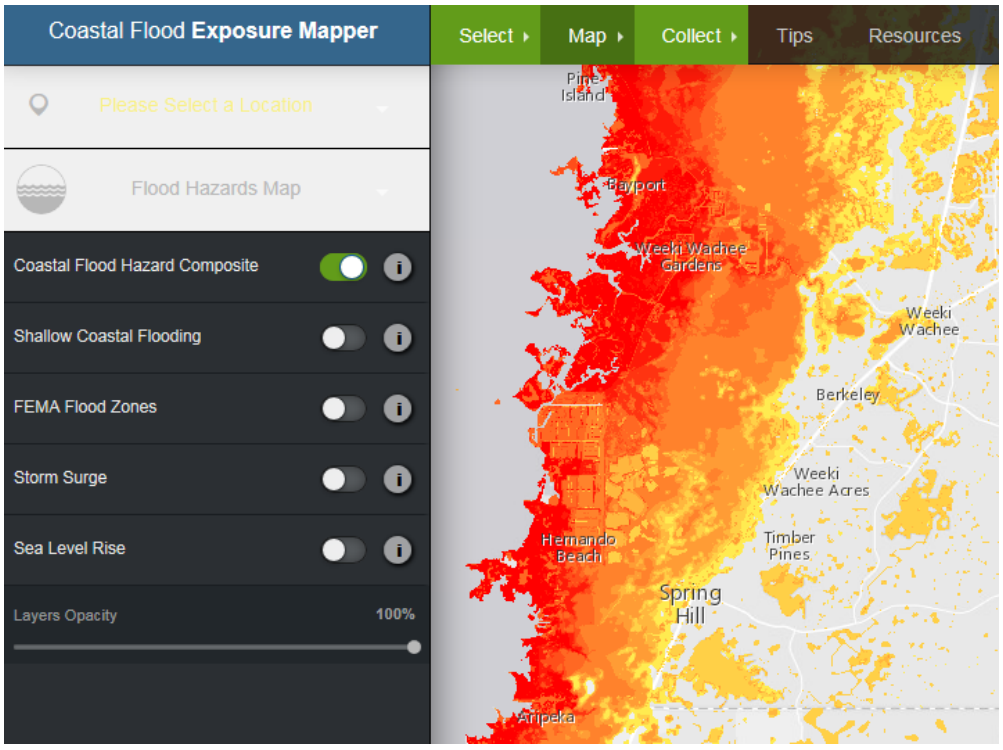
Pilot Vulnerability Assessment of Coastal Flooding Threats Due to Future Climate Projections:

Southern Hernando County

Tampa Bay Regional Planning Council

East Central Florida Regional Planning Council



A Florida DEO and NOAA Statewide Study
Managed by South Florida Regional Council

In 2011, the Florida Department of Economic Opportunity (DEO) initiated a five-year project to integrate sea level rise (SLR) adaptation into planning, including the local comprehensive plan, hazard mitigation plan, and post-disaster redevelopment plan[1]. The initiative is supporting this project of special merit in piloting adaptation planning guidance in coastal communities as well as compiling lessons learned and conducting information dissemination and outreach. Through funding from the National Oceanographic and Atmospheric Administration (NOAA) and the Florida Department of Environmental Protection (DEP), DEO is working with the South Florida Regional Planning Council (SFRPC) and Florida's nine other Regional Planning Councils to create resources including regional Vulnerability Assessments and a series of trainings.

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[1] For more information on DEO's resources for Adaptation Planning, please visit http://www.floridajobs.org/adaptationplanning

Background

This project promotes the translation of science to policy and risk preparedness in Florida communities by increasing understanding of, access to, and utilization of a range of existing tools. Projected sea level rise impacts are another threat contributing to the vulnerability of Florida's at-risk coastal resources.

Due to the prevalence of numerous references to climate change and sea level rise, Federal and State agencies have deemed it appropriate to educate and allow communities to be proactive in the protection and enhancement of our precious coastal resources.

The general idea is to promote tools that can be used in the various communities and counties within the state to educate and prepare with enough time for future climate developments that will affect the coastline in some way, shape, or manner.

Project Summary

In conjunction with DEO and NOAA office for Coastal Management, a partnership was developed throughout the state led by South Florida Regional Council, and the remaining 9 Regional Planning Councils (RPCs). The RPCs were paired up for their relative geographic locations to approach this project development. The purpose is to train the trainers that would disseminate the information and toolset usage through the communities and counties in the state. The project title reflects this goal: "Trainers and Tools: Building Coastal Flood Hazard Resiliency in Florida's Regional Planning Council Communities".

Through the 'training the trainers', various tools providing flood awareness that are available can be tested as possible methods for assessing and responding to Nature's flood encroachment along the coastal areas of Florida.

This particular report is a pilot vulnerability assessment of a coastal area in mid-Florida that has urban and rural components, as well as a major north-south corridor for the west coast of Florida. This preliminary assessment will investigate:

- Types of coastal flooding that can occur

- Community assets and facilities that may be affected
- Possible coastal shoreline using 'High Curve NOAA' projection
- Actual assets and facilities inundated by projection
- The current flood threshold depicting 'shallow coastal flooding'

A conclusion narrative will address these points at the end of the report.

Overall Perspective on Scenarios and Projections

Here in 2016, considerable dialog has been already exhausted on climate change and the future effects thereof. Whether or not there is belief in certain scenarios based on overall global warming or other manifestations of climate change, empirical measurements have indicated increases in sea level in the lower coterminous states. NOAA has tide gauges placed throughout the United States and a number of these have been in operation for a long enough period to use as a comparison 'yardstick' for recording sea level over time.

In the geographic area of this assessment, the Cedar Key gauge is the closest of such long-term NOAA placements. Because of this long-term recording of data, we have information going back before 1920. This data (Figure 1) shows us an upward trend, although shallow, but upward none-the-less. This is also with the climate we know and have been used to for decades.

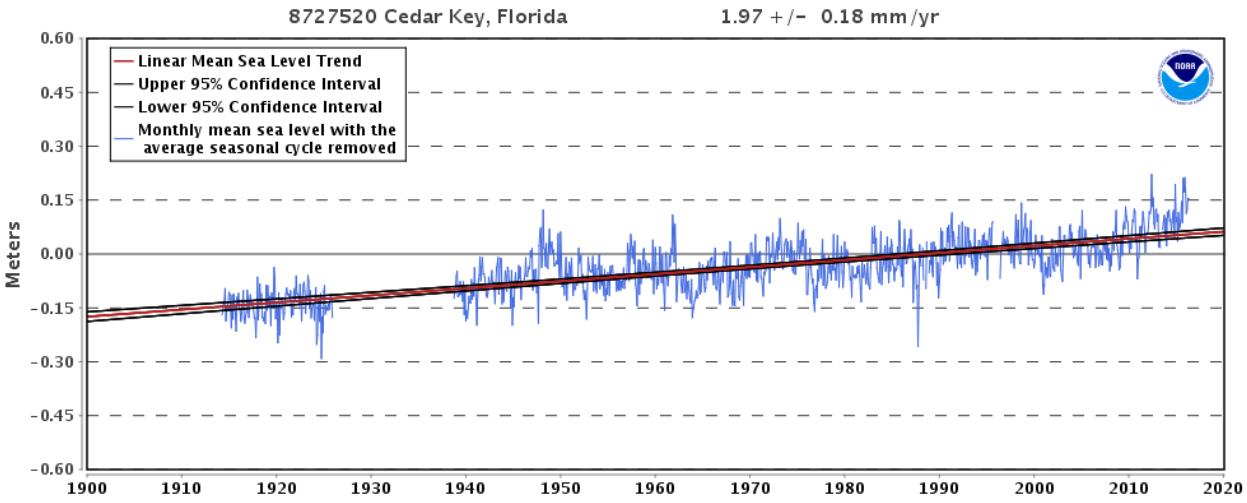


Figure 1. Long-term NOAA recording Mean Sea Level

Beyond 2016, we know that the level will rise, but by how much is the subject for much debate. Within the scientific community, there are a number of theories and scenarios. In North

America, there are three generally recognized scenarios; Intergovernmental Panel on Climate Change, NOAA Coastal Services, and U.S. Army Corps of Engineers.

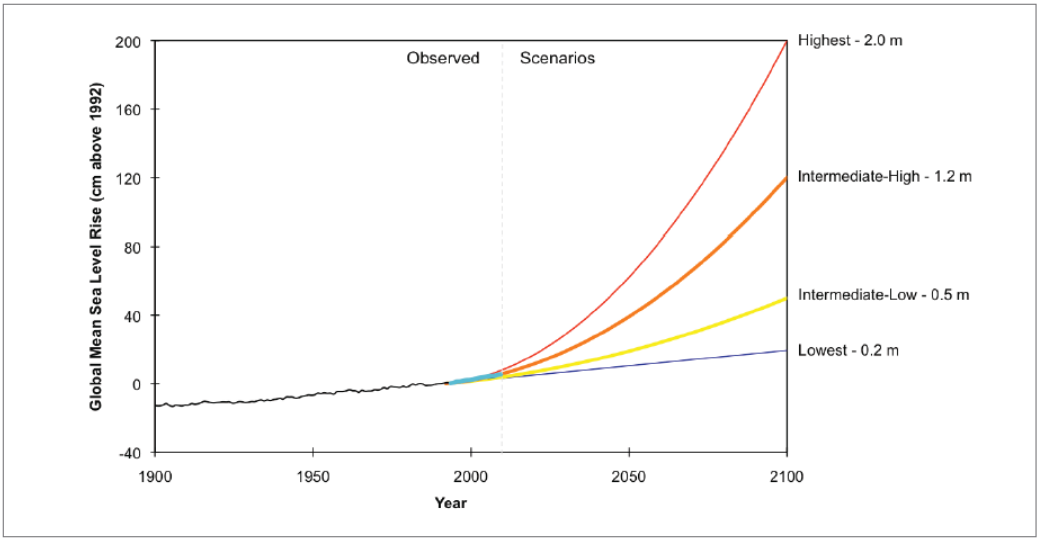


Figure 2. Global Mean Sea Level Rise Scenarios from NOAA

The Tampa Bay Region has had meetings with policy makers and coastal resource agencies and stewards for the past two years on the subject of coastal flooding and sea level rise. This effort under the heading of "One-Bay Resilient Communities" came away with three recommendations among other things, regarding sea level rise in the Tampa Bay area:

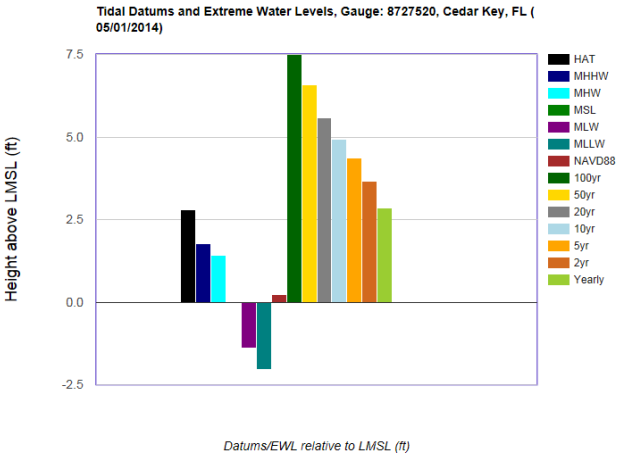
1. Projections of SLR should be "regionally corrected" using the St. Petersburg tide gauge.
2. Projections of SLR should be consistent with NCA (NOAA) estimates and methods.
3. Adaptation planning should employ a scenario-based approach that considers, at a minimum, location, time horizon and risk tolerance.

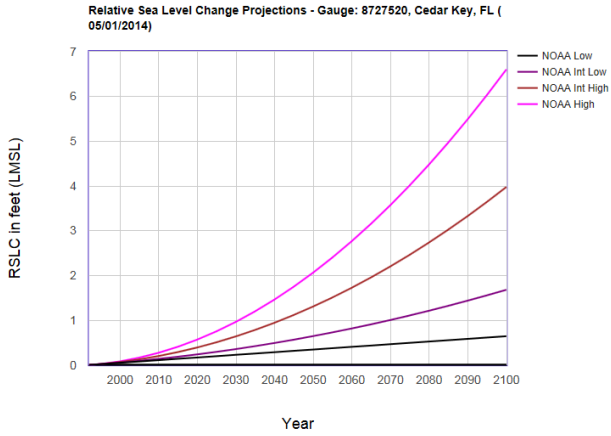
This culminated with the Tampa Bay Regional Council formally accepting the Tampa Bay Climate Science Advisory Panel (CSAP) report entitled "Recommended Projection of Sea Level Rise in the Tampa Bay Region" on October 12, 2015.

As for the NOAA projections for this assessment, the choice of the 'high' curve was chosen. Taking the same approach we take with storm surge inundation scenarios using worst case modeling, the high NOAA curve gives us worst case to visualize. Decision-makers and Community Planners must address issues within the coastal and tidal zone, and often are concerned with chance events like a 100-year storm. This is an important consideration for the new Federal flood risk management standard (FEMA 2015).

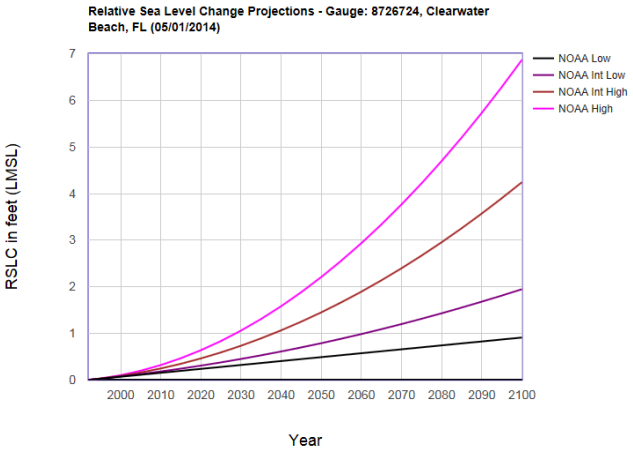
For the mid-portion of Florida, both east and west coast have similar future sea level projections within a fraction of a foot. For the Hernando assessment area, the Cedar

Key tidal gauge was chosen as a reference, not because it is any closer than the Clearwater Beach gauge, but mainly because of the bathymetry and coastal similarity to the Hernando County area. The Clearwater Beach gauge is set along a beach, which is topographically different, as well as the bathymetry leading up to it.





With that said, the projection for the Clearwater Beach gauge is similar enough.



Coastal Risk Assessment

Two tools were used in the Assessment of this area. One tool was a custom tool from Tampa Bay Regional Planning Council (TBRPC) which uses NOAA data and creates GIS layers suitable for analysis with other GIS layers. This tool is available as an Add-In to ArcGIS. The second tool (or suite of tools) comes from NOAA Coastal Services in South Carolina. It is a web-based tool which can give overview results on the fly because the data is already created. It is essentially an overlay tool for visualization. This tool is called the 'Flood Exposure Mapper'.

Custom GIS Add-In Tool

First, we will run the TBRPC tool so we can interact with other layers and perform analysis. This is the user interface presented to the user:

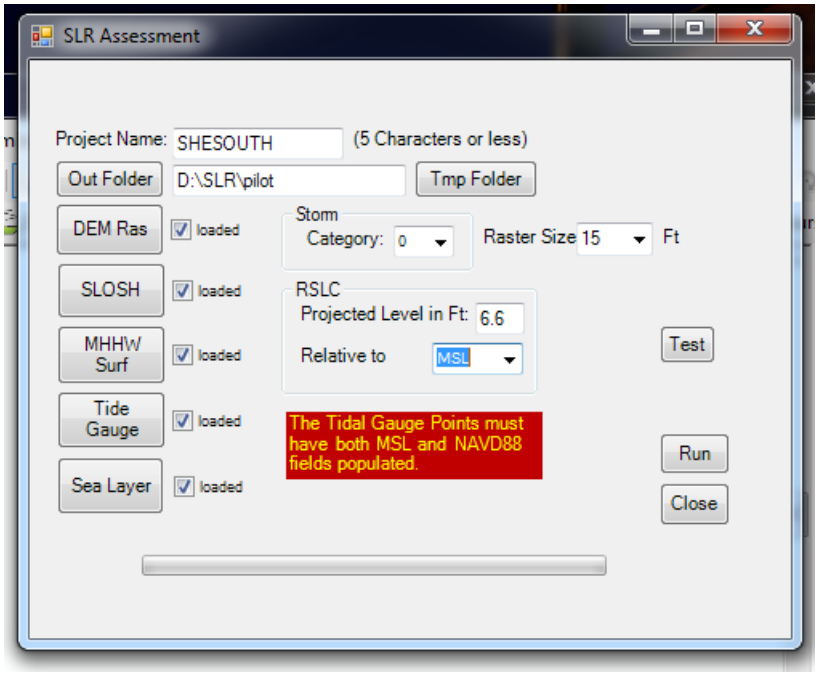


Figure 3. TBRPC SLR Assessment Tool

The tool has the ability to incorporate storm surge as well as sea level rise. This tool does not model with a bathtub methodology. It relies on true tidal surface which is presented from the tidal gauges. NOAA has developed this layer and it is incorporated into the model, so it is necessary to use it. Further processing is done with tidal gauges, so those have to be incorporated in your source layers as well. The SLOSH basin is used even if there will be no storm processing, as it is used as a calculating container in the model.

The following map plates will illustrate the assessment ability with a customized GIS approach that allows analysis with other layers and geoprocessed results.

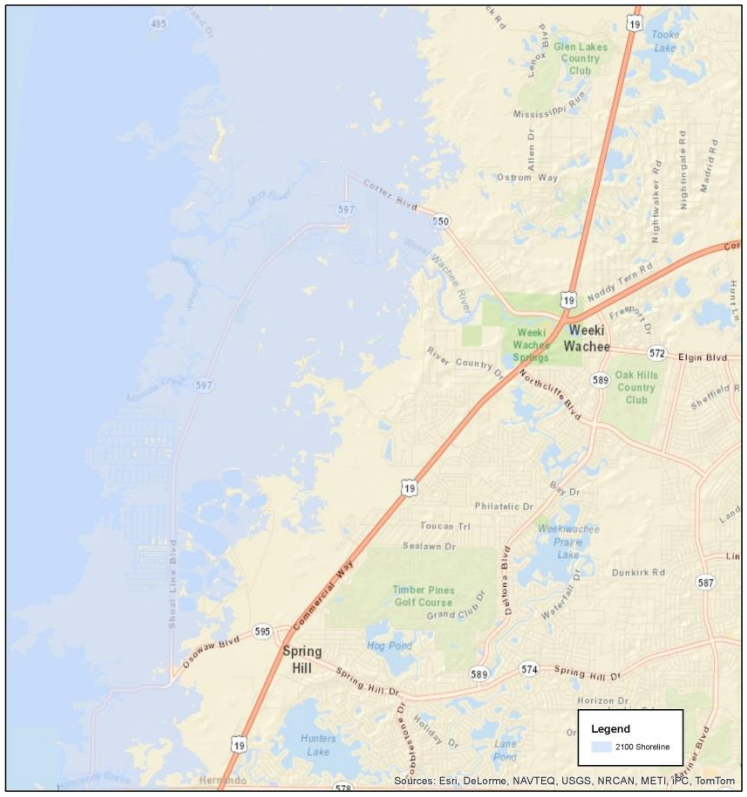


Figure 4 Year 2100 Shoreline using NOAA High Curve

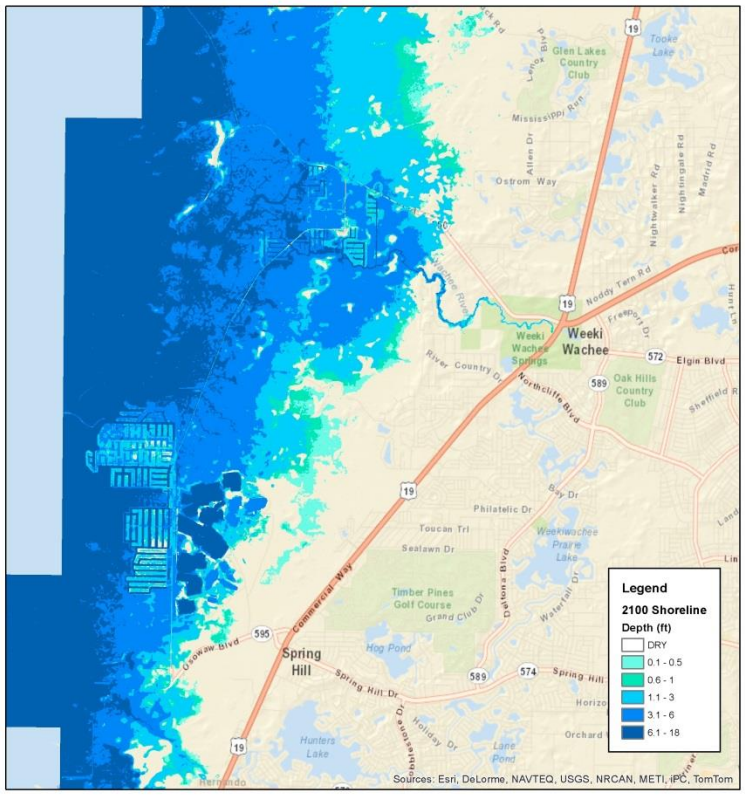


Figure 5. year 2100 Sea level Depth Over Existing land

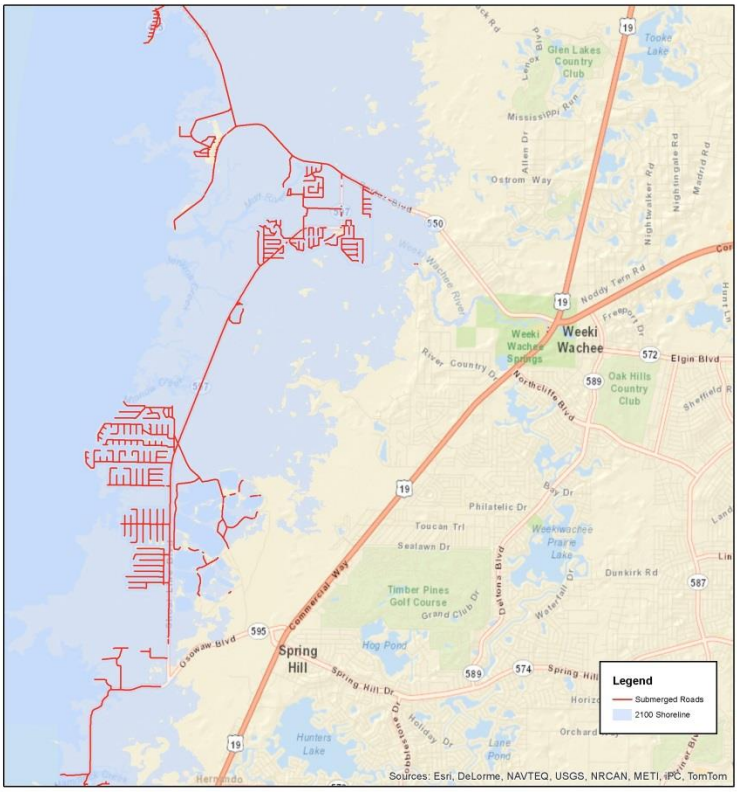


Figure 6. Current Roads Submerged in 2100

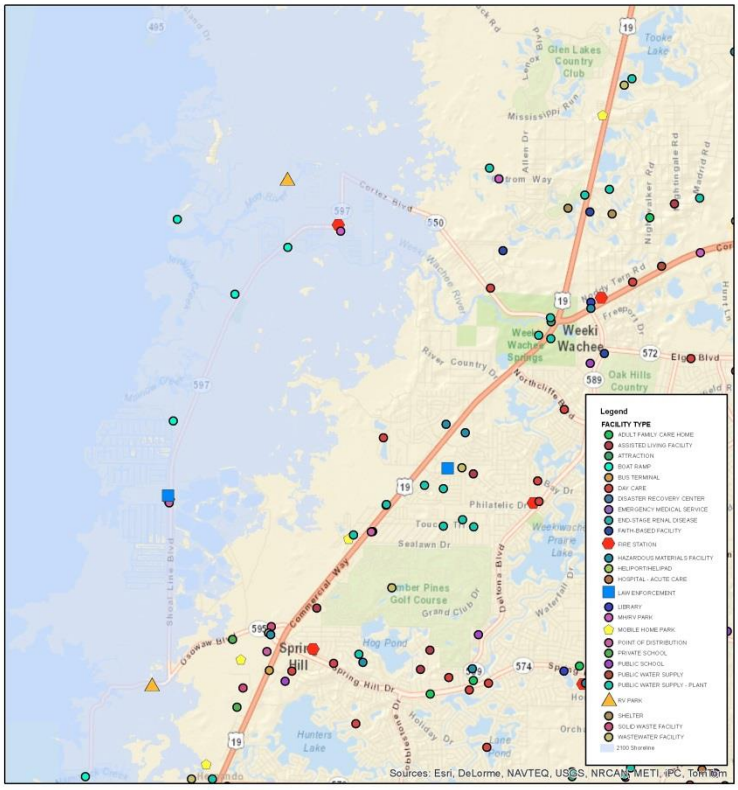
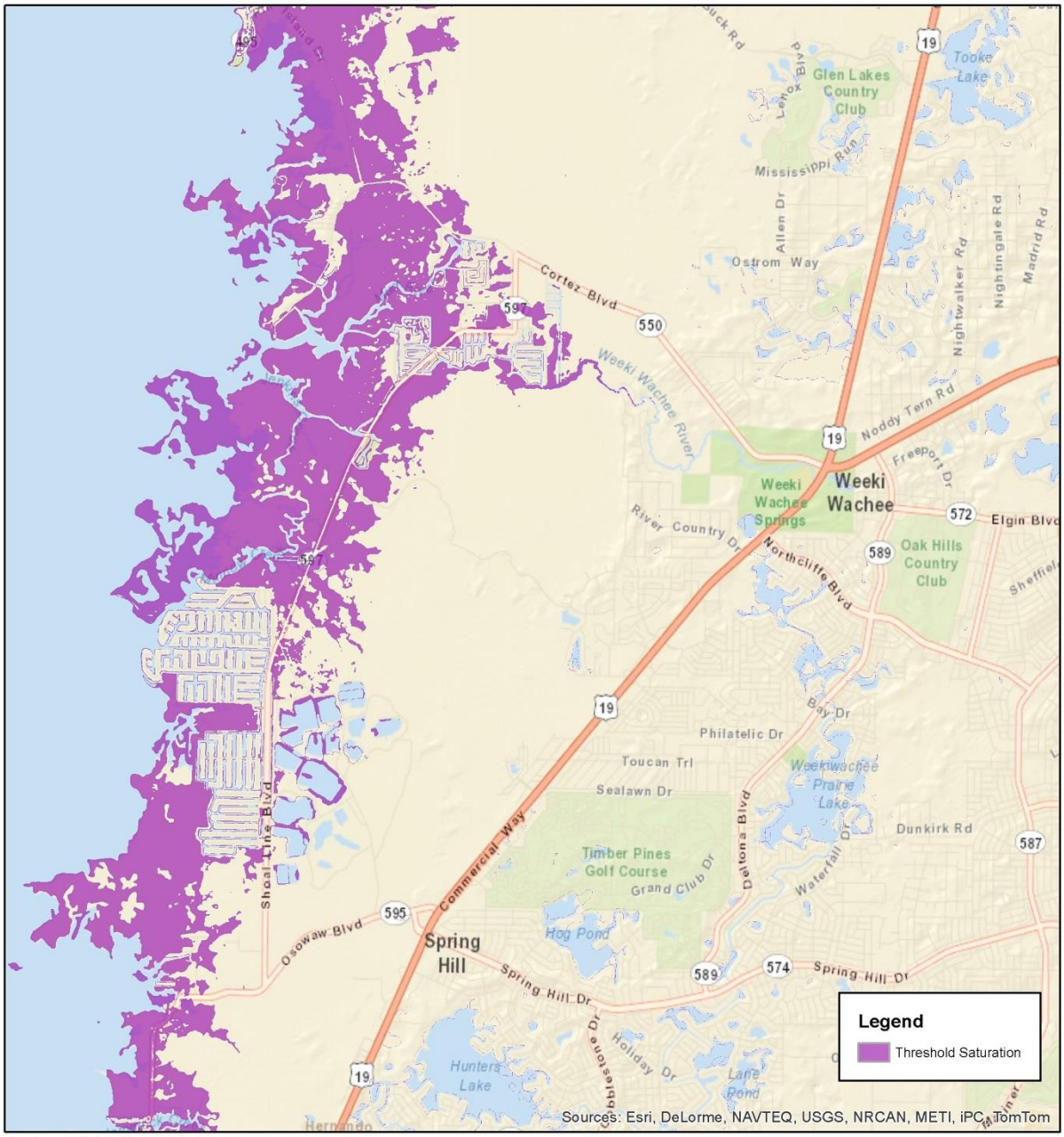


Figure 7. Important Assets and Facilities



Data: NOAA Coastal Services

These data illustrate the potential flooding from coastal flood advisories as issued locally by the National Weather Service. The inundation layer depicts flooding above local flooding thresholds. When the water levels go above a threshold designated by NWS, shallow coastal flooding occurs. Shallow coastal flooding is usually caused by the extreme high tides that occur a few times per year when the sun, moon, and earth align, or during storm events. Rainfall or wind pushing water over land can increase flooding levels.

Table 1: Affected Parcels by Year 2100 SLR with Current Justified Value

DOR USE TYPE	NUMBER OF PARCELS	2014 DOLLARS
ACREAGE NON-AGRIC	52	$4,820,947.46
AIRPORT	6	$3,349,077.09
AUTO SALES	4	$560,645.02
CAMPS	3	$346,627.00
CHURCH OWNED	2	$841,707.44
CLUB/LDG/UNION HALL	5	$1,555,694.00
CONDOMINIUM	5	$288,573.00
COUNTY OWNED	5	$1,003,807.55
FINANCIAL	1	$142,743.00
FOREST	20	$4,461,159.82
MFR <10 UNITS	2	$182,847.00
MOBILE HOME SUB	415	$31,675,738.48
MOTEL/HOTEL	3	$690,813.97
NIGHTCLUB LOUNGE	2	$418,296.00
OFFICE 1 STORY	10	$1,820,158.55
OFFICE MULTI STORY	1	$370,269.00
OPEN STORAGE	1	$75,658.00
PARKING LOT COMMERCL	5	$340,188.70
RESTAURANT	10	$3,243,904.81
RIGHT-OF-WAY	57	$694,360.80
SERVICE STATION	2	$417,163.73
SINGLE FAMILY RES	2185	$328,492,067.07
STATE OWNED	74	$25,077,058.91
STORE-OFF-RES COMB.	3	$363,247.00
STORE 1 FLOOR	7	$1,147,180.99
SUBMERGED	42	$104,000.04
UTILITY	8	$661,539.99
VAC COMM'L	106	$6,415,493.45
VACANT INSTITUTIONAL	6	$122,609.34
VACANT RESIDENTIAL	1379	$59,696,164.65
WAREHOUSE	4	$620,092.00

DOR USE TYPE	NUMBER OF PARCELS	2014 DOLLARS
WASTE LAND G.B.	56	$1,083,951.60

The previous pages have shown the types of analysis that can be done with the custom assessment tool. It creates GIS layers that can be geoprocessed with others and the limits are up to one's imagination. The table directly above uses property appraiser data and with overlay analysis, we have extracted current parcels that would be submerged in the future. One part of the tool that has not been demonstrated is the addition of storm surge inundation on top of higher future sea level. Currently, it is beyond the scope of this brief assessment demonstration report.

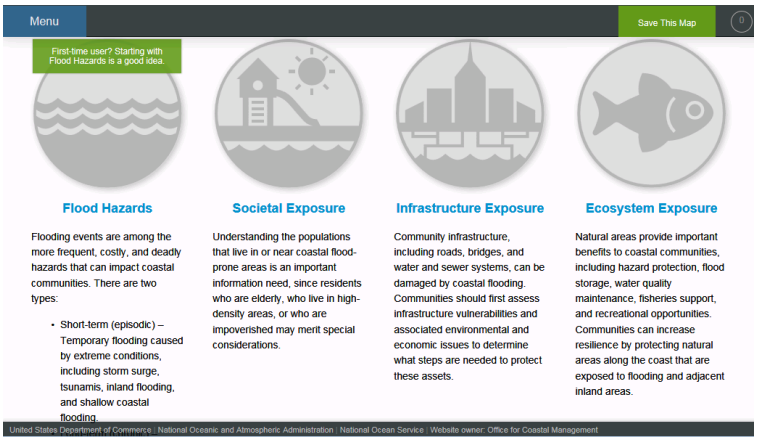
NOAA Online Flood Tool(s)

This tool can be found on the NOAA Coastal Services site and has a multi-layered approach to depicting flood exposure. This is the description of the background for developing the tool:

In recent years, with many universities and states developing risk and vulnerability assessments, our agency updated its approach to focus more on community engagement and less on a prescribed way to conduct an assessment. We developed the Coastal Flood Exposure Mapper to help communities kick-start conversations about coastal risks. The mapper enables users to explore maps that show people, places, and natural resources exposed to coastal flood hazards and create a collection of maps to share and communicate about flood exposure. Training is available on this approach.

https://coast.noaa.gov/floodexposure

The Exposure tool and all the tools available on the NOAA site have descriptions of use as well as videos showing the full breadth of how to use them. The following pages will illustrate the capability of the tool and highlight what it tells us about the Hernando coastline.



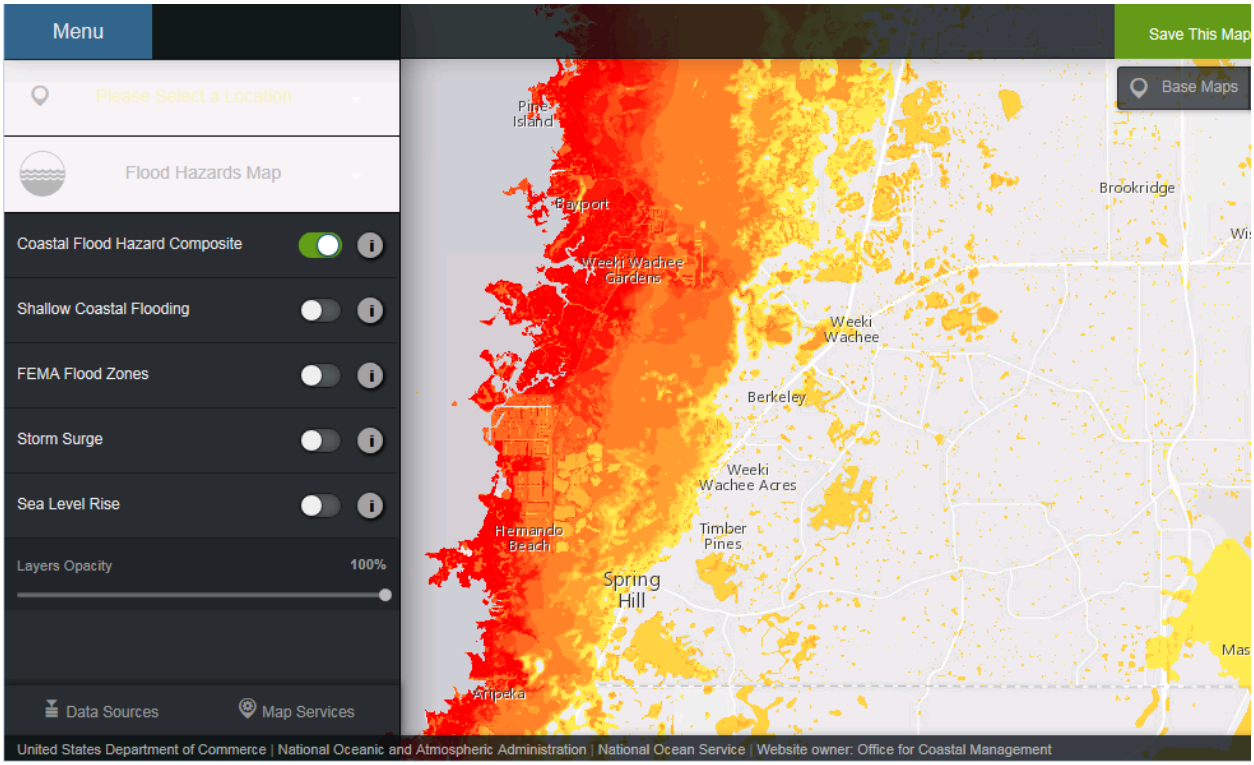


Figure 8. Composite showing all flood hazards at once

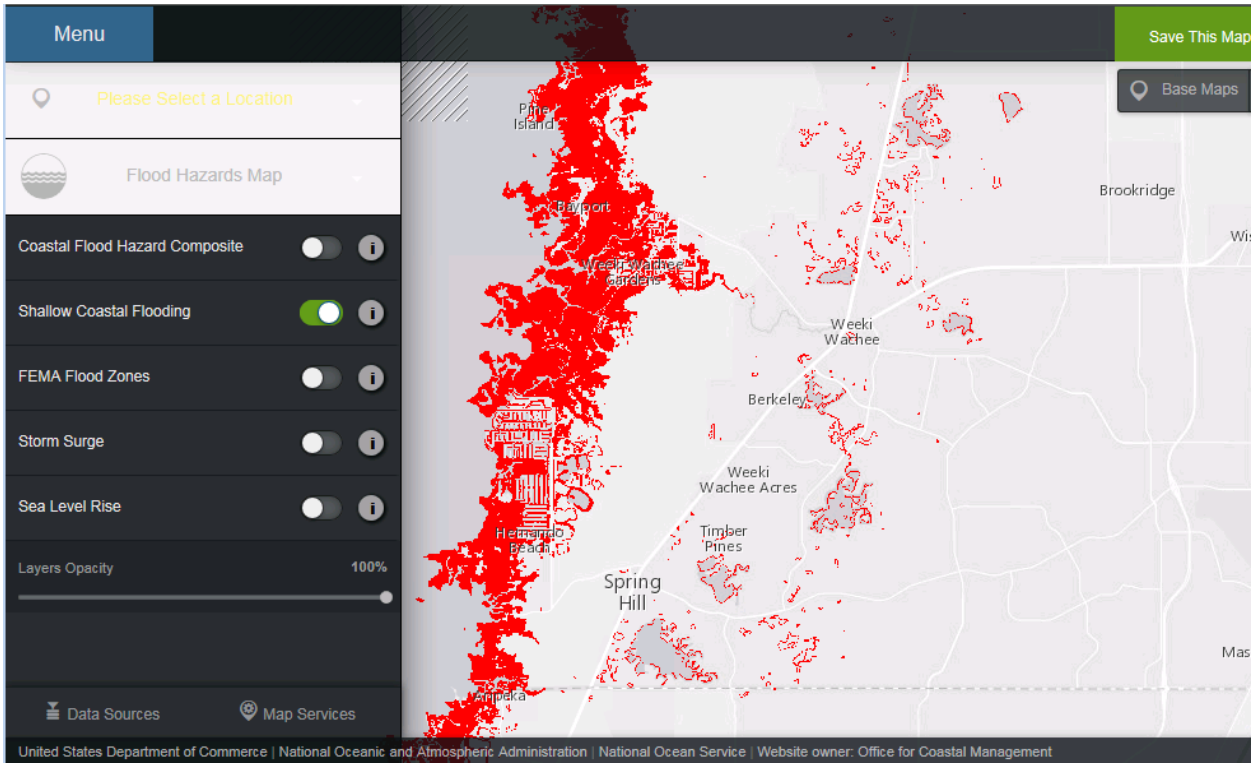


Figure 9. Current flood frequency threshold extent

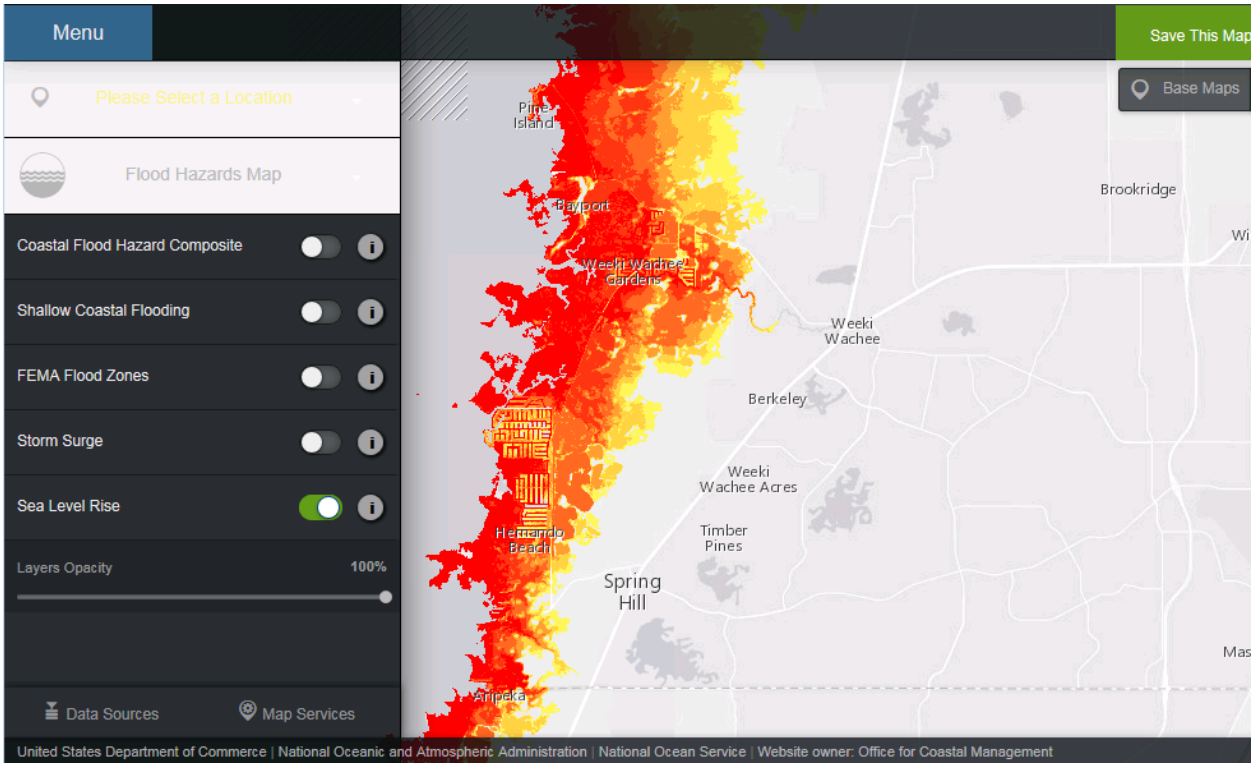


Figure 10. Sea level rise color-coded by feet up to 6ft

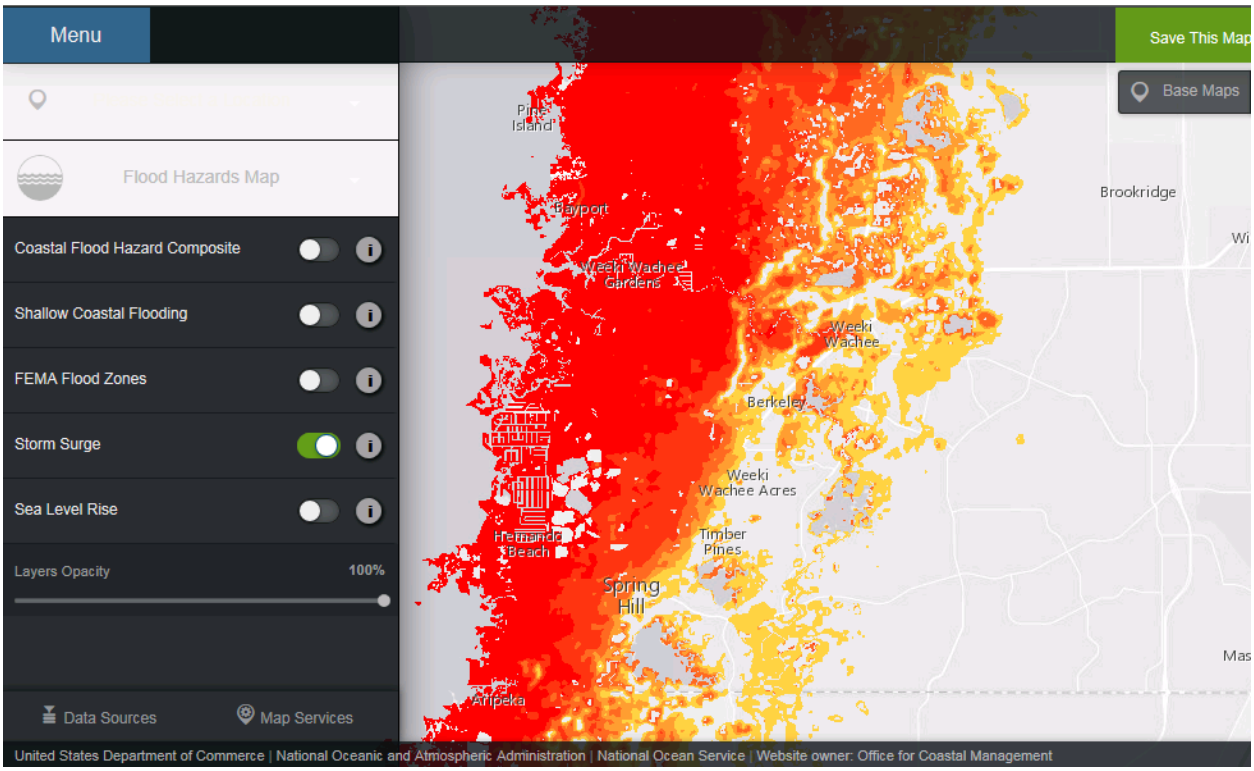


Figure 11. Storm surge coded by category

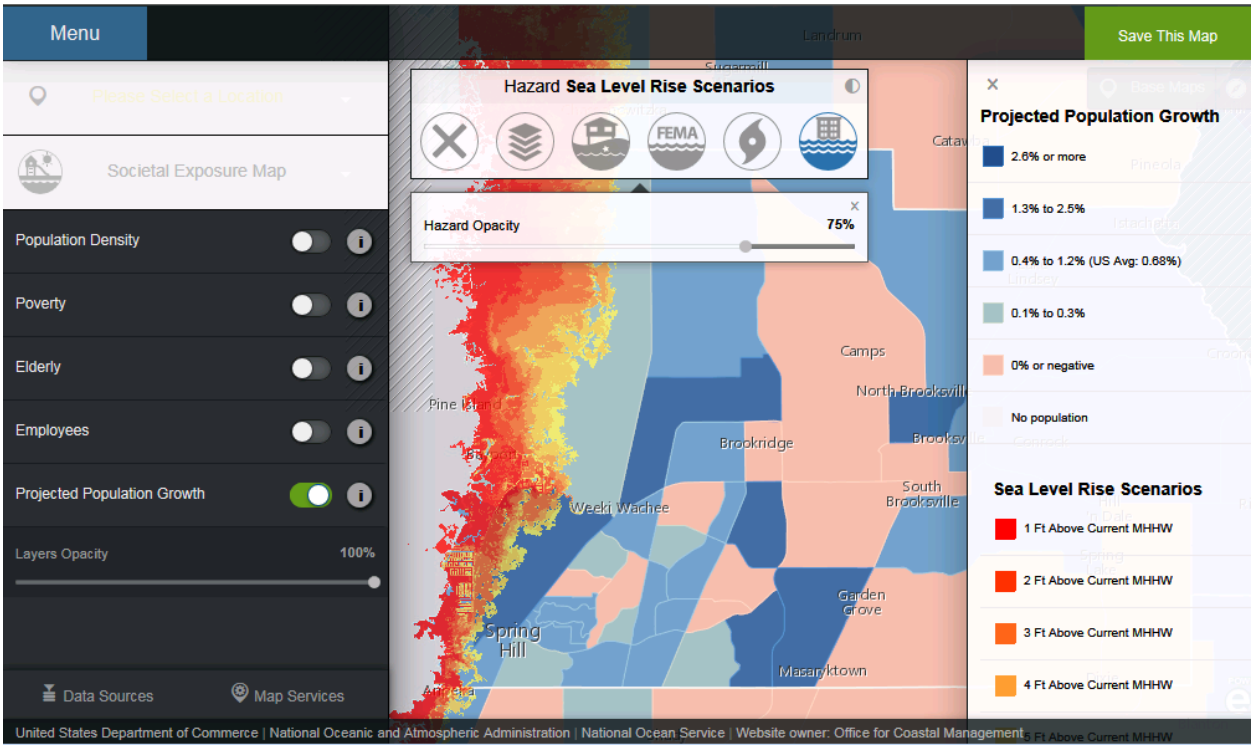


Figure 12. Projected population with sea level rise

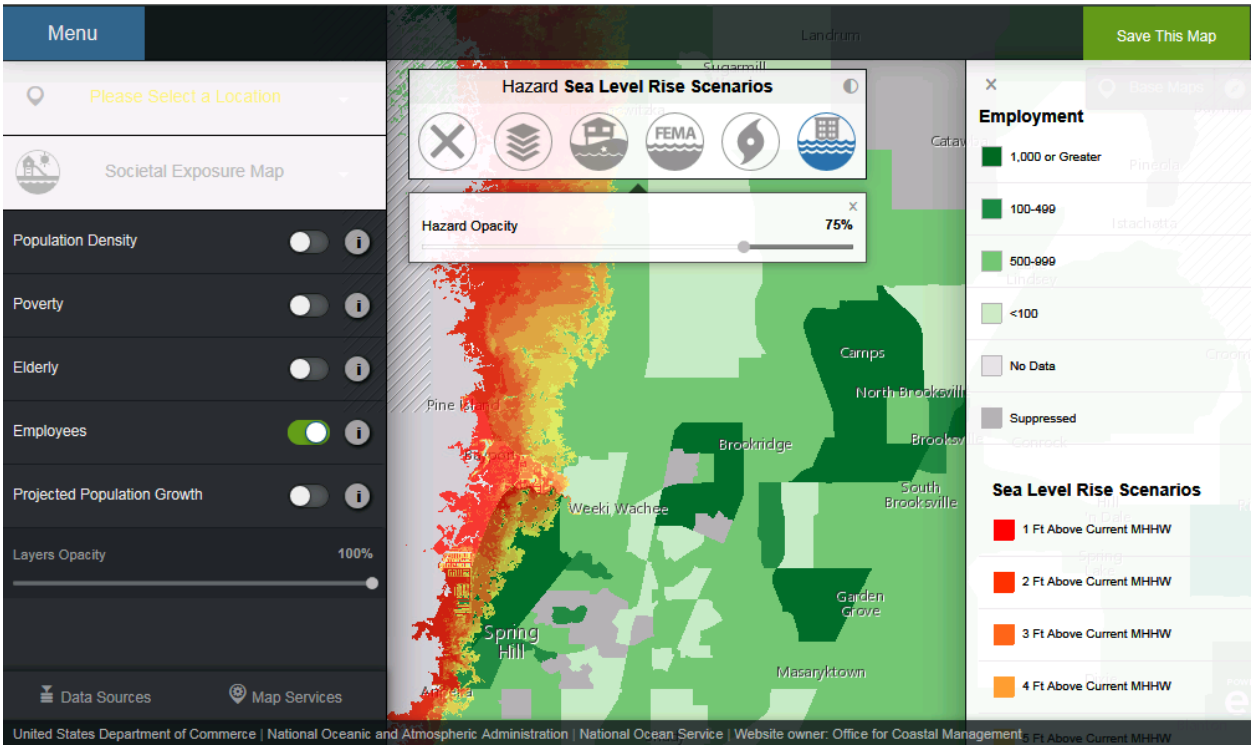


Figure 13. Employment population with sea level rise

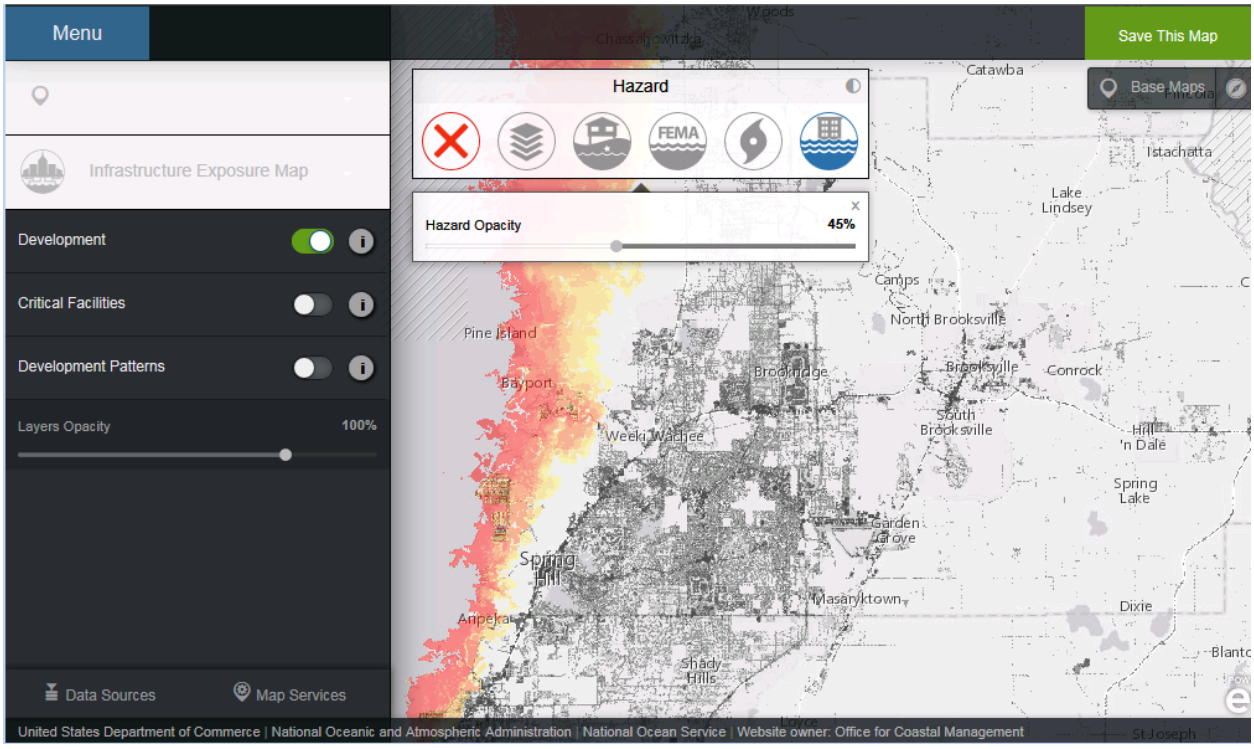


Figure 14. Current development with sea level rise

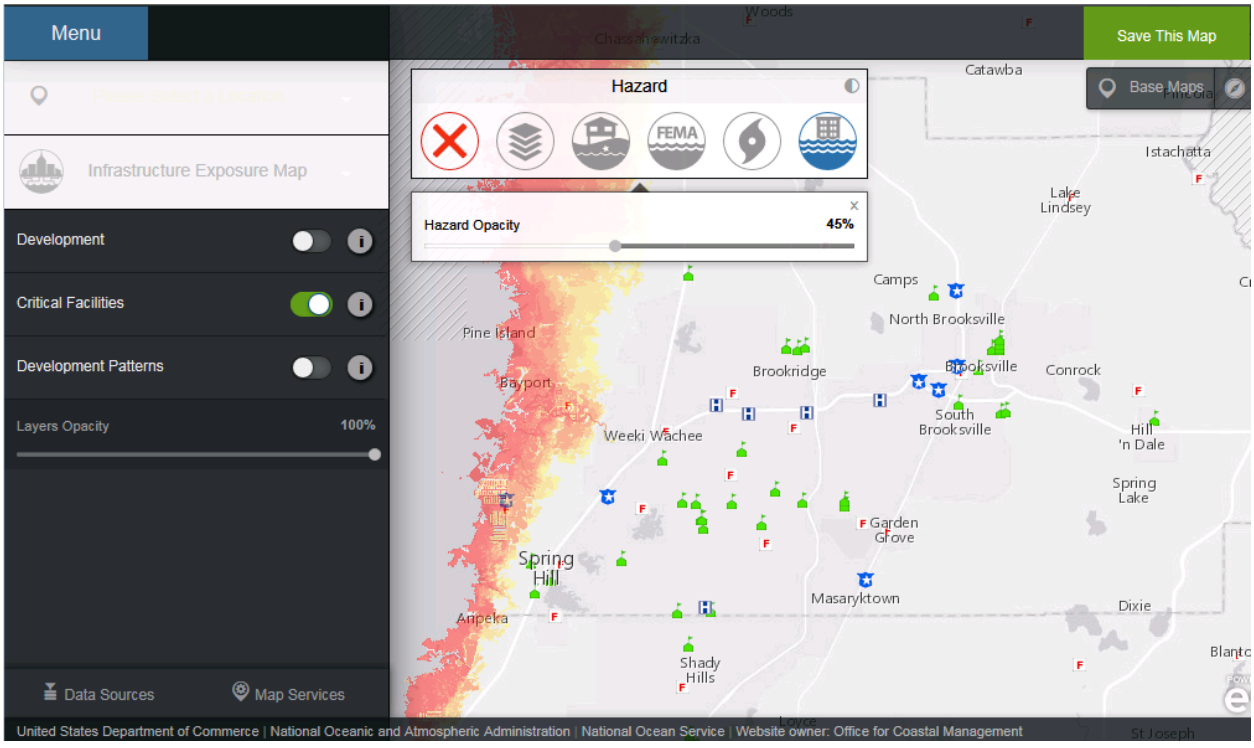


Figure 15. Critical facilities with sea level rise

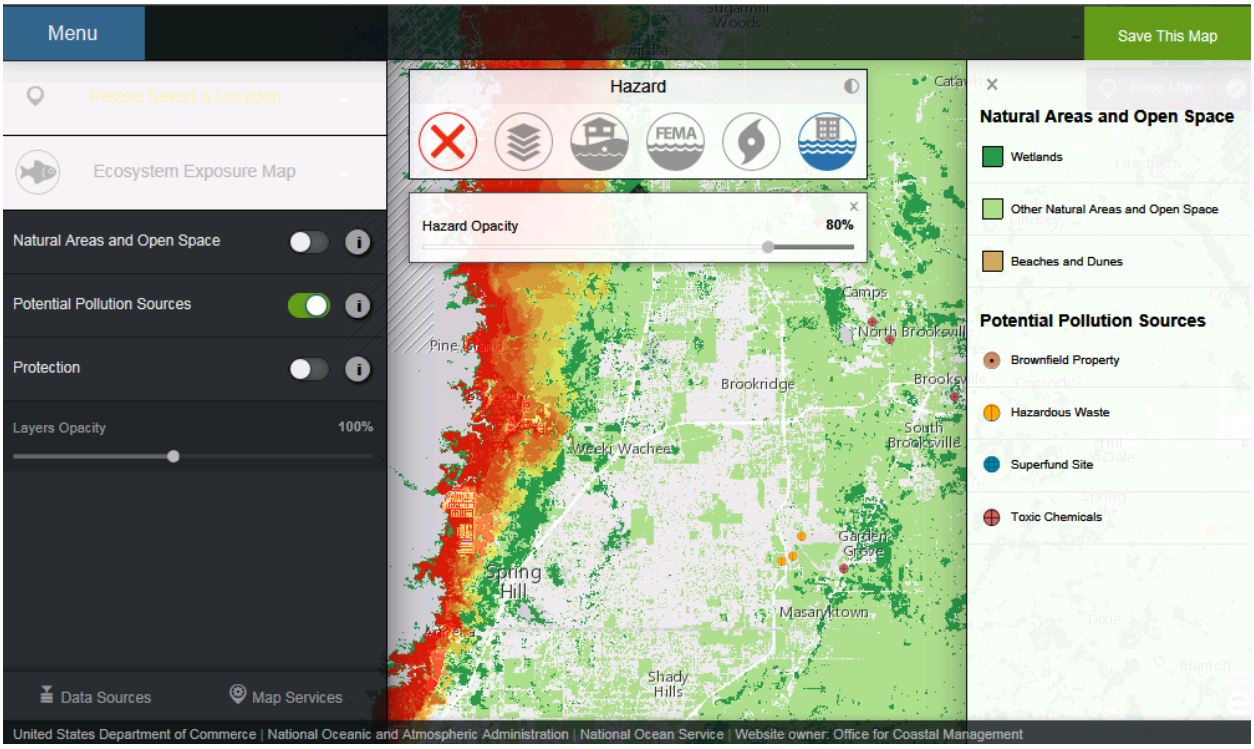


Figure 16. Ecosystem and pollution sources with sea level rise

The previous maps have shown how the Flood Exposure mapper can give snapshots of pre-selected variables and community risks with flood potential. All flood threats can be explored, including inland rain flooding (FEMA FIRM). Using this tool is a rather simple and quick way to understand the possible risks involved with flooding and increase risk awareness for coastal areas around the state and country.

If further investigation is brought to light, then a tool like the custom assessment tool mentioned earlier in this report can be leveraged to do granular detailed analysis.

Conclusion

Now that a few tools have been demonstrated, we can render a brief assessment of the lower Hernando coastal area.

First of all, this investigation is for demonstration purposes to show the capabilities of the tools at hand. A full detailed assessment is beyond the scope of this project. Having said that, we can highlight some things learned for the lower half of Hernando coast:

- Worse case 6.6ft sea level rise in 2100 does not affect any major road corridors (like U.S. 19)
- Current shallow flooding can be fairly extensive

- Few critical facilities in proportion to total are at risk from 6.6ft rise
- There are isolated communities that will be affected by rise of worse case level

It is important to realize that if this high end rate of rise were to happen, it would be 84 years before that sea level would be evident. It is not a rapid change either. To keep perspective, that is the difference between now and 1932. The landscape and development is radically different in most Florida areas since then. The amount of infrastructure that has been created and changed since then is staggering.