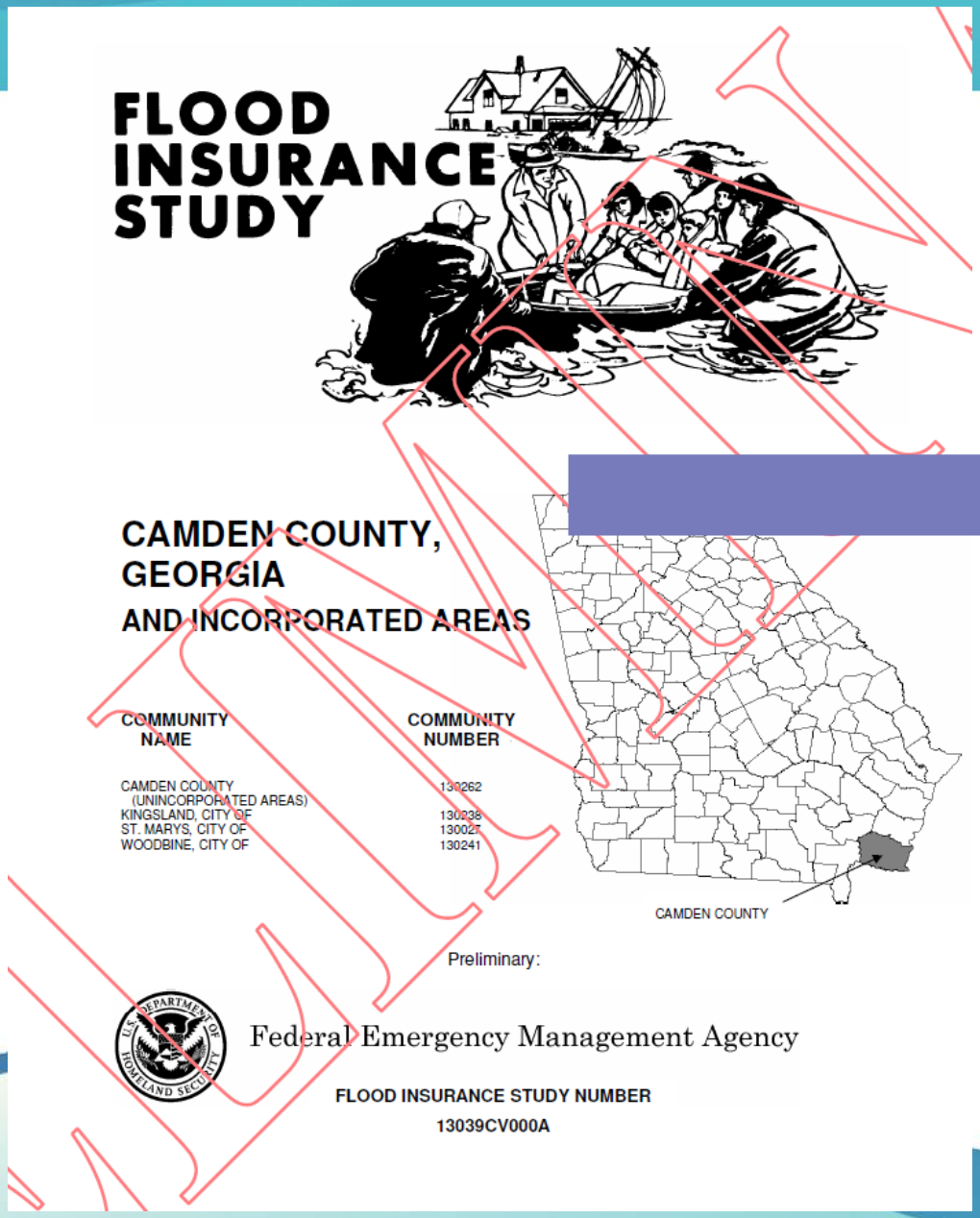


FEMA FLOOD ZONES and BUILDING FOOTPRINTS




FEMA FLOOD ZONES
and BUILDING
FOOTPRINTS
(WITH .2% FLOOD ZONE)
Laurel Island
Kings Bay
NSB Kings Bay
North River
Crab Island
Stafford Island
Cumberland Sound
Mill Creek
St Mary's Airport
GEORGIA
FLORIDA
Cumberland Island Fry
Cumberland Sound Fry
Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community


Zoomed Footprint
Solve for ground elevation under each building
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



Flood heights

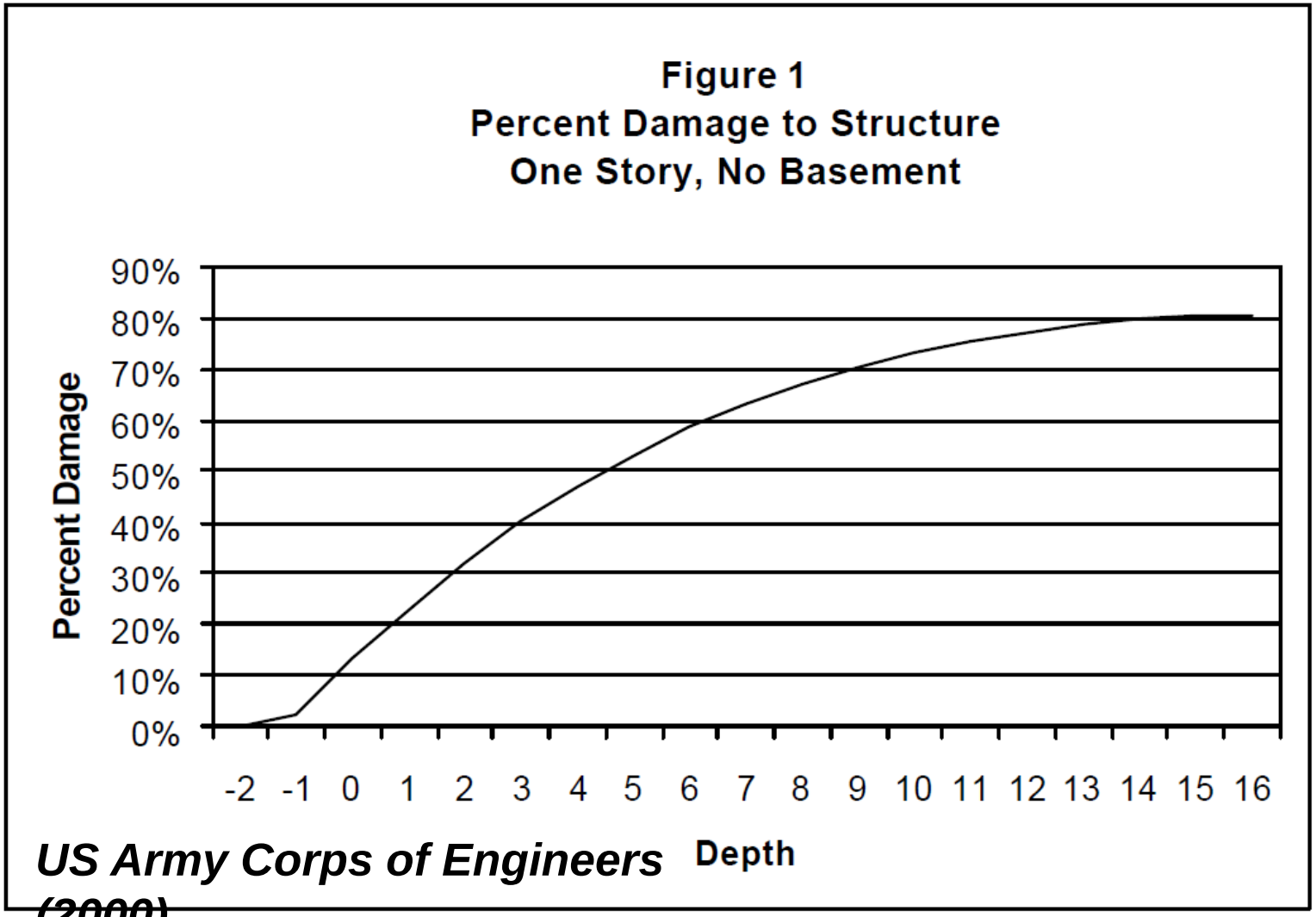
10-Year (10%)

50-Year (2%)

100-Year (1%)

500-Year (0.2%)

Flood-damage curve

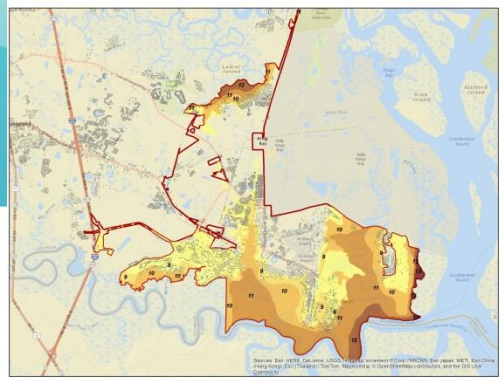


US Army Corps of Engineers (2000)

Sea Level Rise Scenarios (Inches)

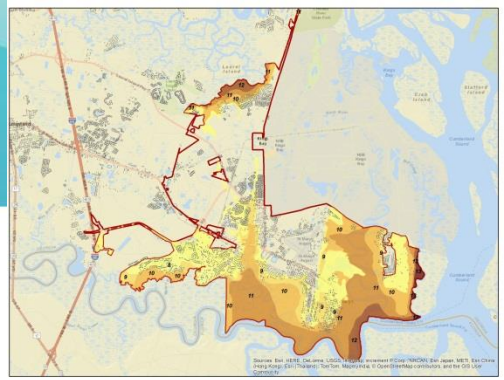
	Low	Intermediate	High
2025	0.8	1.9	4.1
2035	1.6	4.2	9.4
2045	2.4	6.8	15.8
2055	3.2	9.8	23.2
2065	4.0	13.2	31.8

City-wide totals



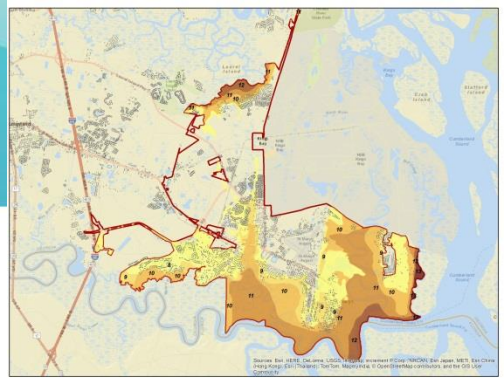
Flood height	Elevation below
10 Year	0
50 Year	151
100 Year	292
500 Year	1,284

City-wide totals
6,436 Buildings



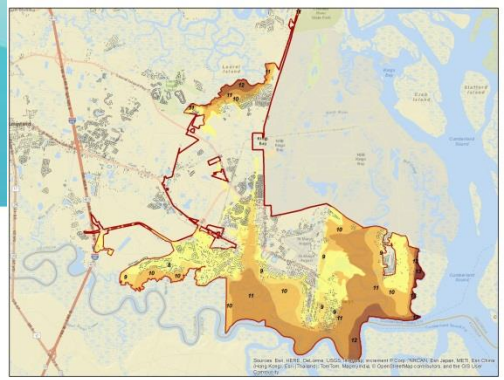
Flood height	Elevation below	Total Building Value
10 Year	0	N/A
50 Year	151	$23.2 M
100 Year	292	$45.4 M
500 Year	1,284	$318.0 M

City-wide totals
6,436 Buildings



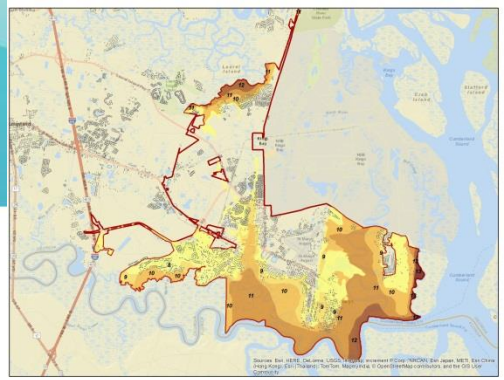
Flood height	Elevation below	Total Building Value	50 Yr Flood Risk (Low SLR)
10 Year	0	N/A	$0.5 M
50 Year	151	$23.2 M	$8.4 M
100 Year	292	$45.4 M	$15.8 M

City-wide totals
6,436 Buildings



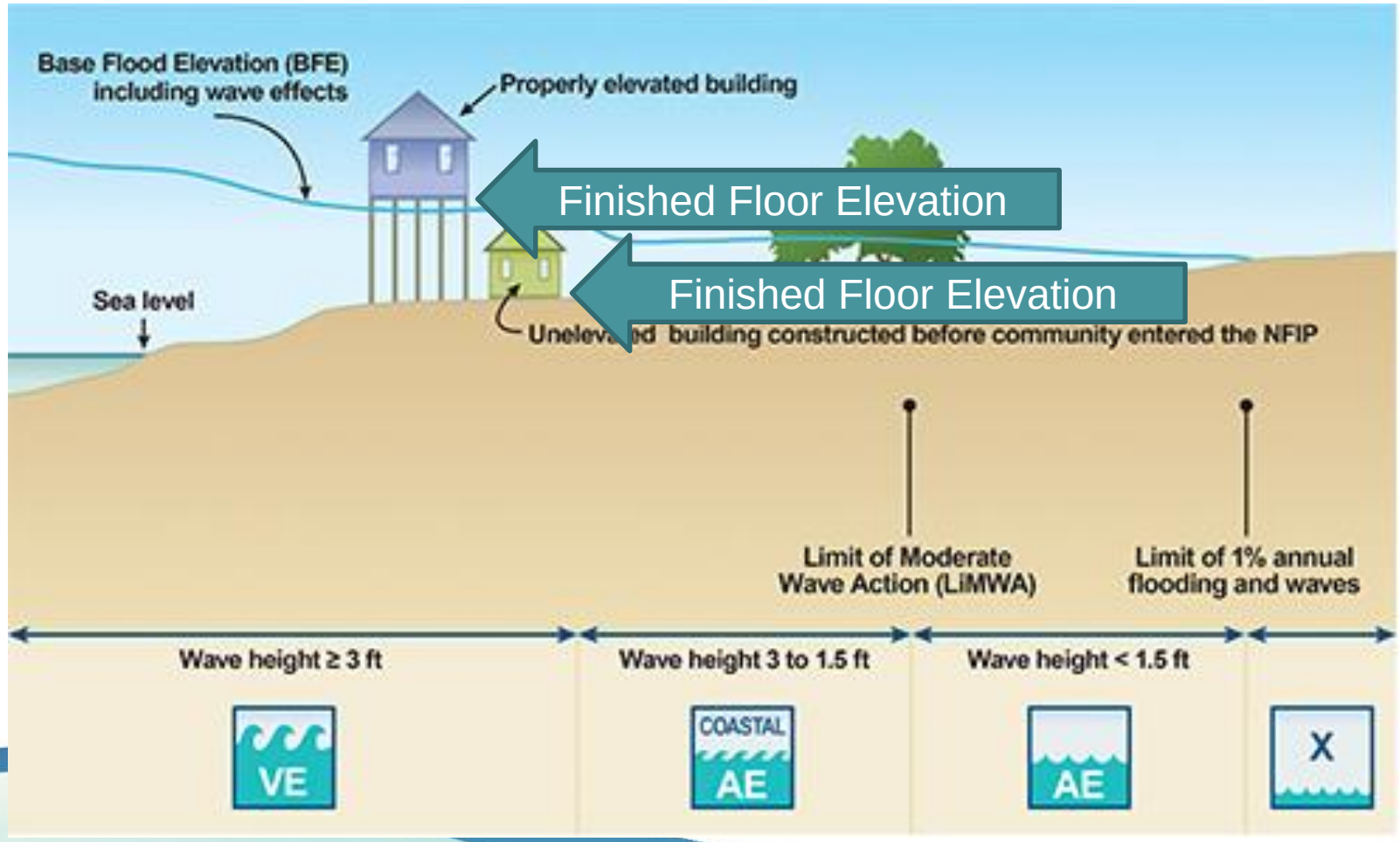
Flood height	Elevation below	Total Building Value	50 Yr Flood Risk (Low SLR)	50 Yr Flood Risk (Int SLR)
10 Year	0	N/A	$0.5 M	$1.1 M
50 Year	151	$23.2 M	$8.4 M	$10.0 M
100 Year	292	$45.4 M	$15.8 M	$18.1 M

City-wide totals
6,436 Buildings

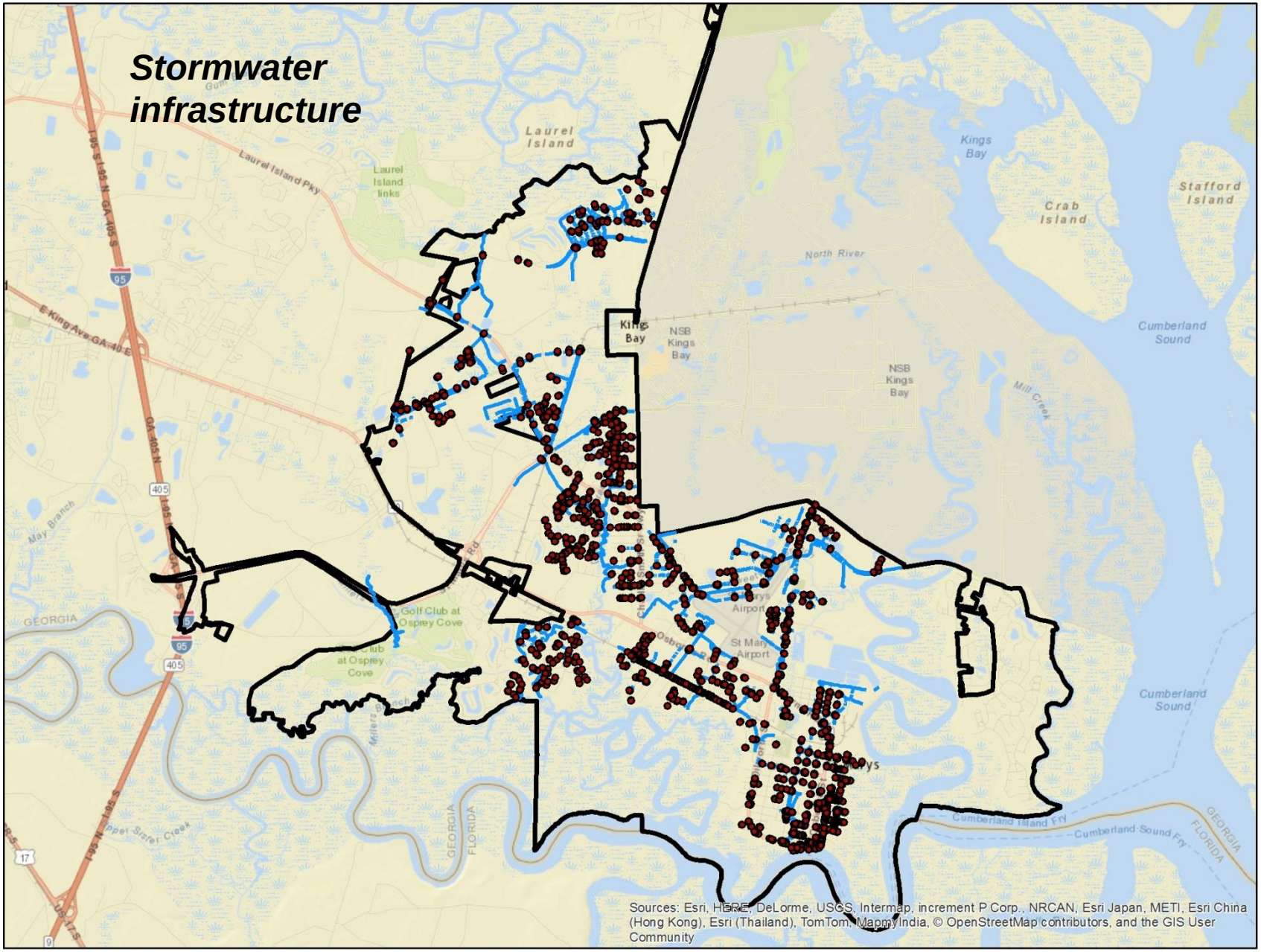


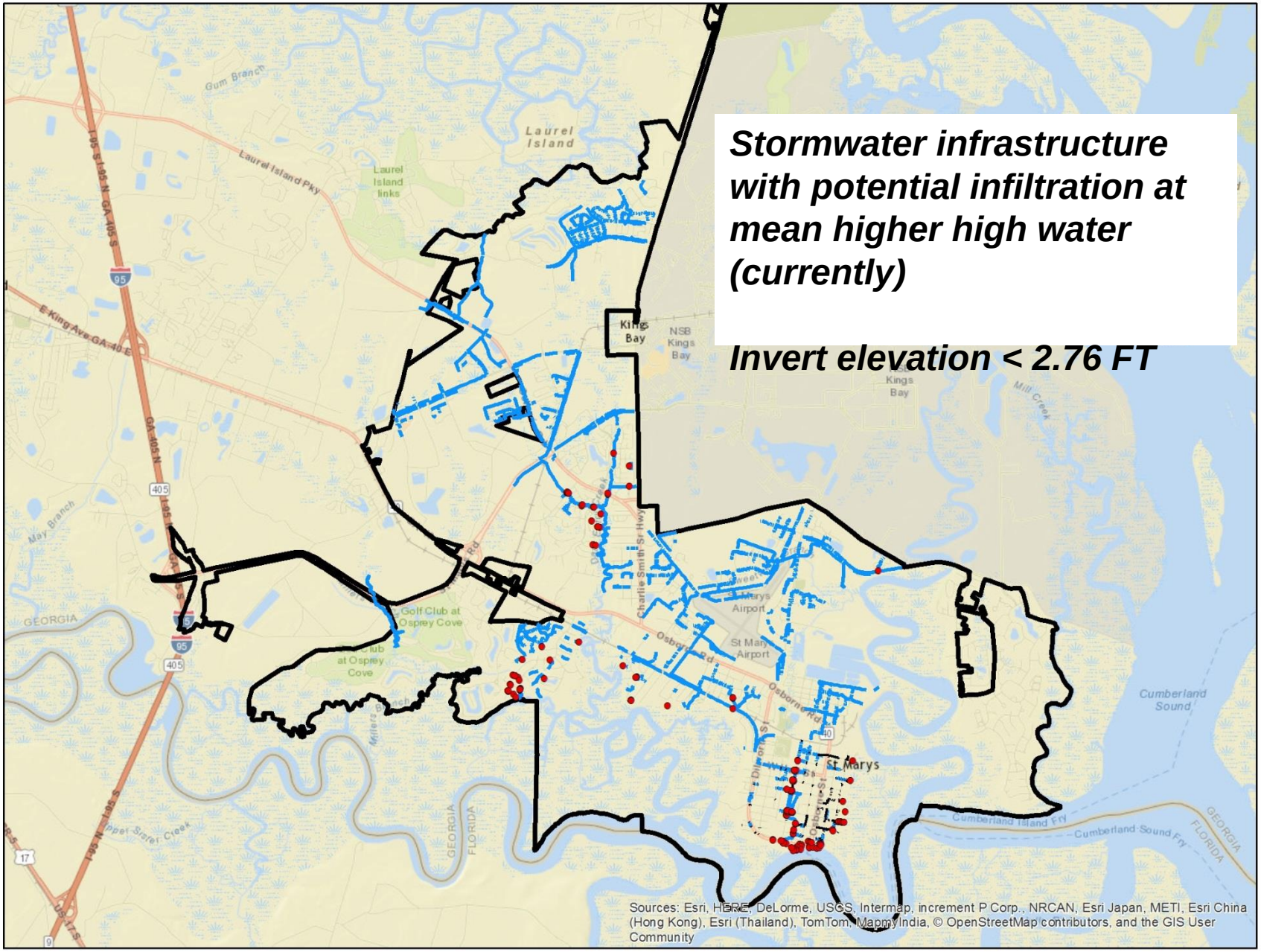
Flood height	Elevation below (currently)	Total Building Value	50 Yr Flood Risk (Low SLR)	50 Yr Flood Risk (Int SLR)	50 Yr Flood Risk (High SLR)
10 Year	0	N/A	$0.5 M	$1.1 M	$3.8 M
50 Year	151	$23.2 M	$8.4 M	$10.0 M	$16.2 M
100 Year	292	$45.4 M	$15.8 M	$18.1 M	$26.2 M

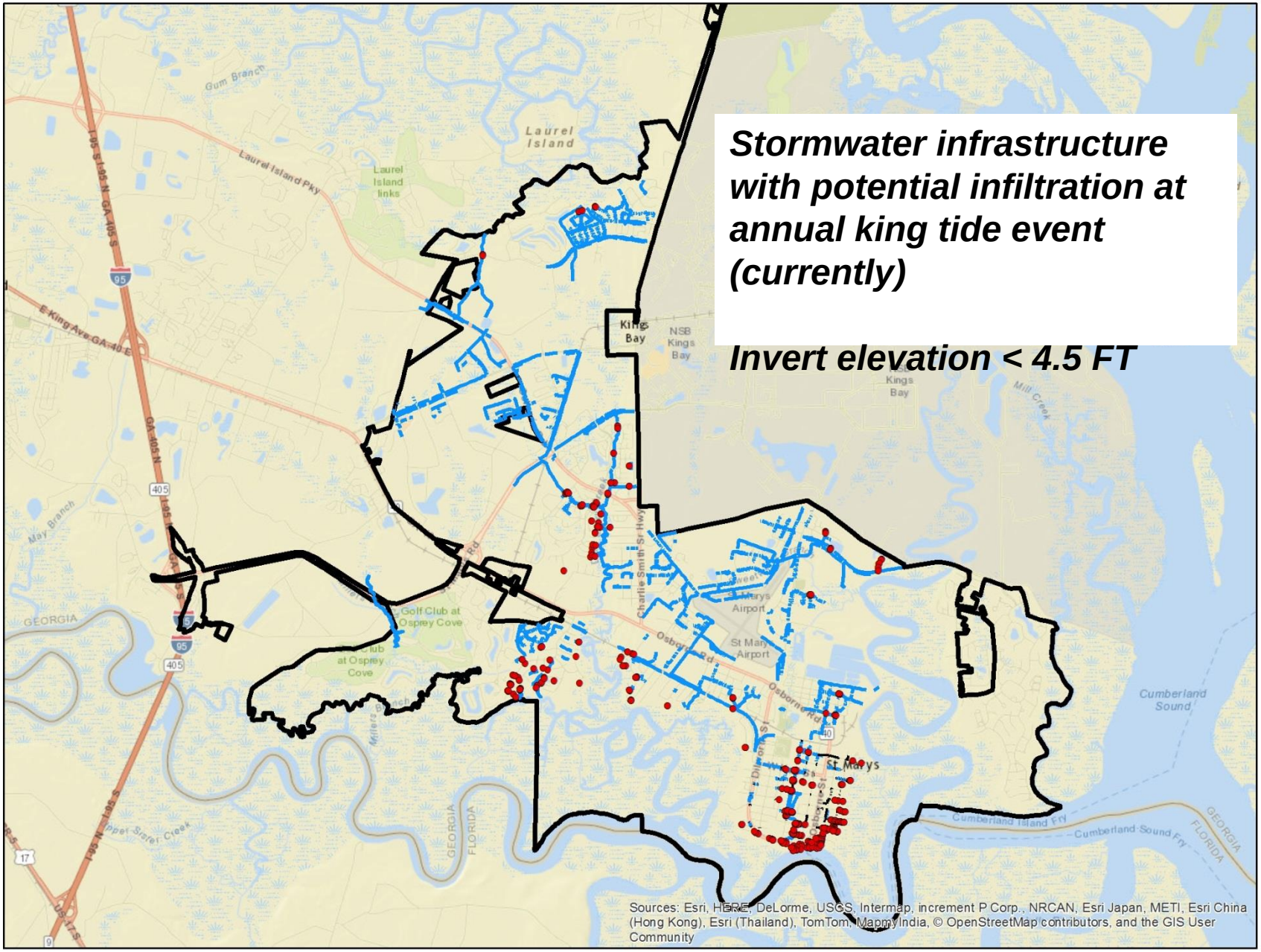
Next step?
First Floor Elevations to Footprint data

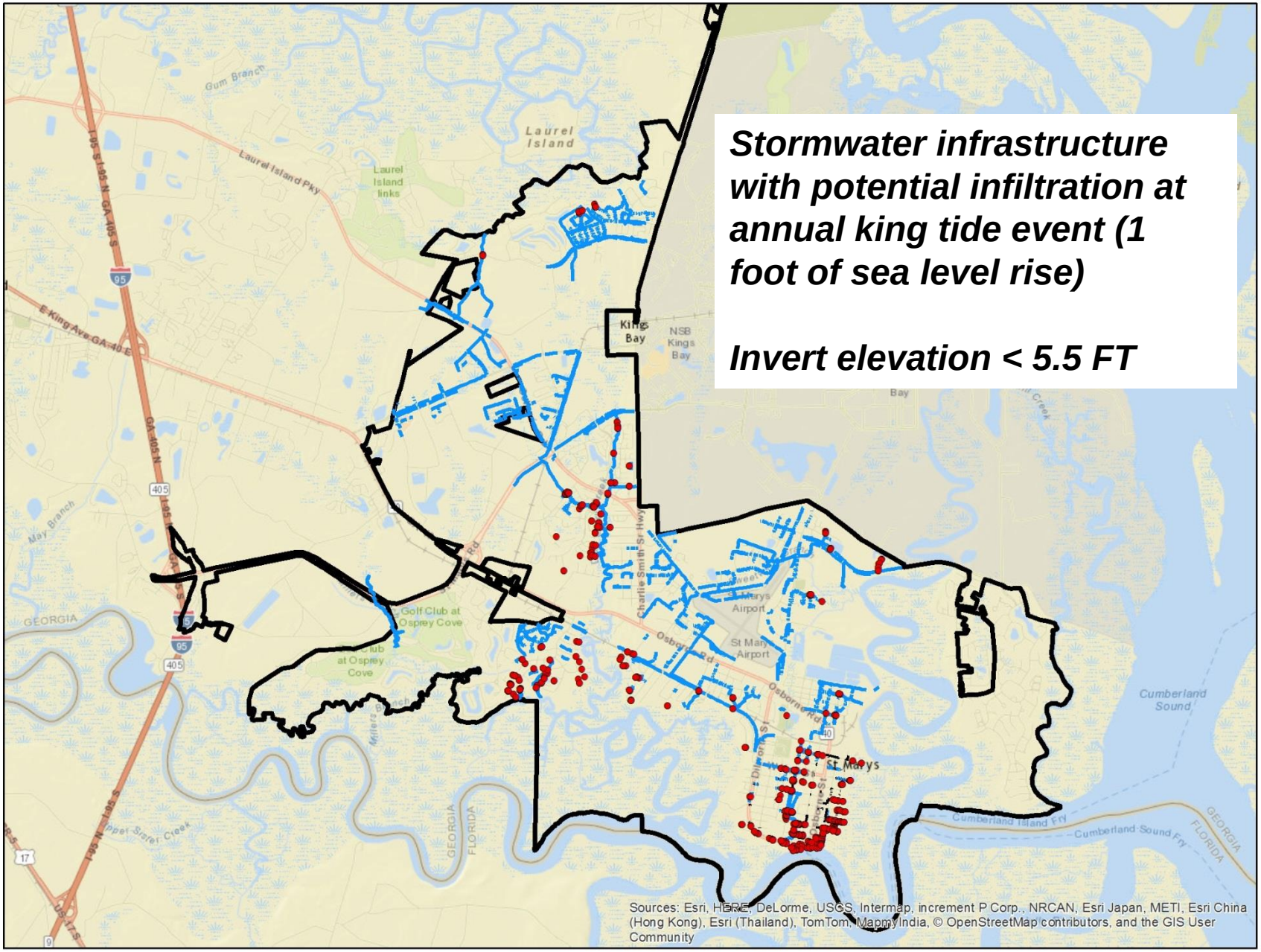


Stormwater infrastructure




Stormwater infrastructure with potential infiltration at mean higher high water (currently)
Invert elevation < 2.76 FT
Laurel Island
Laurel Island links
Gum Branch
Laurel Island Pky
E King Ave GA 40 E
GA 405 N
GA 405 S
I-95 S
I-95 N
May Branch
Golf Club at Osprey Cove
Club at Osprey Cove
GEORGIA
FLORIDA
Kings Bay
NSB Kings Bay
Mill Creek
Charlie Smith Sr Hwy
St Marys Airport
Osborne Rd
St Marys
Cumberland Sound
Cumberland Island Fry
Cumberland Sound Fry
Upper Starr Creek
Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community


Stormwater infrastructure with potential infiltration at annual king tide event (currently)
Invert elevation < 4.5 FT
Laurel Island
Laurel Island links
Gum Branch
Laurel Island Pky
E King Ave GA 40 E
Kings Bay
NSB Kings Bay
Kings Bay
Mill Creek
May Branch
GEORGIA
Golf Club at Osprey Cove
Club at Osprey Cove
Charlie Smith Sr Hwy
St Marys Airport
St Marys Airport
Osborne Rd
St Marys
Cumberland Sound
Cumberland Island Fry
Cumberland Sound Fry
GEORGIA
FLORIDA
Upper Starr Creek
Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community



Stormwater infrastructure with potential infiltration at annual king tide event (1 foot of sea level rise)

Invert elevation < 5.5 FT

Tybee Island Tide Gates and Stormwater Upgrades: Model for St. Marys

Thank you

jevans.1@stetson.edu

Funding support for portions of this work provided by Georgia Sea Grant, National Sea Grant, Monroe County, FL, and Stetson University

STETSON UNIVERSITY

Sea Grant