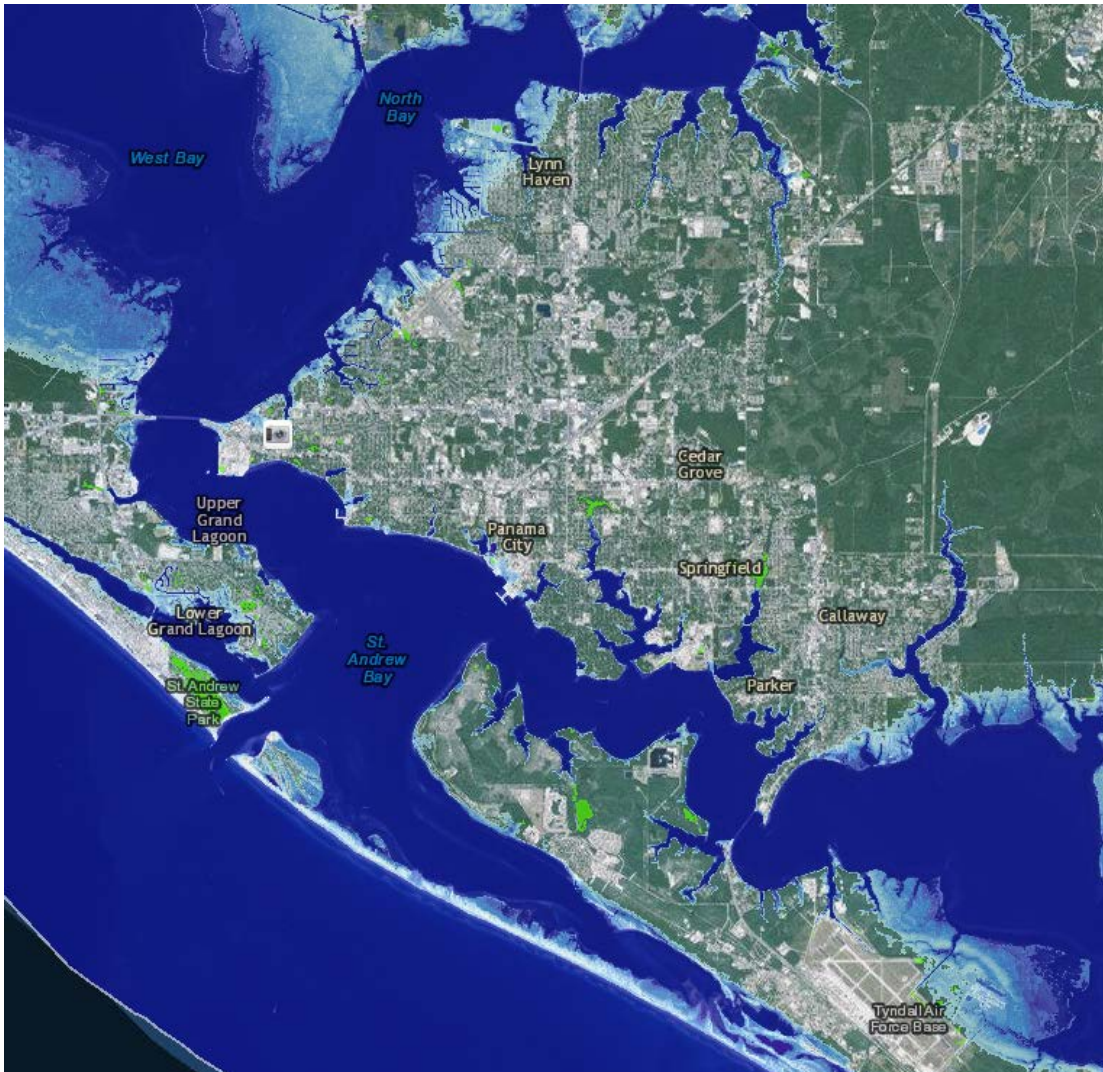


# Workshop Tools Vulnerability Assessment: Panama City, FL



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## Background

The Florida Department of Economic Opportunity (DEO), in partnership with the South Florida Regional Planning Council, University of Florida (UF), and National Oceanic and Atmospheric Administration (NOAA) Office for Coastal Management, undertook a statewide Training of Trainers project. The goal of this project is to promote the translation of science to policy and risk preparedness in Florida communities by increasing understanding of, access to, and use of existing tools. This project will also benefit communities by enhancing the understanding of coastal vulnerability and by increasing Regional Planning Councils' capacity to train and provide technical assistance with the use of coastal flood hazard tools and associated techniques.

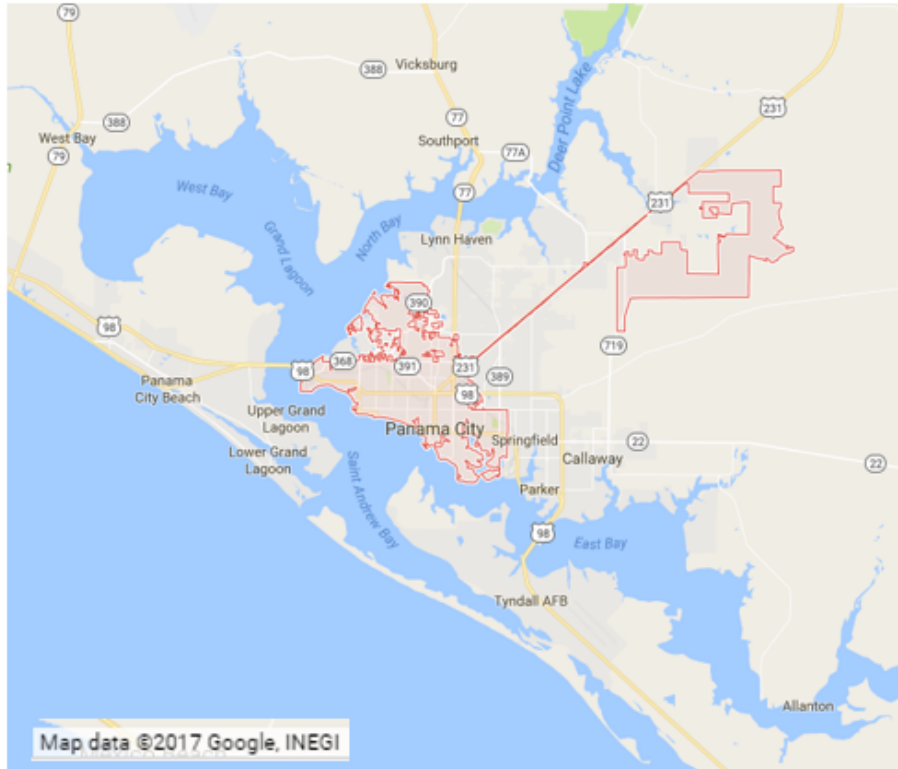
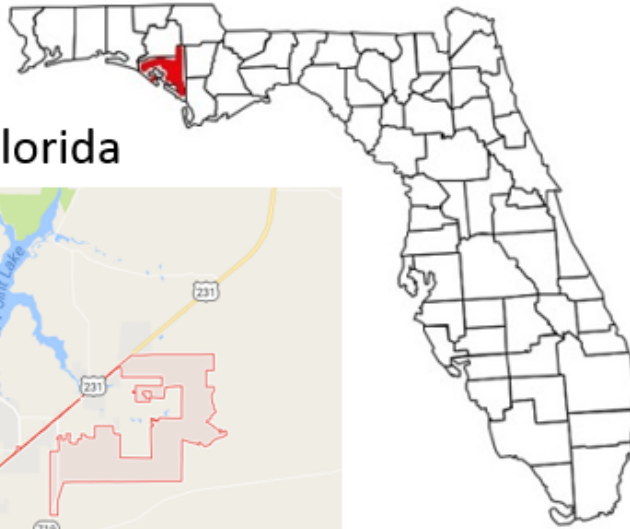
The West Florida Regional Planning Council (WFRPC) partnered with the Apalachee Regional Planning Council (Apalachee RPC) to conduct the project and held a workshop on October 26<sup>th</sup>, 2016. The workshop was essential to promote the use of coastal flood hazard assessment tools and create vulnerability assessments for local communities. The workshop aimed to introduce three NOAA adaptation assessment tools and the University of Florida's Sketch Planning Tool for visualizing vulnerability and enhancing preparedness. In efforts to provide ongoing assistance to communities in the WFRPC planning area, the tools introduced in the workshop were used to create this vulnerability assessment for Panama City, FL and the immediate surrounding areas in southern Bay County, FL.

## Study Area Summary

Panama City, FL is the county seat for Bay County. According to <http://www.pcgov.org>, "Panama City is located in Northwest Florida on the Gulf Coast along U.S. Highway 98, south of I-10. With over 36,000, residents, it is the largest city between Pensacola and Tallahassee and serves as the Bay County seat. It is the heart of the Panama City-Lynn Haven-Panama City Beach MSA which includes almost 170,000 people and is the anchor of a 60-mile workforce drive-time area of 573,000 people."

Panama City was selected for this vulnerability assessment in part because of this influx of area workforce. In addition, the area surrounding Panama City beach has vibrant tourist and services industry, as well as being home to several Navy, Air Force, and Coastguard installations. Port Panama City, a Free Trade Zone, is a growing deep-water gateway port offering rail connectivity to the rest of the U.S. The geography of the peninsulas upon which Panama City and Panama City Beach on St. Andrews Bay provides challenges to infrastructure and economy when considering sea level rise.

## Panama City and surrounding bay systems in Bay County, northwest Florida

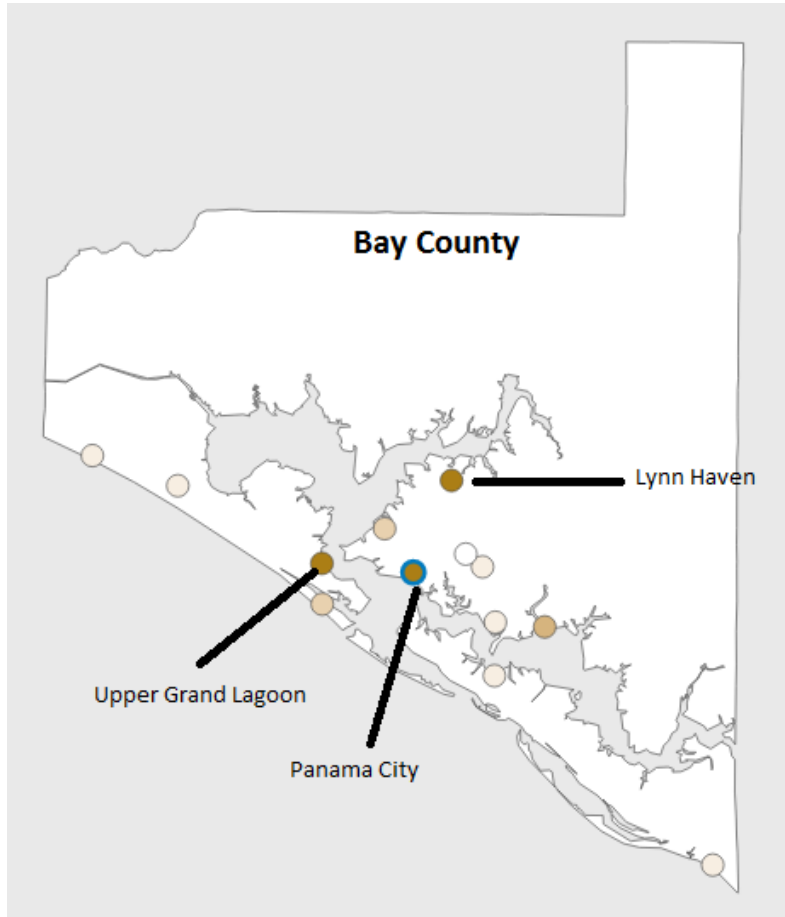


Bays, Left to Right:  
West Bay  
Grand Lagoon  
North Bay  
Saint Andrews Bay  
East Bay

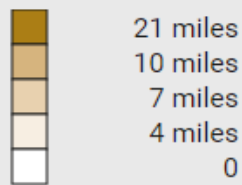
## Impacted Population & Infrastructure

The 2016 Climate Central *Sea Level Rise and Coastal Flood Exposure: Summary for Panama City, FL*, indicates that 2,730 people will be at risk of exposure in Panama City on land below 7-feet Mean Higher High Water (MHHW). In the same scenario, 1,055 acres of land, 1,504 housing units, and 21 miles of road will be also significantly affected. At a 10-foot level, 5,027 people (13.8% of the total population in Panama City) and \$700 million in properties will be exposed in total. Panama City is in the bottom half for cities in Florida for total exposure of homes on land below 7 feet for cities under 10,000 in population; and it is in the bottom half if ranked by percentage of homes exposed.

Images below sourced from riskfinder.climatecentral.org, obtained March 16, 2017.  
 (Sources for raw roads data: Census 2012. Sources for raw population data: Census 2010.)



**Miles of road**

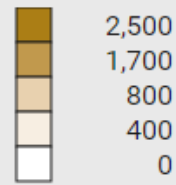


Legend values are bin upper limits

**Top threats on map**

Lynn Haven	21 miles
Upper Grand Lagoon	20 miles
Panama City	19 miles
Callaway	10 miles
Lower Grand Lagoon	7 miles

**Population**



Legend values are bin upper limits

**Top threats on map**

Panama City	2,531
Upper Grand Lagoon	2,420
Lynn Haven	2,189
Callaway	1,698
Lower Grand Lagoon	822

## INFRASTRUCTURE TABLE

<http://riskfinder.climatecentral.org>

	Elevation relative to local high tide line (Mean Higher High Water)									
	< 1ft	< 2ft	< 3ft	< 4ft	< 5ft	< 6ft	< 7ft	< 8ft	< 9ft	< 10ft
High social vulnerability population	14	25	44	75	129	212	299	391	489	603
Medium social vulnerability population	47	85	160	373	697	1119	1549	2009	2420	2839
Low social vulnerability population	16	48	123	275	504	709	881	1071	1296	1585
Property value (\$Million)	27	47	86	154	238	325	418	511	606	700
Population	76	158	326	724	1330	2040	2730	3471	4204	5027
Caucasian population	67	139	290	640	1173	1789	2384	3008	3637	4355
Population of color	10	21	40	94	174	279	387	521	640	760
African-American population	7	14	26	58	108	178	249	340	420	503
Asian population	2	5	10	21	35	50	67	86	105	126
Hispanic population	2	4	9	25	49	82	118	156	192	231
Native American population	1	2	3	7	16	27	39	52	63	72
Homes	43	86	174	397	739	1130	1504	1880	2252	2667
Schools	0	0	0	0	1	1	1	1	1	1
Colleges and Universities	0	1	1	1	1	1	1	1	2	3
Houses of worship	1	1	2	2	2	2	3	3	3	3
Roads (Miles)	0	0	1	5	9	14	21	27	35	42
Federal roads (Miles)	0	0	0	0	1	2	2	3	3	4
Local roads (Miles)	0	0	1	5	8	12	17	23	30	36
Secondary roads (Miles)	0	0	0	0	1	2	2	3	3	4
State roads (Miles)	0	0	0	0	0	1	1	1	2	2
Intermodal freight terminals	1	1	1	1	1	1	1	1	1	1
Heliports	0	0	0	0	0	0	1	1	1	1
EPA listed sites	0	0	1	4	4	5	8	14	19	24
NPDES sites	0	0	0	1	1	2	4	6	10	13
RADINFO sites	0	0	1	3	3	3	4	7	7	9
Hazardous waste sites	0	0	1	3	3	3	4	7	7	9
Minor hazwaste source sites	0	0	0	0	0	0	1	4	4	6
Unspecified hazardous waste sites	0	0	1	3	3	3	3	3	3	3
Wastewater sites	0	0	0	1	1	2	4	6	10	13
Nonmajor wastewater sites	0	0	0	1	1	2	4	6	10	13
Land (Acres)	72	128	226	392	597	814	1055	1319	1593	1866
Protected land (Acres)	0	0	1	1	1	2	2	2	2	3
Local protected land (Acres)	0	0	1	1	1	1	2	2	2	2

The figure above tabulates populations, facilities, and other points or places of interest in Panama City that are projected to be inundated under the given sea level rise scenarios. Omitted from the table are one government building and one sewage plant that become inundated at 8 feet SLR; one TRI site, one Hazardous material facility, and one library that become inundated at 9-feet SLR. Vulnerability appears to increase incrementally with each foot of sea level rise. Depending on the projections that are used, inundation may still be experienced through unusually high tides, precipitation induced flooding, or storm surge events.

## Maps: Panama City & Surrounding Area Maps

- NOAA Sea Level Rise Viewer (Sea Level Rise and Marsh Overlays)
- NOAA Coastal Flood Exposure Mapper
- Sea Level Scenario (SLS) Sketch Planning Tool

### NOAA SEA LEVEL RISE VIEWER

#### Sea Level Rise Overlay

Throughout these next NOAA Sea Level Rise Viewer images, green indicates low elevation, and light blue represents land that has been inundated by sea level rise.



NOAA Sea Level Rise Image 1

NOAA Sea Level Rise Image 1 (above) depicts Panama City exposed to six feet of sea level rise (SLR) using NOAA Sea Level Rise Viewer. The following are areas of interest for further sea level rise study as seen on this image: habitat areas surrounding West Bay and East Bay, Hathaway Bridge connecting Panama City Beach and Panama City including the flyover presently under construction, the Baily Bridge connecting Lynn Haven to Southport, and the residential areas along the west edge of North Bay in Lynn Haven.

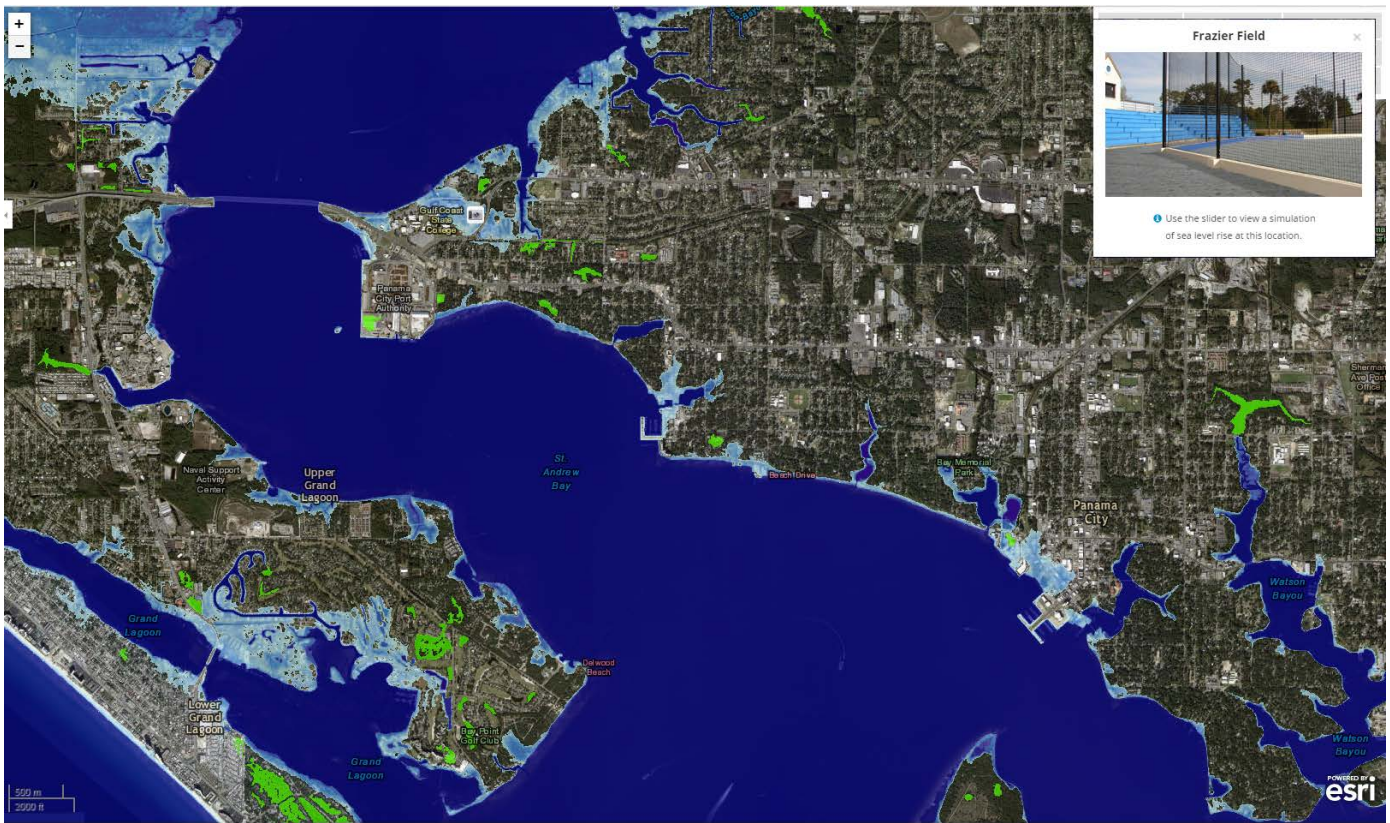
NOAA Sea Level Rise Image 2



NOAA Sea Level Rise Image 2 (to the left) shows Lynn Haven just north of Panama City with four-foot SLR. Of note are the neighborhoods on North Bay with canals along Upper Goose and Lynn Haven Bayous.

NOAA Sea Level Rise Image 3 (below) depicts Panama City at six-foot SLR and illustrates the need for further sea level rise study for the following areas of interest: Panama City Port Authority, the campuses of Gulf Coast State College and Florida State University-Panama City, the marina and civic center near downtown Panama City, and the Navy installations on Upper Grand Lagoon.

The camera symbol indicates a “visualization location,” in this instance it represents Fraizer Field at six-foot SLR as depicted by the gray-colored “water” covering the field in the top right of the image below.



NOAA Sea Level Rise Image 3





NOAA Sea Level Rise Image 4

NOAA Sea Level Rise Image 4 (above) zooms in on downtown Panama City with six-foot SLR and indicates the need for further sea level rise study for low-lying roads and bridges traversing Lake Huntington, Caroline Lake; Johnson, Massalina, and Watson Bayous. Among other businesses along West Beach Drive, potentially inundated areas of downtown include Chevron Products Co City Term, Panama City City Hall, and the Marina Civic Center. Also depicted at six-foot SLR in Image 5 (below) is the area southeast of Panama City including an industrial area, East Bay and Tyndall Air Force Base (below): bridges, low-lying roads, and fuel or chemical storage areas may be at risk.



NOAA Sea Level Rise Image 5

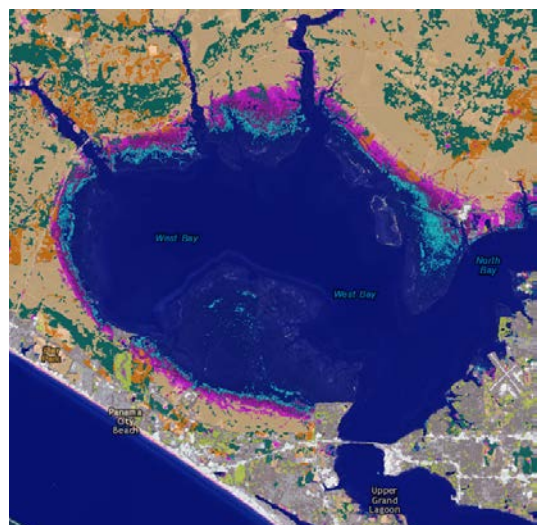
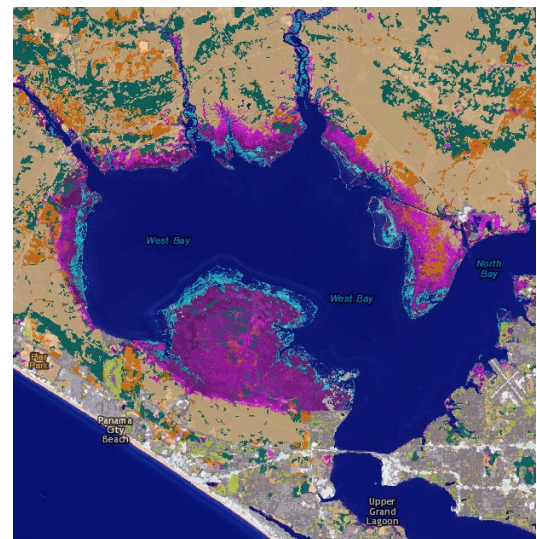
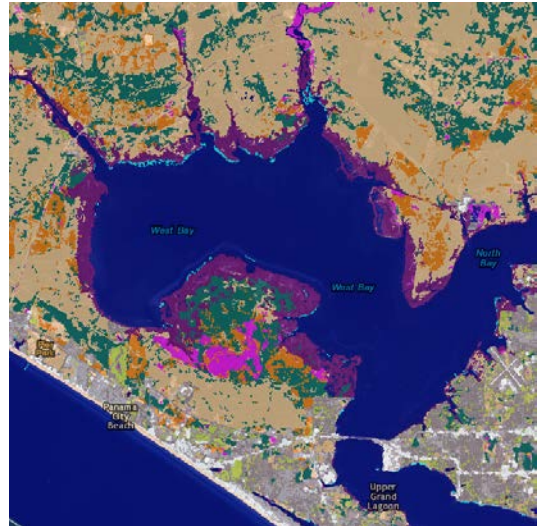
## Marsh Overlay

The NOAA Sea Level Rise Tool’s Marsh Overlay presents predictions that “represent the potential distribution of each marsh and wetland type (see legend) based on their elevation and how frequently they may be inundated. As sea levels increase, some marshes may migrate into neighboring low-lying areas, while other sections of marsh will be lost to open water.”

### Legends

- High Intensity Developed
- Medium Intensity Developed
- Low Intensity Developed
- Developed Open Space
- Upland
- Freshwater Forested Wetland
- Freshwater Shrub Wetland
- Freshwater Emergent Wetland
- Brackish/Transitional Marsh
- Saltwater Marsh
- Unconsolidated Shore
- Water

**Images**      Top:    West Bay at current MHHW  
                  Middle: West Bay at 2-ft SLR  
                  Bottom: West Bay at 6-ft SLR



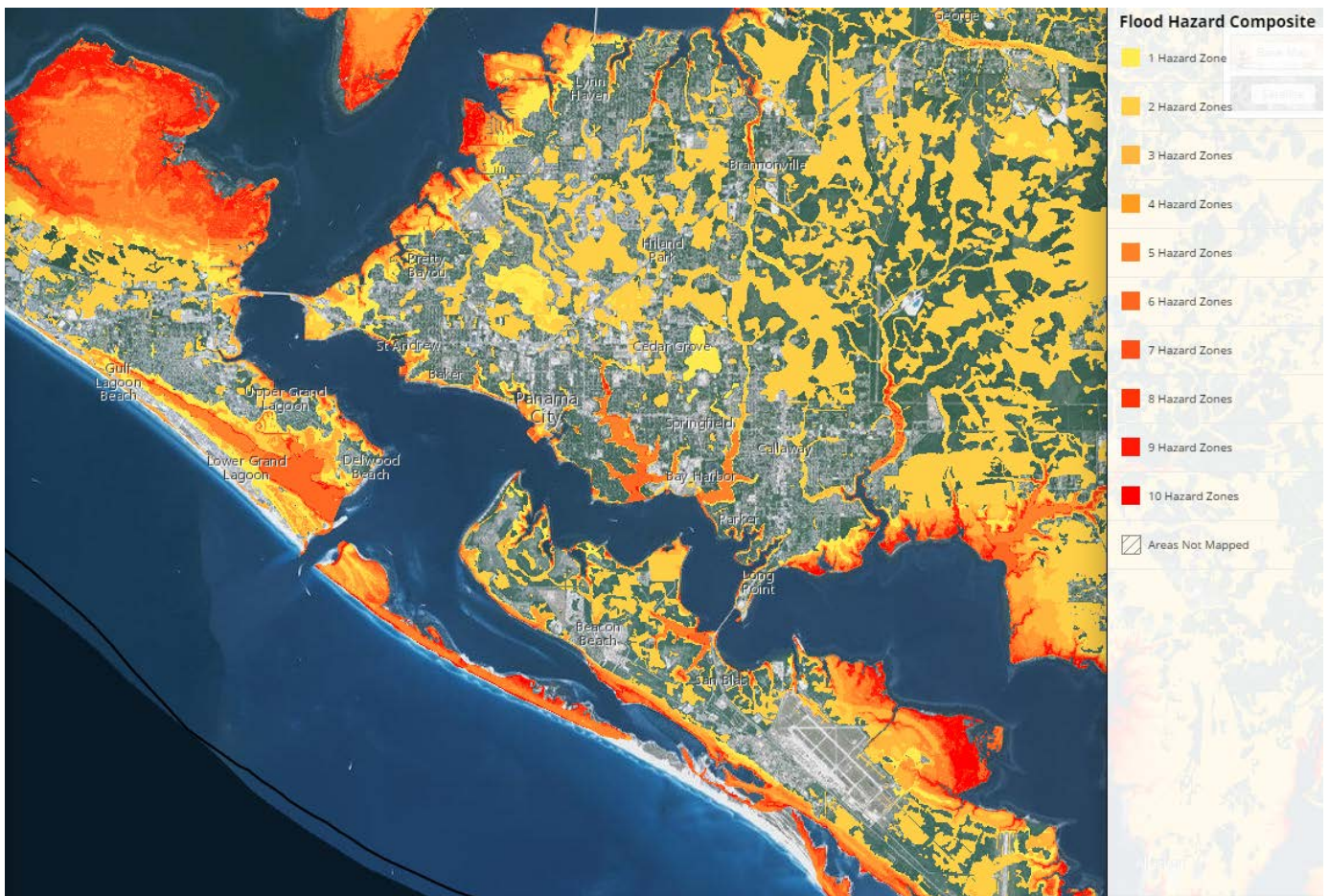
Note the transition of the Freshwater Forested and Shrub Wetlands to Brackish/Transitional Marsh with 2-ft SLR; and their disappearance with 6-ft SLR. Further study of sea level rise impacts on local ecosystem and habitat is recommended.

Built-up areas along the northwest side of West Bay including the Highway 79 bridge crossing the intracoastal waterway between Chactawhatchee and West Bays and West Bay Elementary School will be at risk of inundation or increased flooding with 6-ft SLR.

# NOAA COASTAL FLOOD EXPOSURE MAPPER

## Coastal Flood Hazard Composite

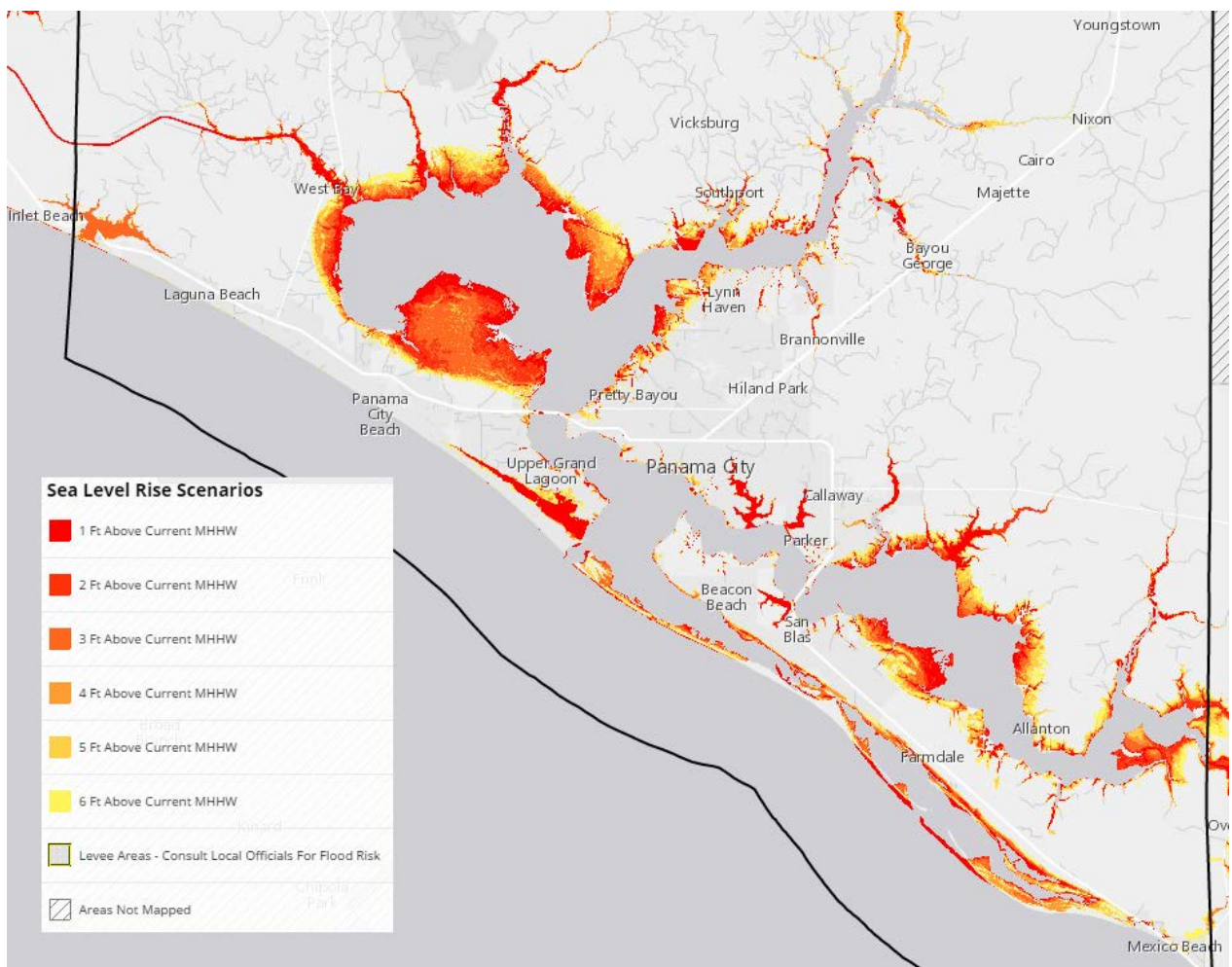
The following images depict an overview of coastal flood hazard vulnerability in Panama City and the surrounding areas using the Coastal Flood Exposure Mapper. NOAA Flood Exposure Mapper Image 1 (below) shows areas prone to flooding from one or more of the following hazards: shallow coastal flooding, high and moderate risk of flooding as designated by the Federal Emergency Management Agency, hurricane storm surge up to category 3, and sea level rise up to 3 feet above MHHW.



NOAA Flood Exposure Mapper Image 1: Coastal Flood Hazard Composite on satellite base map

## Sea Level Rise

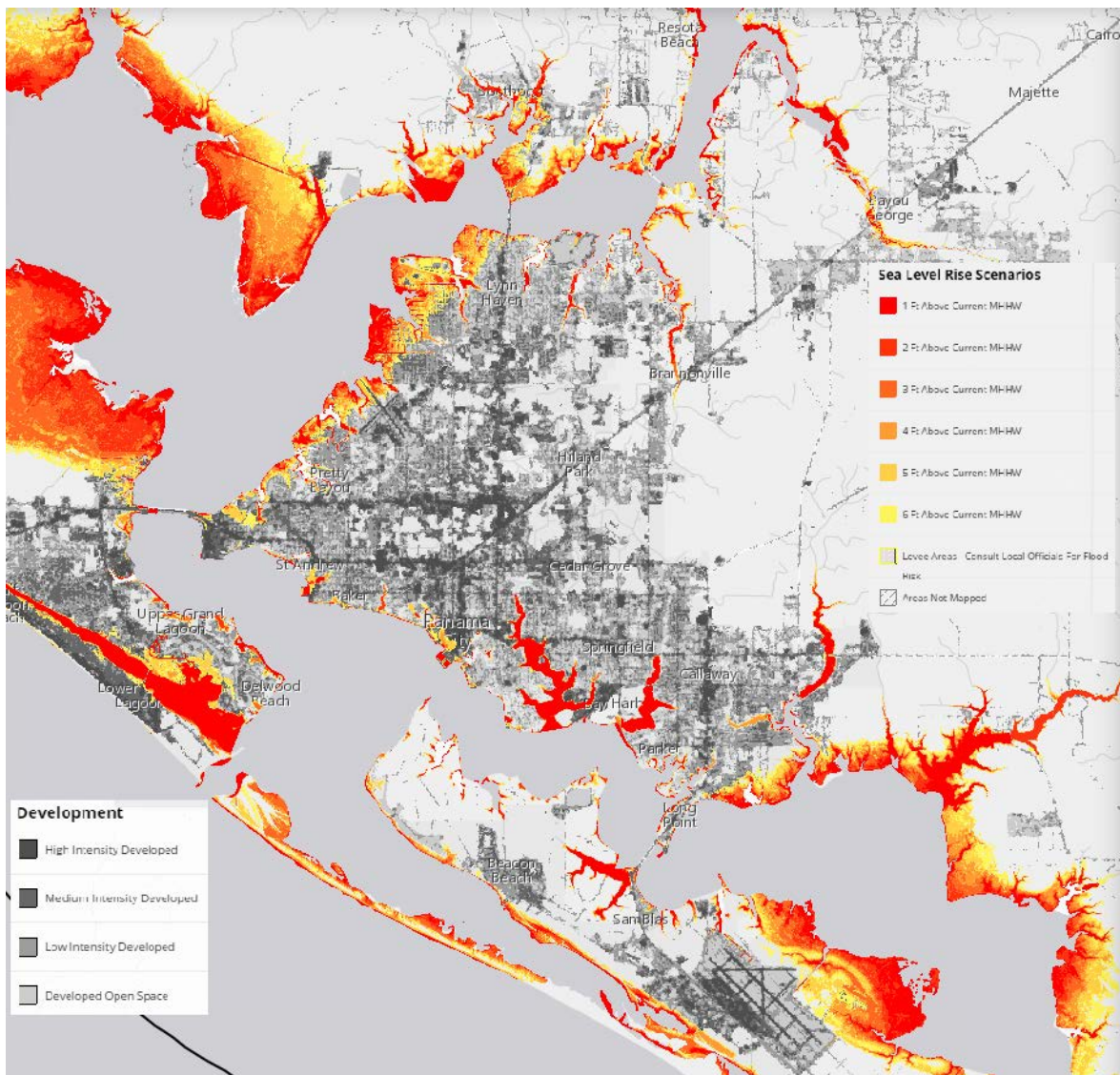
NOAA Coastal Flood Exposure Mapper Image 2 (below) of the coastal areas of Bay County, FL shows sea level rise scenarios of 0 to 6 feet, which represent a rise in water above the average of the highest high tides (called mean higher high water, or MHHW) for hydrologically connected areas. Areas that are lower in elevation will be exposed to flooding from sea level rise first and are represented by the darkest red.



NOAA Coastal Flood Exposure Mapper Image 2

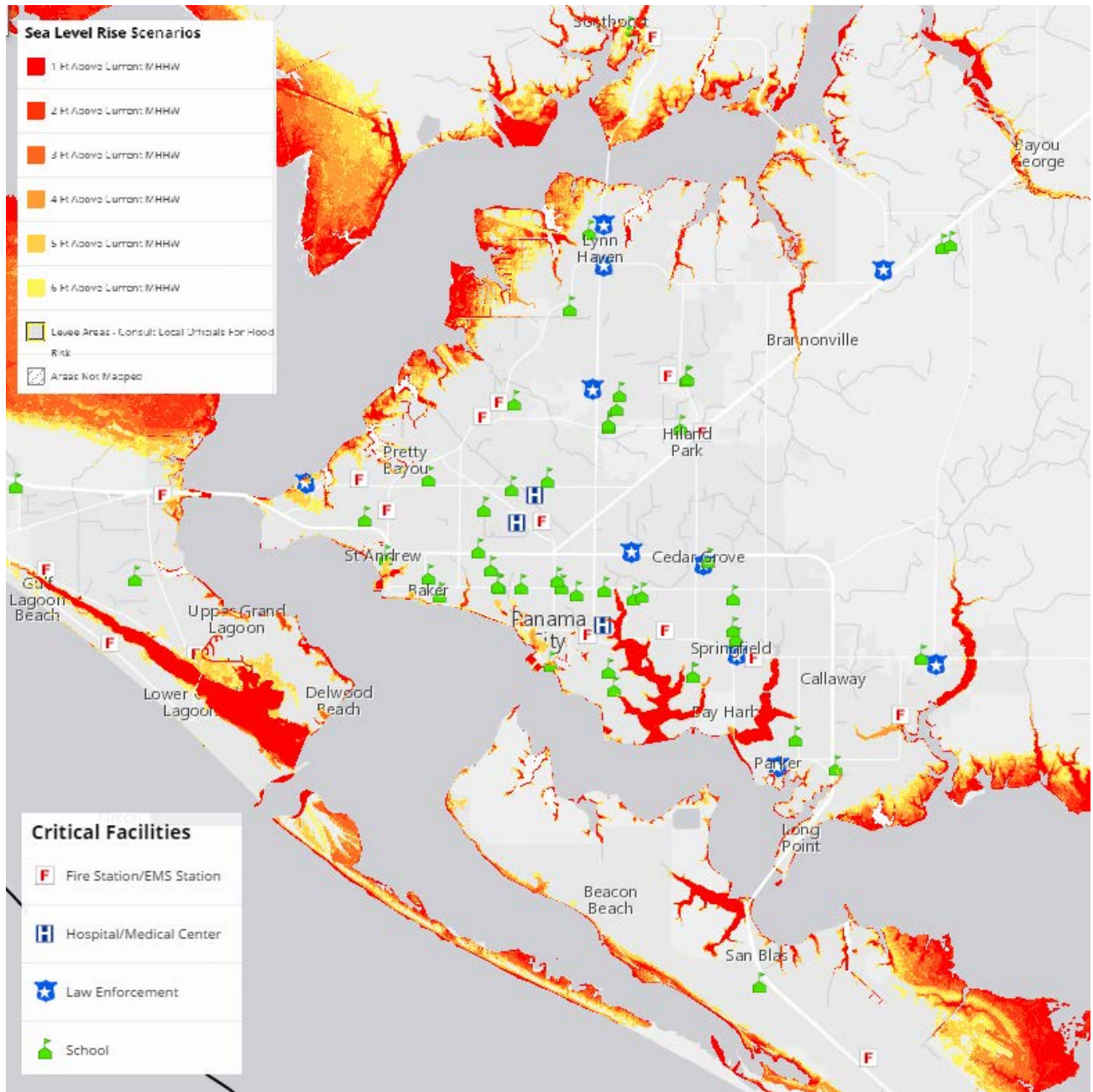
## Infrastructure Exposure Maps

According to NOAA's Coastal Flood Exposure Mapper, the Infrastructure Exposure Image 1 (below) "shows development located in or near coastal flood-prone areas. Development subjected to flooding puts people in harm's way, and can lead to costly infrastructure repairs, business interruptions, inaccessible roads, and utility disruptions... Impervious surfaces (e.g., developed, paved areas) do not allow coastal floodwaters to be absorbed into the ground and can exacerbate flooding issues, create storm water problems, and lead to degraded drinking water. With sea level rise, flooding in low-lying coastal areas may become a more frequent or permanent problem, flooding houses or closing roads. Salt water can infiltrate freshwater aquifers, contaminating drinking water, or corrode sewer and water pipes. Insurance rates may increase because of a new or higher risk."



Infrastructure Exposure Image 1: Development

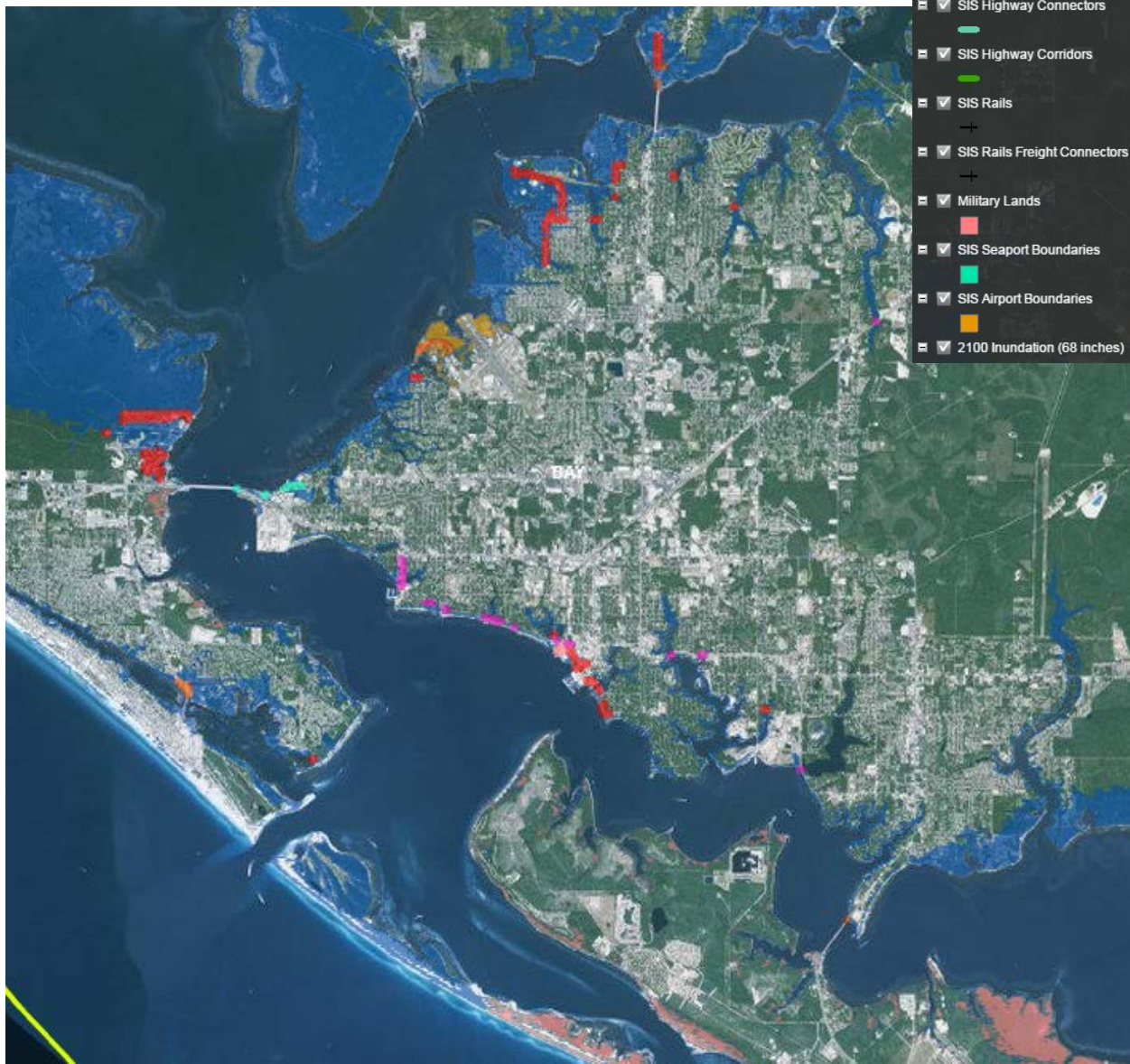
According to NOAA’s Coastal Flood Exposure Mapper, the Infrastructure Exposure Image 2 (below) “shows the approximate location of hospitals, schools, and other critical facilities located in or near coastal flood-prone areas. Critical facilities are community lifelines and need to be functional before, during, and after an event. In addition to structural damage, potential impacts include inaccessible roads that do not allow food and water to be delivered, or electrical outages, meaning no heat or air conditioning.”



Infrastructure Exposure Image 2: Critical Facilities

## SEA LEVEL SCENARIO (SLS) SKETCH PLANNING TOOL

The data and map provided from the Sketch Planning Tool shows the impacts in the year 2100 if the sea level rise continues at a pace in accordance with the high range projection used in the U.S. Army Corps of Engineers (USACE) models. Sea level rise will cause certain negative influences to the key segments of the roadway network and facilities in Panama City. Local planners should incorporate the adaptation strategies to inform existing community plans, policies, and projects. SLS Image 1 (below) shows Panama City with the 2100 High Projection MHHW.



SLS Image 1: Panama City, 2100 High Projection, MHHW

The NAVTEQ County & State Road table (right) depicts the impacted roadways under this projection for the Panama City area. Not included in the table are 6.7 miles of RCI Off Systems Roads and 1.05 miles of RCI On Systems roads that are projected to be inundated. SIS Highway Connectors from Port of Panama City to SR 77 and US 231 from East Ave in Panama City to I-10 are also projected to have less than one mile of inundation.

NAVTEQ County & State Roads 2100 High Projections - MHHW				
ROADWAY	ROUTE	BEGIN_POST	END_POST	MILES_INUNDATED
46070000	CR 388	0	12.339	0.017823588
46521500	CR 3030	0	4.136	0.211406629
46560001	CR 385	0	3.627	0.110653078
46010000	SR 30	0	1.106	0.030399384
46020000	SR 30	0.742	14.214	0.686332786
46040000	SR 75	0	34.764	0.014653778
46060000	SR 77	7.731	20.44	0.031258238
46060001	SR 77	0	1.238	0.077749183
46080000	SR 22	0	13.681	0.010274749
46090000	SR 79	0.02	14.348	0.084864098



Continuing with images from the MHHW for 2100 High Projections, Lynn Haven (left) and the US-98 bridge (bottom right) connecting Panama City to Tyndall AFB are two focus areas. Residential areas, roads (red), and the closed airport (yellow) are projected to be inundated on the Lynn Haven map.

SLS Image 2: Lynn Haven (Left)

SLS Image 3: US 98 Bridge to Tyndall AFB (Bottom)

As indicated in the bottom left image of the US-98 bridge to Tyndall AFB, roads and bridges near bayous as well as military property (pink) are at risk of inundation. In the Panama City area are also 0.01 miles of freight connector rails, 5.08 acres of Port of Panama City seaport boundary, and 6,035 acres of military lands may be at risk of inundation according to the 2100 High Projection – MHHW.

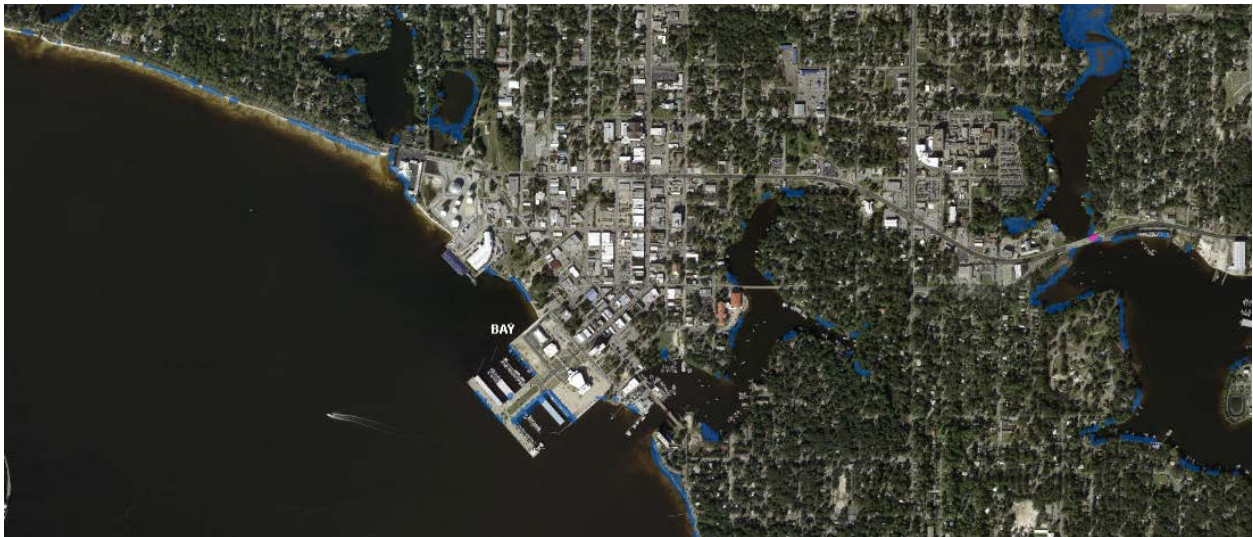




SLS Image 4 (below) shows Panama City with the Sketch Planning Tool’s medium projection for 2040, MHHW. Of note are the waterfront roads along Andrews Bay and the bridge east of downtown crossing Watson Bayou. While the roads are not yet projected to be inundated, closer proximity to the water increases risk of storm surge.



SLS Image 4: Downtown Panama City, 2040 Medium Projection, MHHW



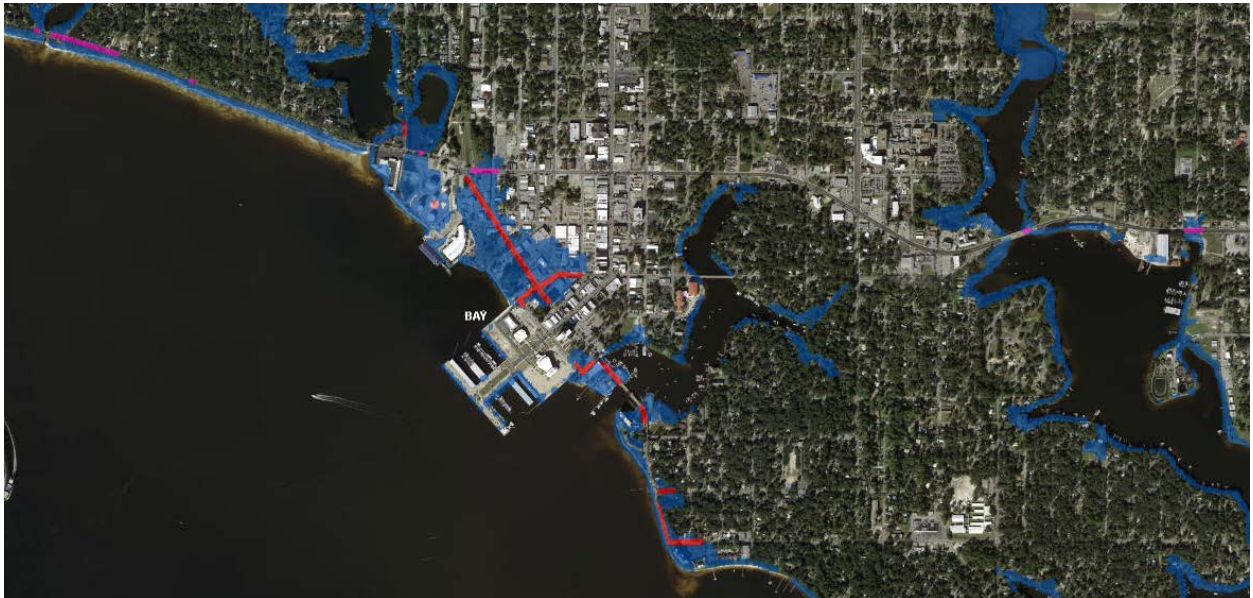
SLS Image 5: Downtown Panama City, 2100 Low Projection, MHHW

The 2100 low projection looks remarkably similar to the 2040 medium projection; the same emphasis exists for further studying the effects of sea level rise on the roads of lower elevation and bridges that provide access to downtown.

These SLS Sketch Planning Tool images contrast the difference between 2100 medium and high, MHHW projections for downtown Panama City.



SLS Image 6: Downtown Panama City, 2100 Medium Projection, MHHW



SLS Image 7: Downtown Panama City, 2100 High Projection, MHHW

Panama City downtown area, as depicted in SLS Image 7, shows that several businesses, roads, and bridges as well as the Chevron USA Products facility freight terminal are at risk of inundation by 2100 if the sea level rise continues at a pace in accordance with the high range projection used in the U.S. Army Corps of Engineers (USACE) models.

## Conclusion

This assessment builds upon what was taught in the October 2016 workshop held with local planners and stakeholders. The goal of this assessment was to test the utilization of the NOAA Sea Level Rise Viewer, NOAA Coastal Flood Exposure Mapper, and Florida Sea Level Rise Scenario Sketch Planning tools in an in-depth example. The results served to answer questions about the impacts of sea level rise on one growing community within the West Florida Regional Planning Council's service area, while also raising concerns warranting additional study.

In efforts to provide ongoing assistance to communities in the WFRPC planning area, this assessment focused on Panama City, FL and the immediate surrounding areas in southern Bay County, FL. As a case study, this assessment provides an example of how relevant and easy to use the information is that is offered by the coastal flood hazard tools. This vulnerability assessment promotes the translation of science to policy and enhances risk preparedness by presenting approachable imagery. Increased awareness of coastal vulnerability is more accessible through the tools explored in this assessment.