

VULNERABILITY ASSESSMENT WITH CITY SIMULATOR

FDEP Grant #22PLN91
Clearwater #24-0020-EN

Presentation to
City Council
September 16, 2024





The city seeks to further understand the future impacts of both sea level rise and extreme heat by conducting city-wide vulnerability assessments using AtkinsRéalis' City Simulator tool.

This work was funded in part through a grant agreement from the Florida Department of Environmental Protection's Office of Resilience and Coastal Protection Resilient Florida Program. The views, statements, findings, conclusions, and recommendations expressed herein are those of the author(s) and do not necessarily reflect the views of the State of Florida or any of its subagencies.

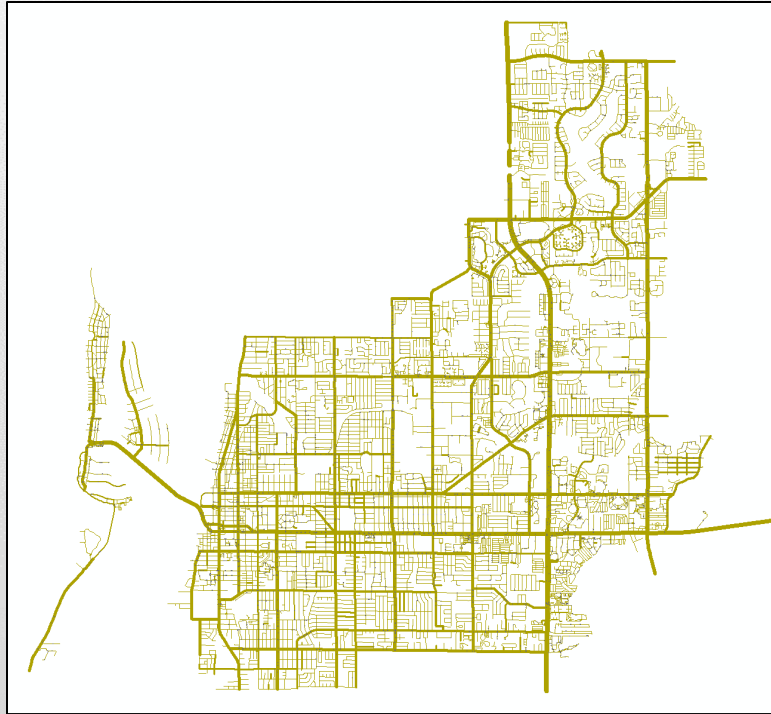


Executive Overview

- **Vulnerability Assessment is required for certain grants**
- **Staff utilized Vulnerability Assessment to test several key conditions to help influence decisions and future projects**
- **Data driven decision making**
- **ROI focused projects and data**

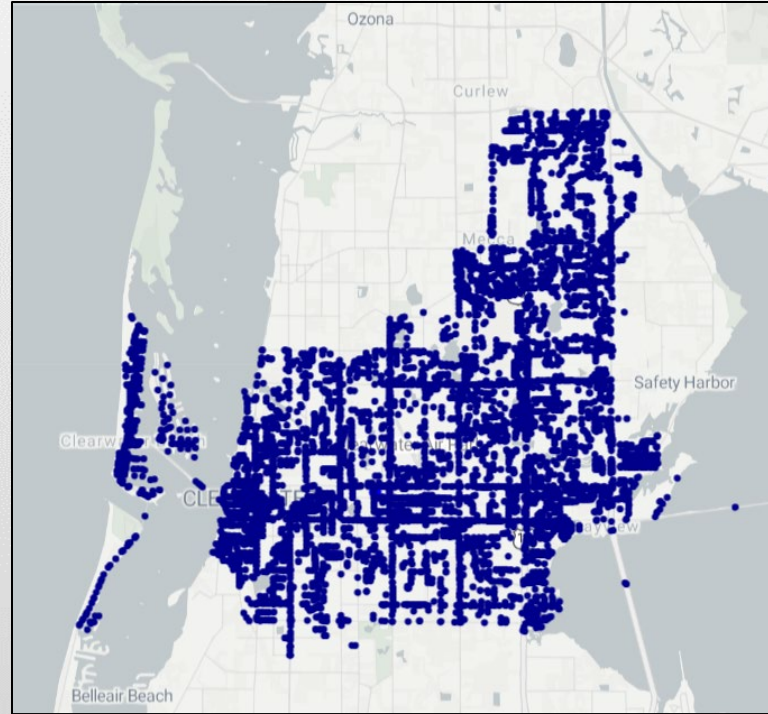


Representations of Community Features Used in the Model



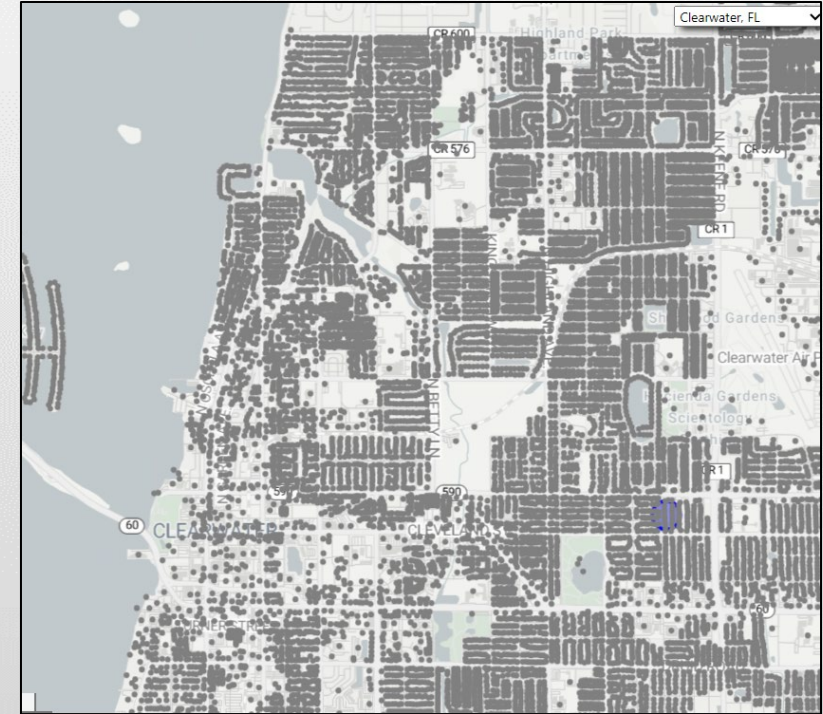
Road Network

Used to approximate daily trips and to model the trips disrupted



~8,000 Stormwater Nodes

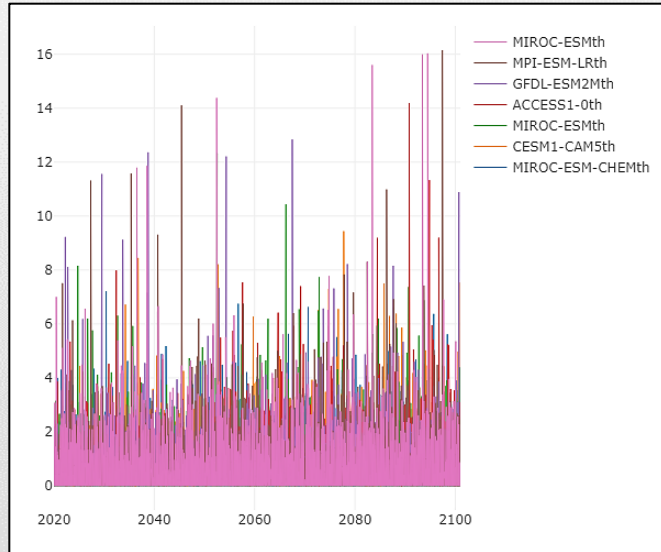
Those nodes along transportation features used to model travel disruption



~31,000 Structures

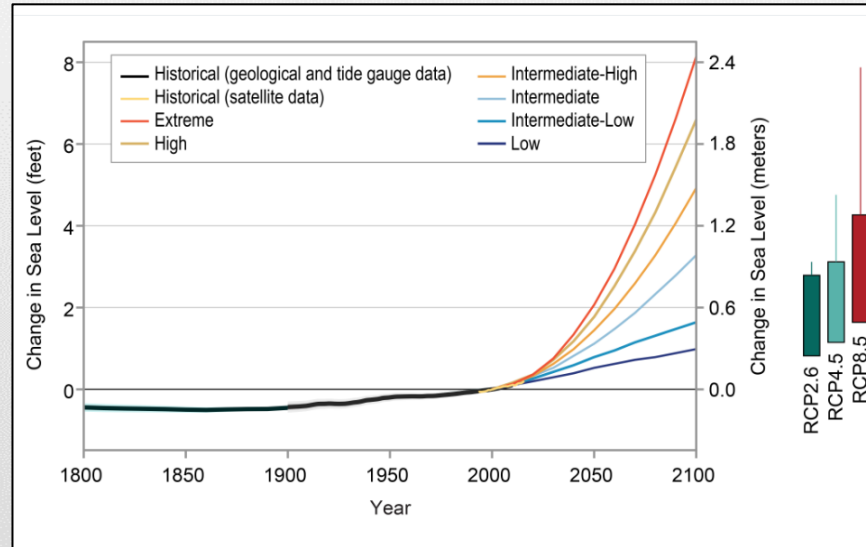
Building footprints, to include representations of critical assets for the model

Climate Stressors Used in the Model



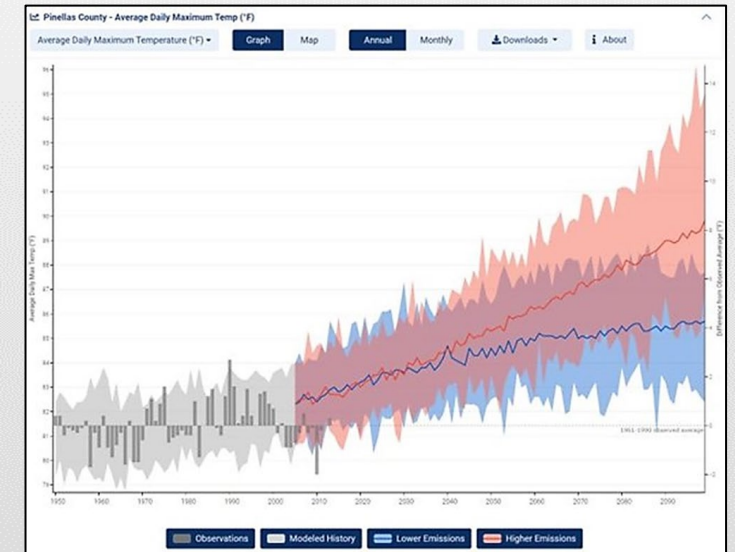
Future Rain

24% increase in 100-year
24-hour rainstorm by 2100



Future Sea Level

2017 intermediate-low and
intermediate-high projections for
2040, 2070, and 2100

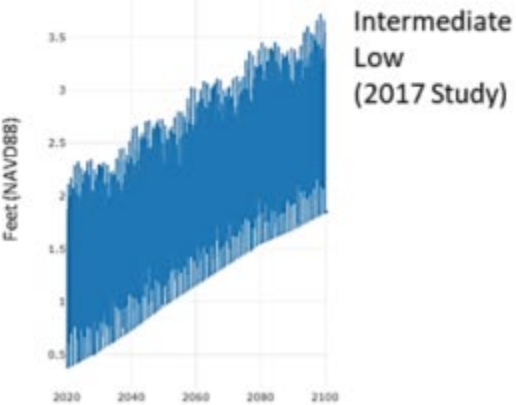
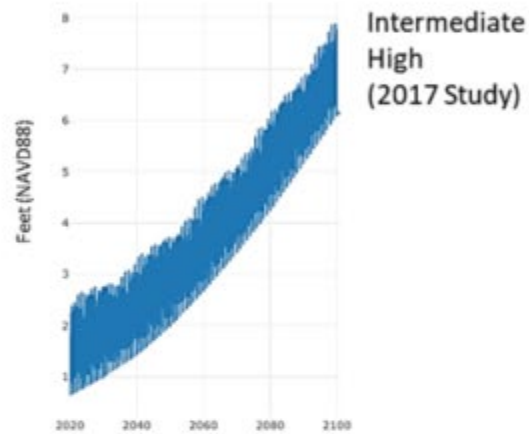


Future Temperature

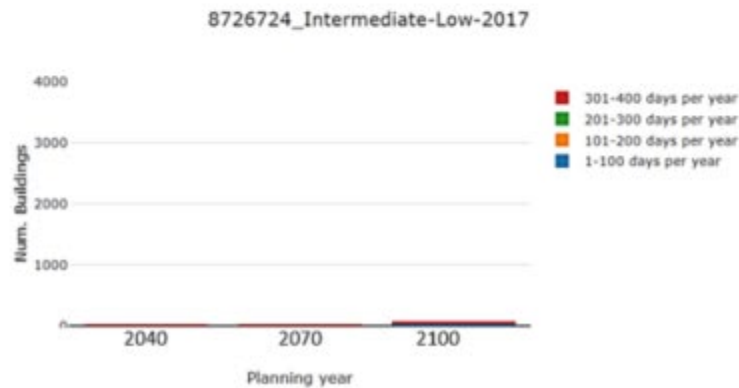
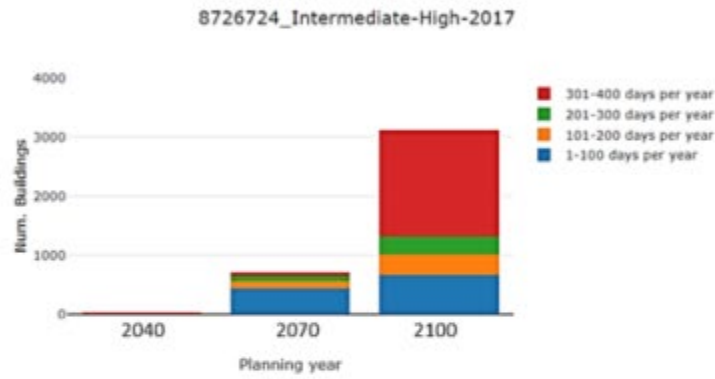
300% increase in days per year
where temperature is greater
than 90 degrees

Findings: Future Sea Level

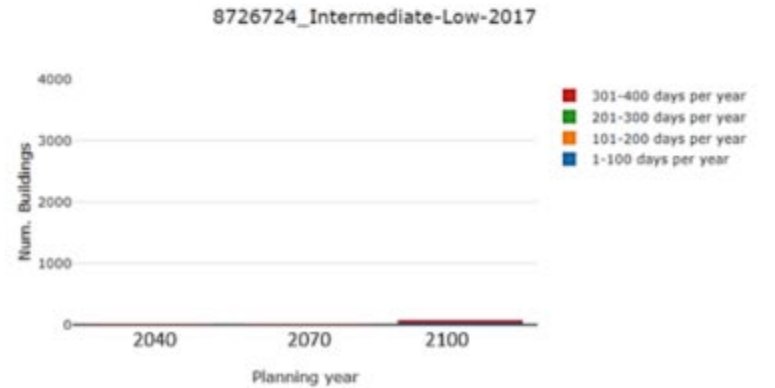
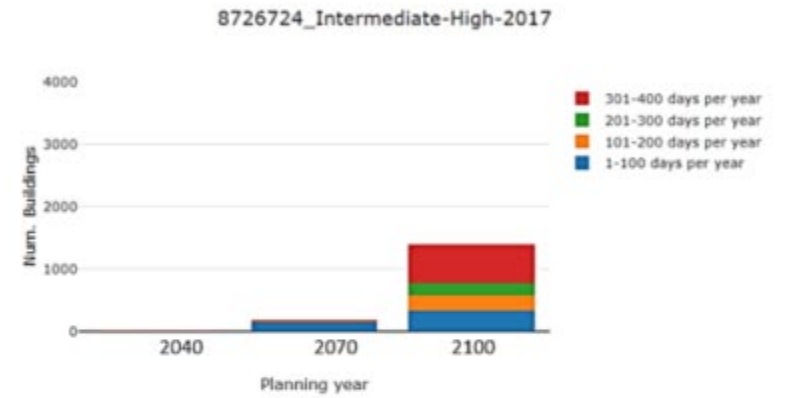
Buildings Inundated by SLR Scenarios



Parcels Inundated



Buildings Inundated



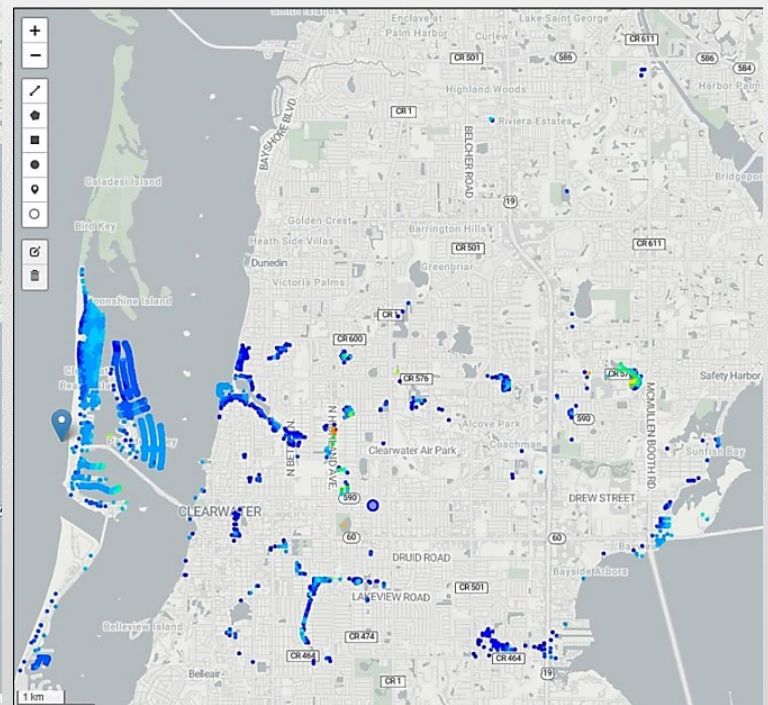
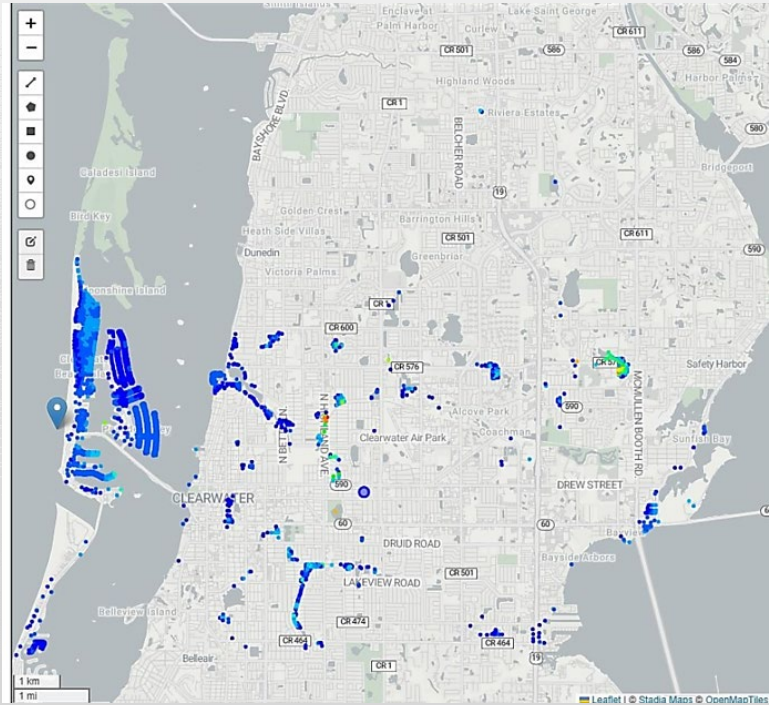
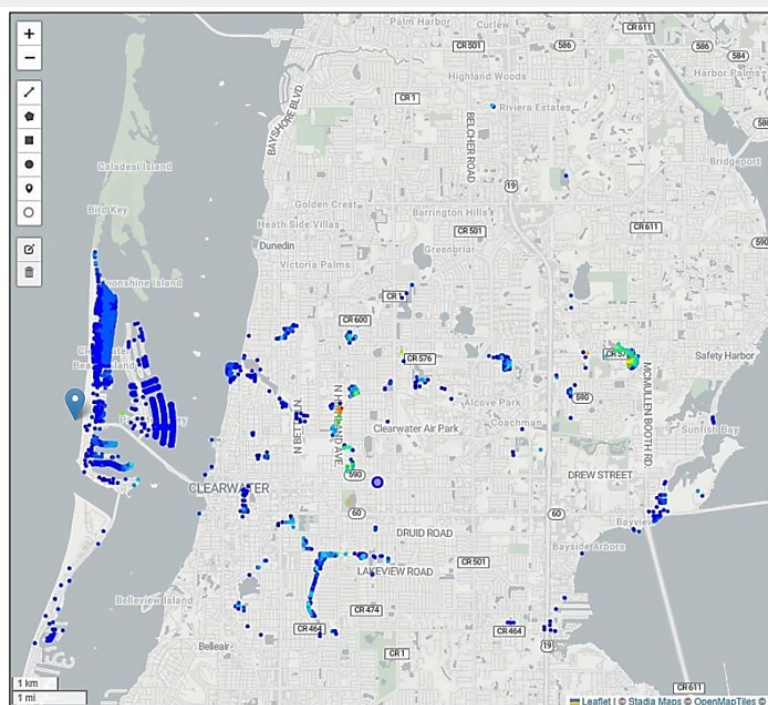
Increasing Flood Hazard Exposure

2017 Intermediate Low

2040

2070

2100



Legend

Flood Depth:
Intermediate
Low-2017 -
2100

Impacted:
2577

- >8 ft (1)
- 8 - 8.5 ft (0)
- 7.5 - 8 ft (0)
- 7 - 7.5 ft (9)
- 6.5 - 7 ft (5)
- 6 - 6.5 ft (5)
- 5.5 - 6 ft (8)
- 5 - 5.5 ft (5)
- 4.5 - 5 ft (10)
- 4 - 4.5 ft (8)
- 3.5 - 4 ft (24)
- 3 - 3.5 ft (39)
- 2.5 - 3 ft (322)
- 2 - 2.5 ft (979)
- 1.5 - 2 ft (724)
- 1 - 1.5 ft (380)
- 0.5 - 1 ft (58)
- 0 - 0.5 ft (0)

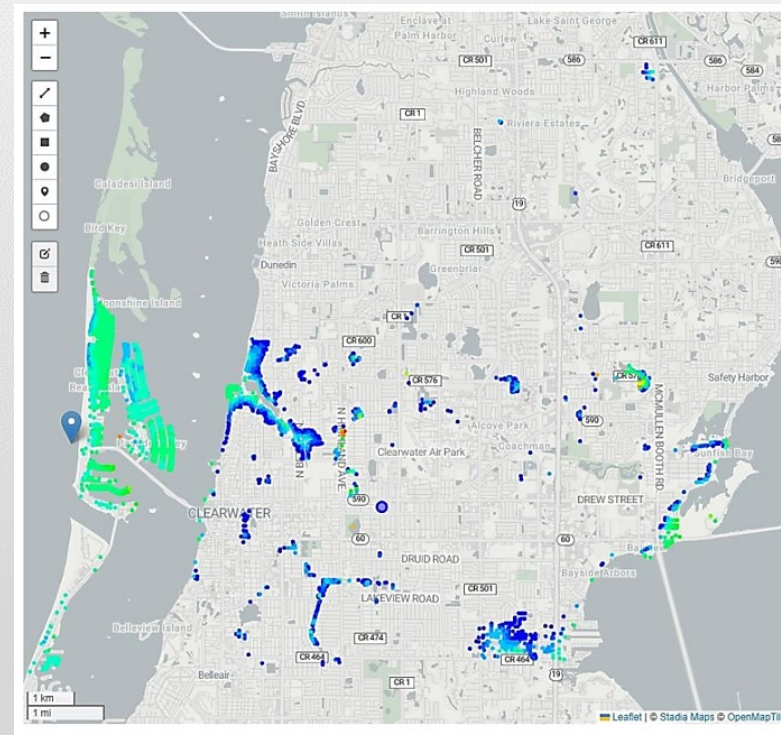
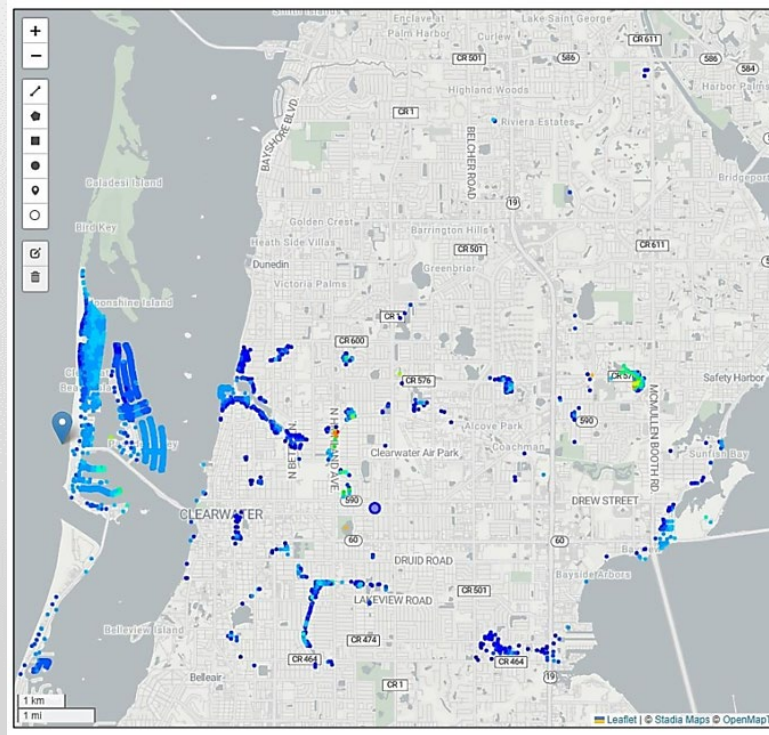
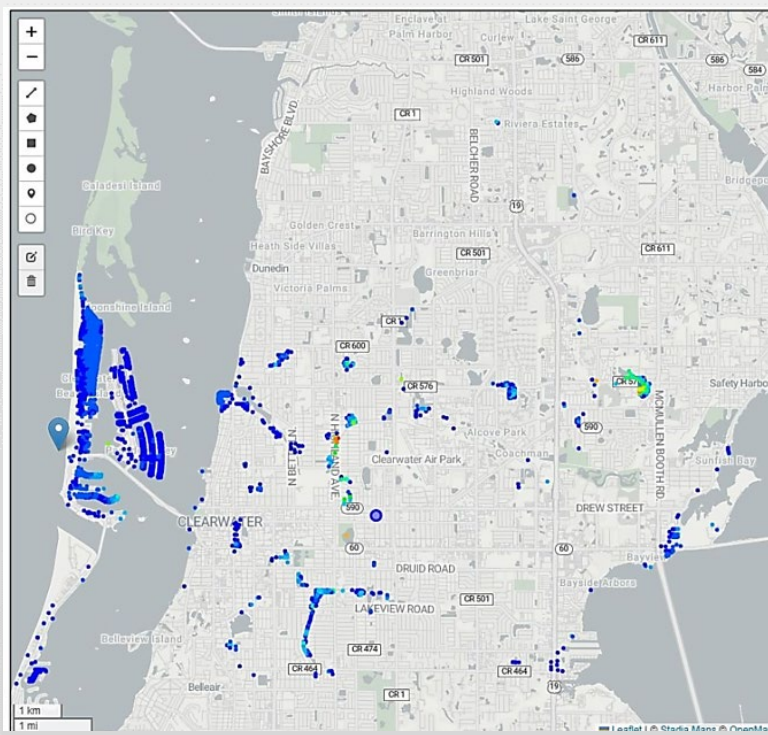
Increasing Flood Hazard Exposure

2017 Intermediate High

2040

2070

2100



Legend

Flood Depth:
Intermediate
High-2017 -
2100

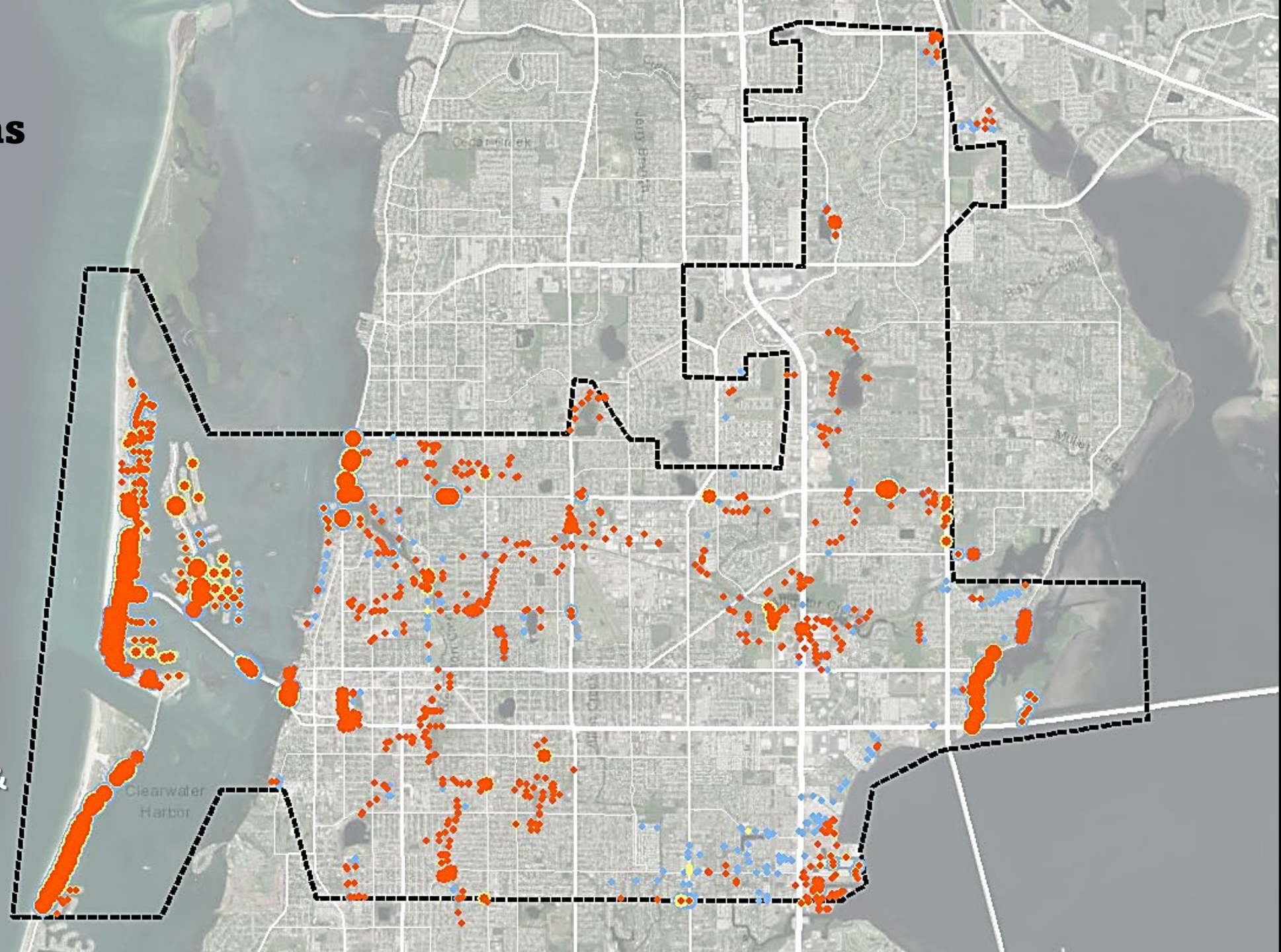
Impacted:
3215

>8 ft (1)
8 - 8.5 ft (0)
7.5 - 8 ft (0)
7 - 7.5 ft (10)
6.5 - 7 ft (5)
6 - 6.5 ft (5)
5.5 - 6 ft (7)
5 - 5.5 ft (9)
4.5 - 5 ft (31)
4 - 4.5 ft (70)
3.5 - 4 ft (879)
3 - 3.5 ft (760)
2.5 - 3 ft (360)
2 - 2.5 ft (274)
1.5 - 2 ft (296)
1 - 1.5 ft (462)
0.5 - 1 ft (46)
0 - 0.5 ft (0)

Findings: Trip Disruptions

424

Stormwater tracking
points with Avg.
Annual Disrupted
Trips > 10,000



Gulf of
Mexico

- Major disruptions in coastal islands
- N. Fort Harrison Ave & Sunset Point Rd
- Stevenson Creek area

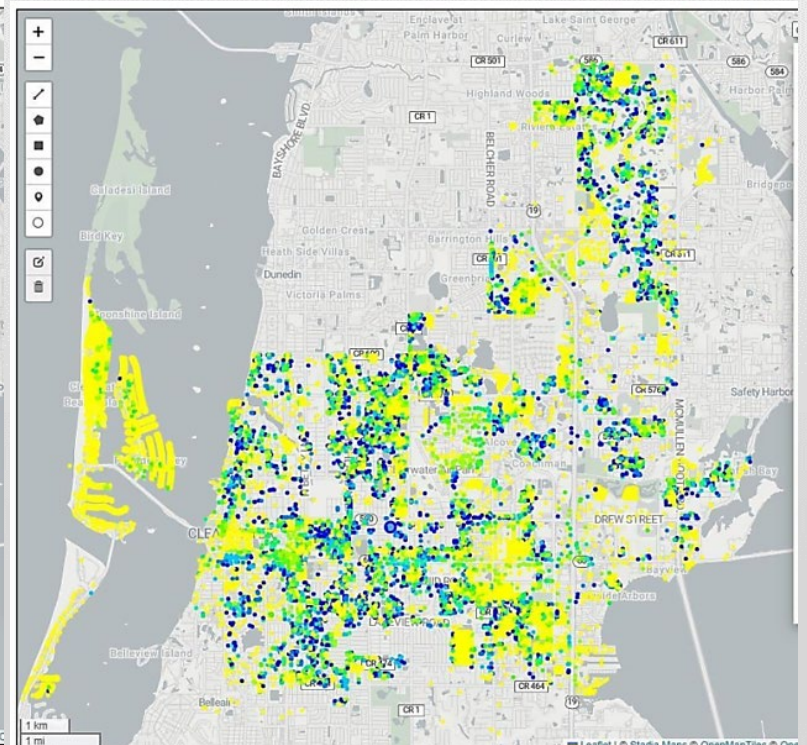
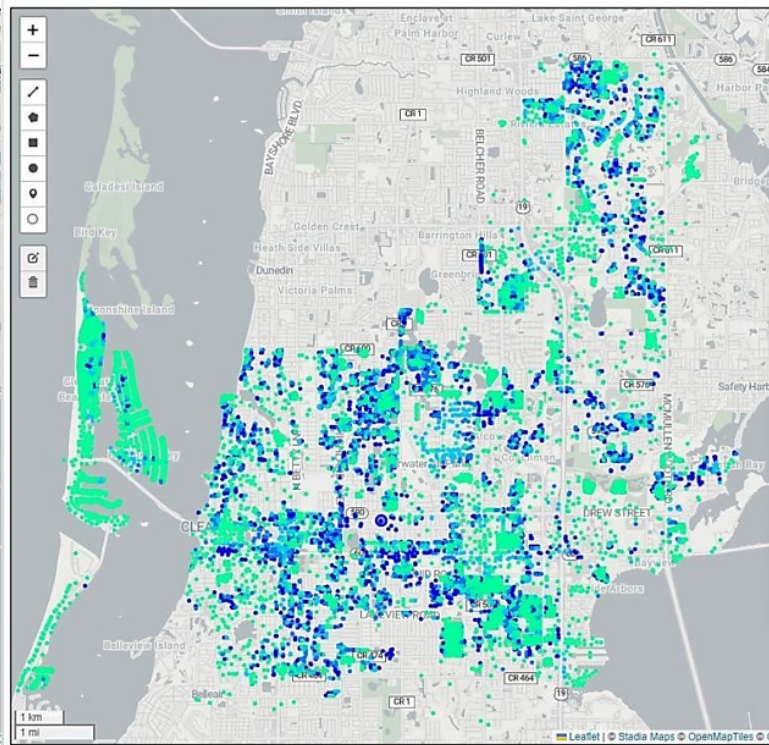
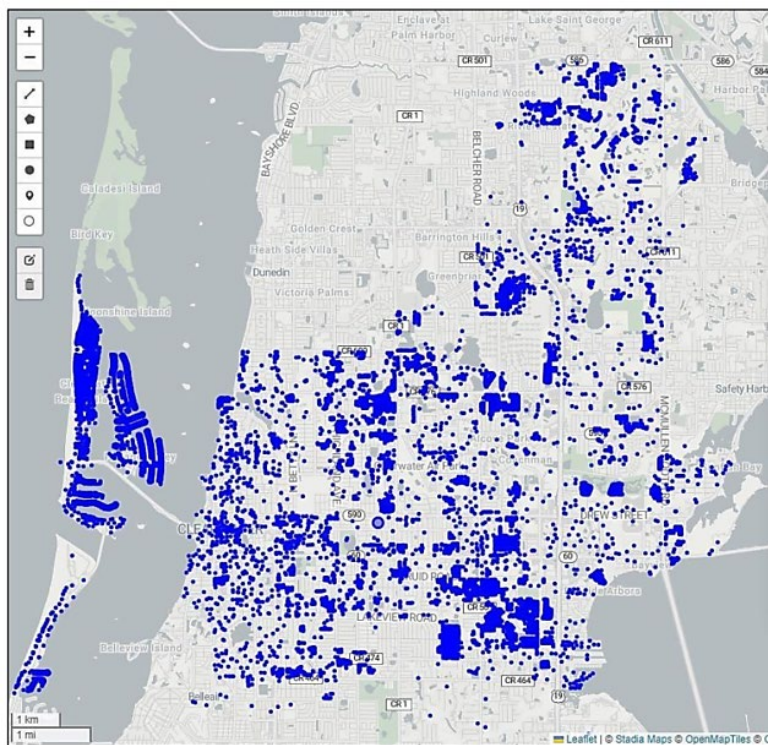
Findings: Future Temperature

Days above 90 degrees

2040

2070

2100



Legend

Days > 90F -
Intermediate
Low-2017 -
2100

>225 Days (0)

225 - 250
Days (0)

200 - 225
Days (0)

175 - 200
Days (9262)

150 - 175 Days
(2064)

125 - 150 Days
(1136)

100 - 125 Days
(613)

75 - 100 Days
(832)

50 - 75 Days
(911)

25 - 50 Days
(1009)

0 - 25 Days
(1619)

-25 - 0 Days
(0)

Scenario Development



Scenario Planning

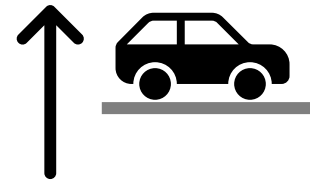
Project Action Team goals when identifying scenarios:

- Improve CRS rating to help reduce resident flood insurance premium costs
- Reduce flooding and impacts to residents and businesses
- Most impactful locations to improve urban forest
- Target revitalization and redevelopment funding and craft regulations or land uses
- Gain knowledge on seawall elevations
- **Identify specific projects that city can target to have largest ROI**

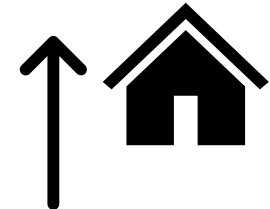
10 scenarios originally tested, plus 5 additional scenarios

A scenario includes a geographic area of interest and 1 or more adaptation actions to test.

Potential actions included:



Elevate Roads



Elevate Houses



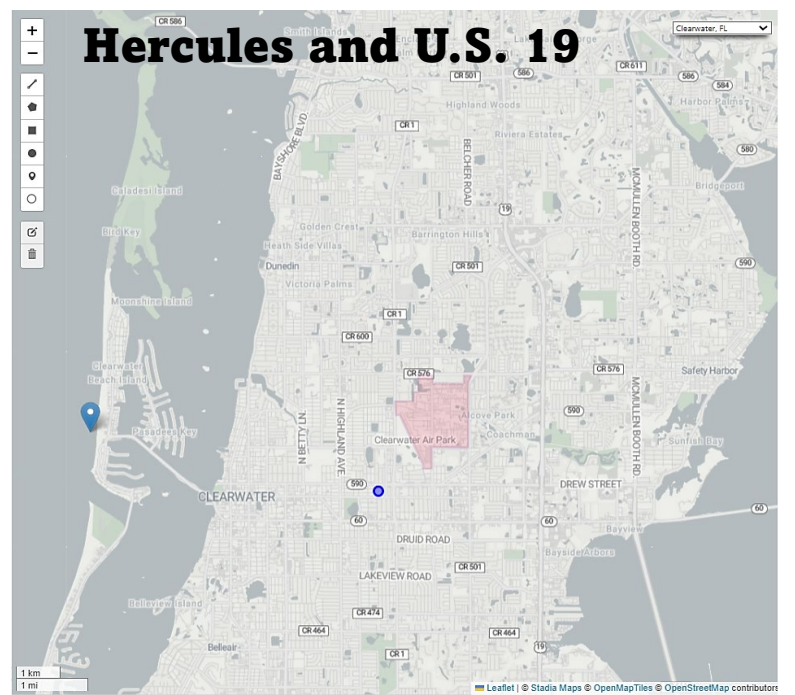
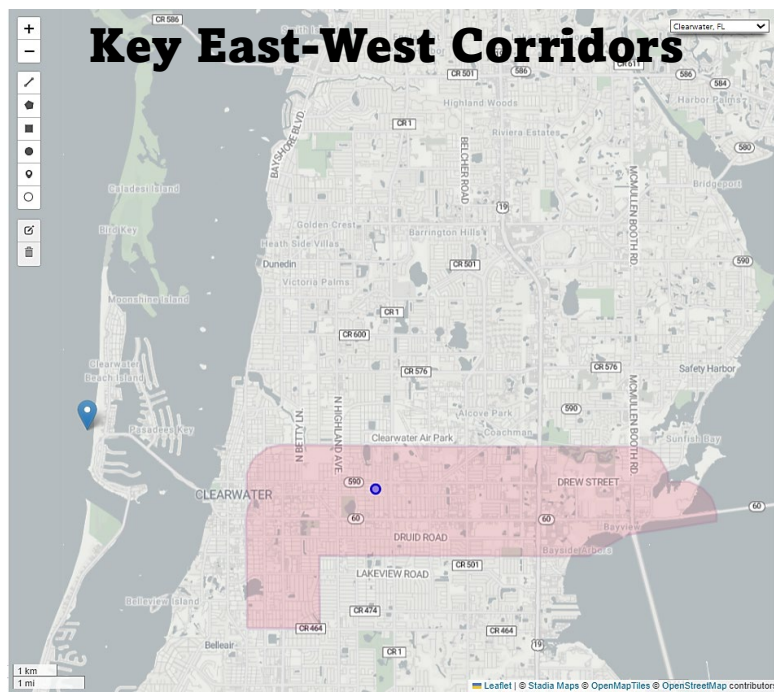
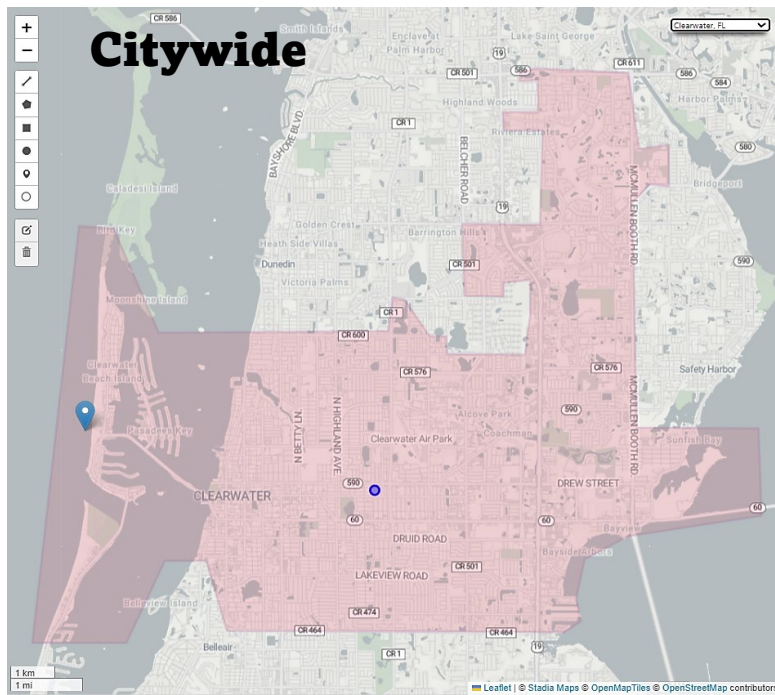
Acquire Houses



Add Coastal Barrier

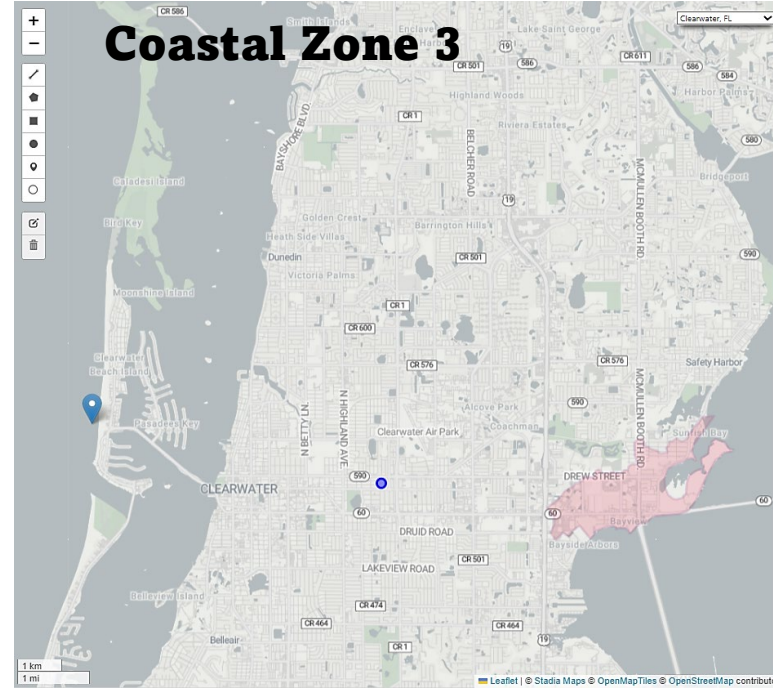
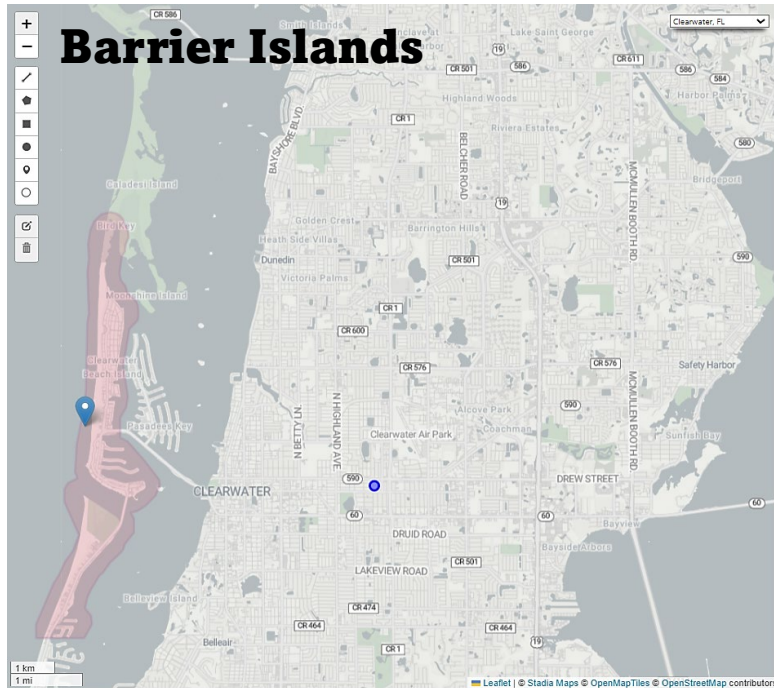


Plant Trees

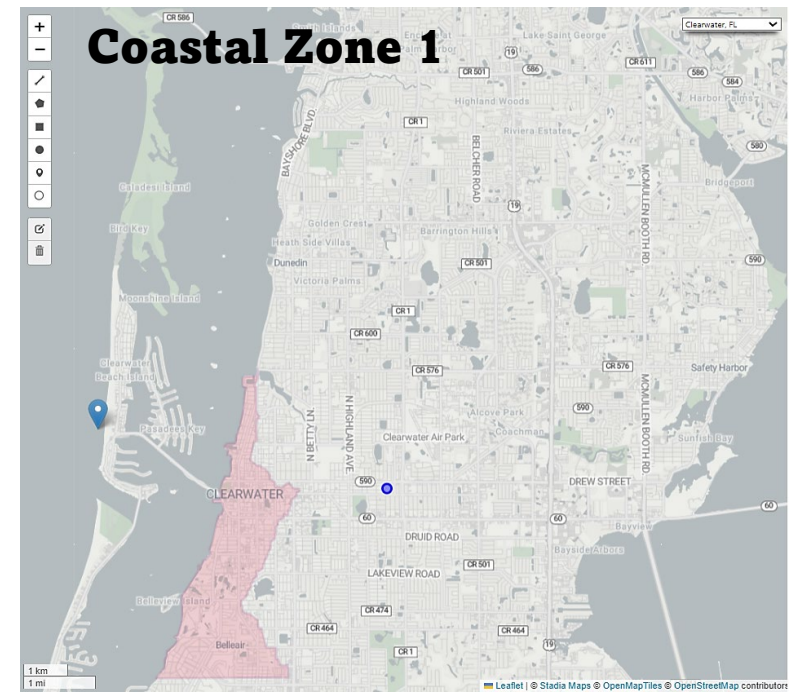
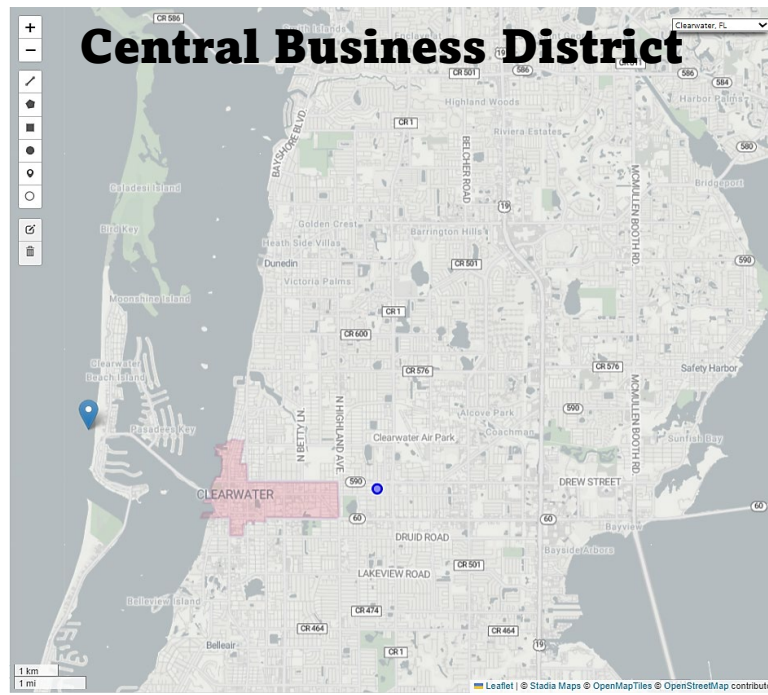
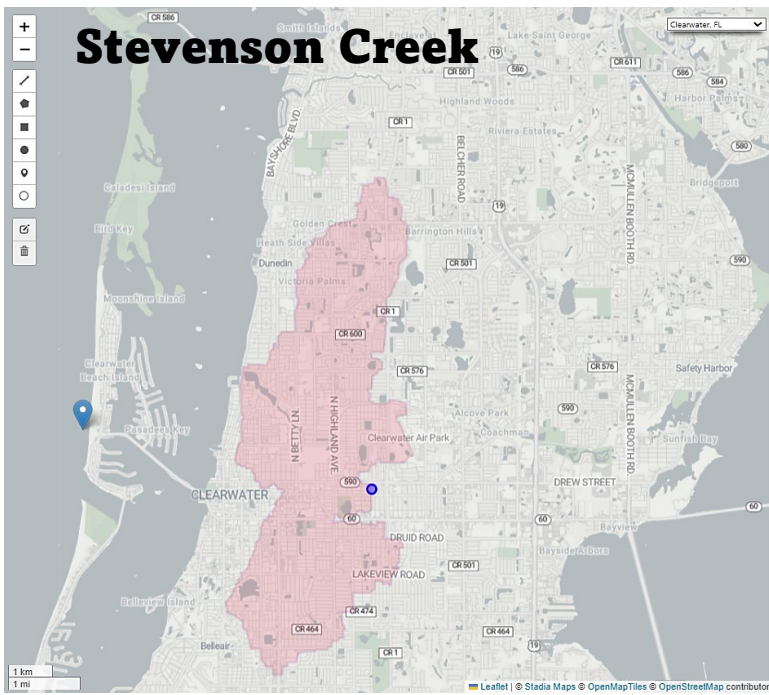


Areas of interest were selected based on

- hazard exposure
- economic development
- social vulnerability concerns

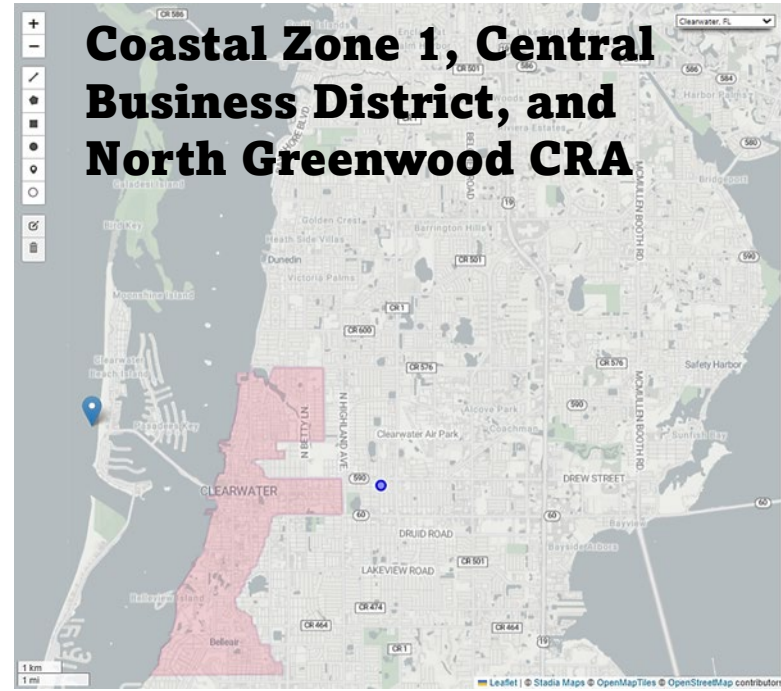
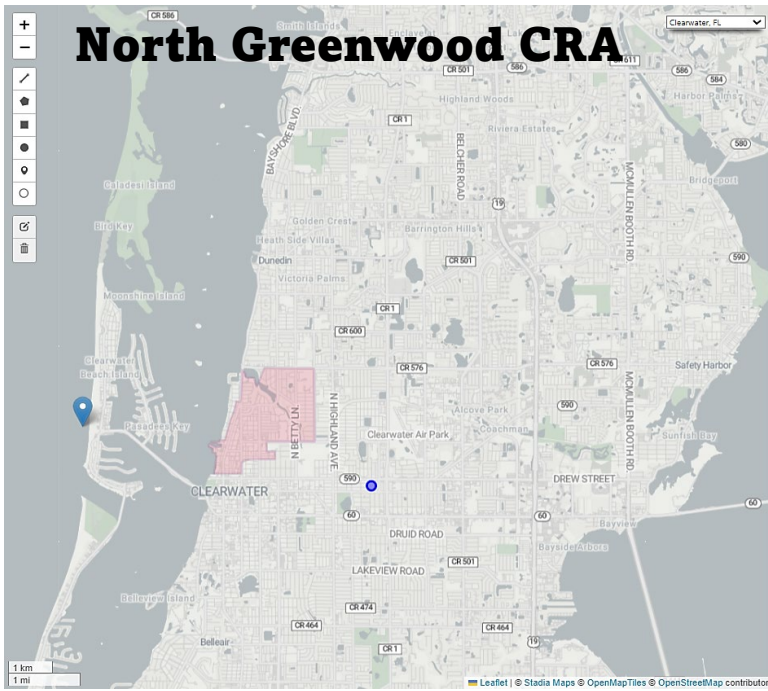


Note: Additional areas of interest can be added for future planning



Areas of interest were selected based on

- hazard exposure
- economic development
- social vulnerability concerns



Note: Additional areas of interest can be added for future planning

Scenario 1: Stevenson Creek - Acquire Homes and Elevate Roads

Full Cost Estimate

- Cost of implementation: \$197,340,000
- Number of Projects: 79 Projects
 - Elevate Roads: 8 Projects
 - Acquire Buildings: 71 Projects

75% of Cost Estimate

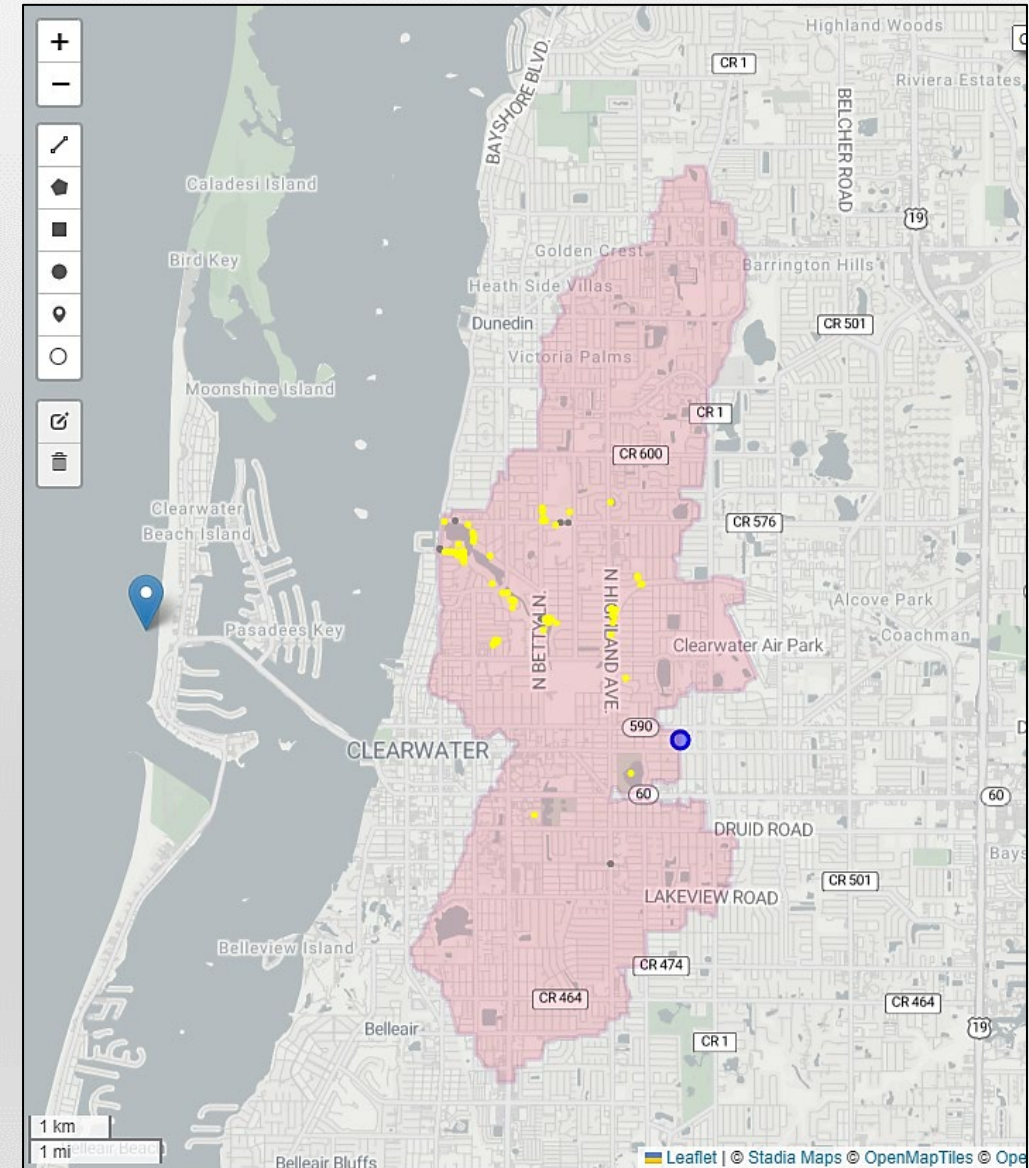
- Cost of implementation: \$145,600,000
- Number of Projects: 44 Projects
 - Elevate Roads: 8 Projects
 - Acquire Buildings: 36 Projects

50% of Budget

- Cost of implementation: \$101,000,000
- Number of Projects: 35 Projects
 - Elevate Roads: 5 Projects
 - Acquire Buildings: 30 Projects

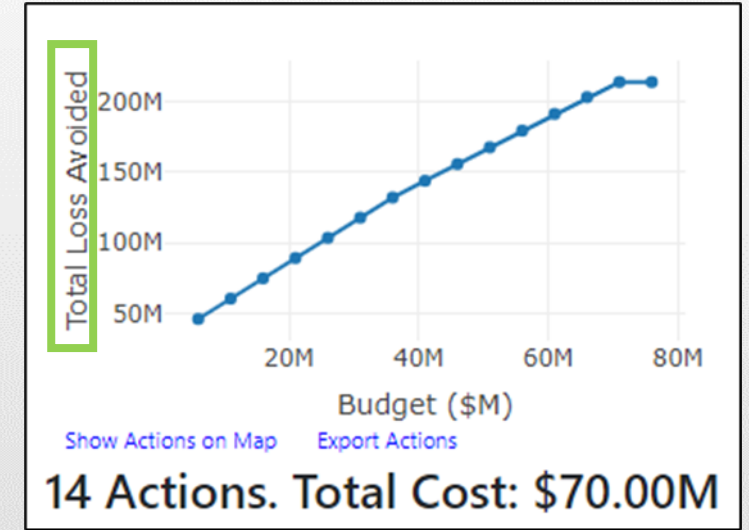
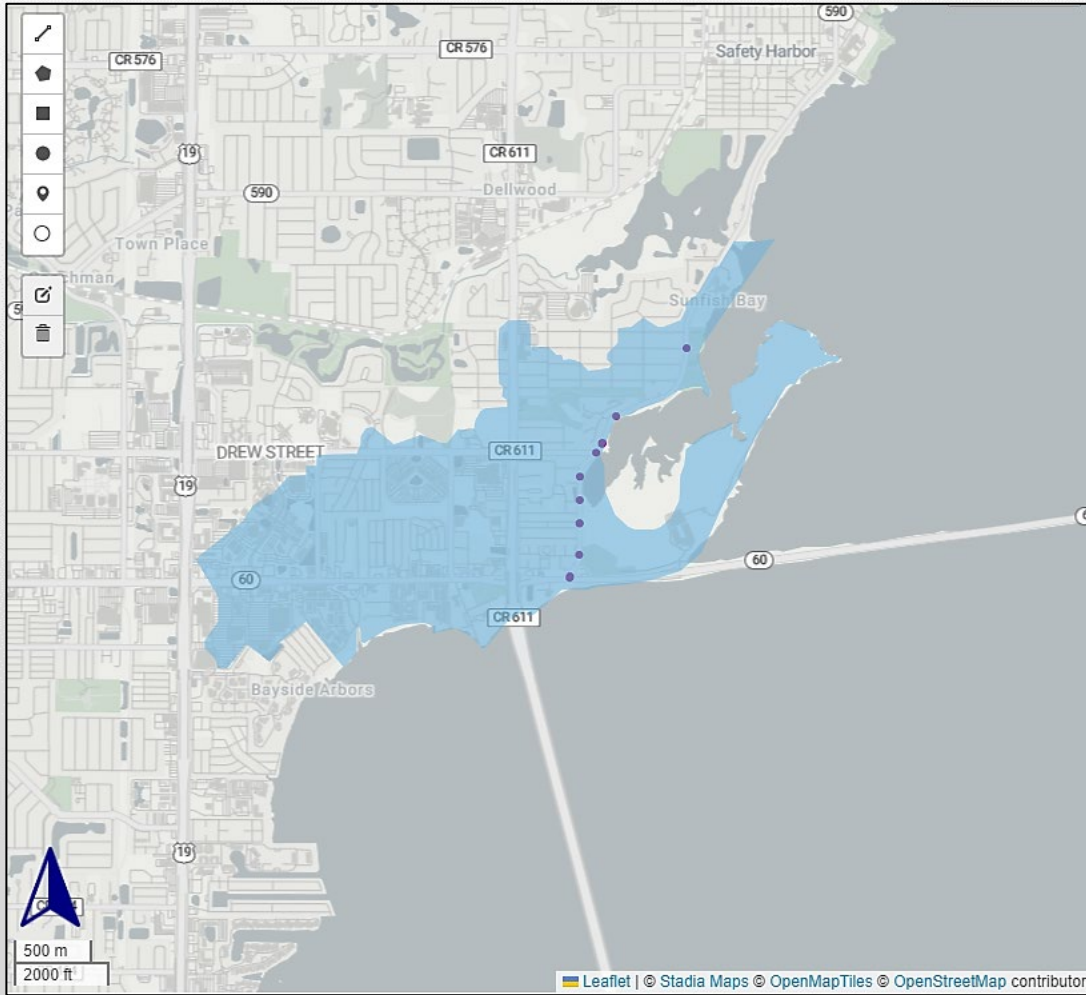
25% of Project Costs

- Cost of implementation: \$51,000,000
- Number of Projects: 22 Projects
 - Elevate Roads: 4 Projects
 - Acquire Buildings: 18 Projects



Graphics and scenarios shown are not meant to imply that the City would take these actions. This is a planning-level tool that lets the City select adaptation actions and geographies of interest to help inform future strategic actions that may be considered.

Scenario 4: Coastal Zone 3 – Elevate Roads



100% of Potential Costs (All projects)

- Cost of implementation: \$71,000,000
- Number of Projects: 14 Projects

75% of Project Costs

- Cost of implementation: \$50,000,000
- Number of Projects: 10 Projects

50% of Project Costs

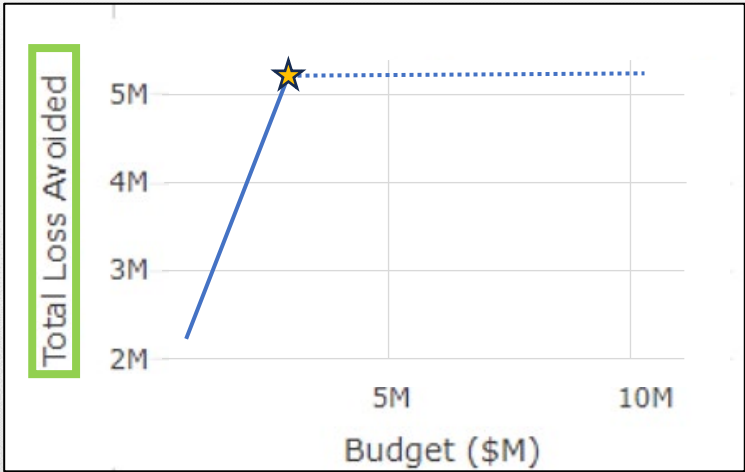
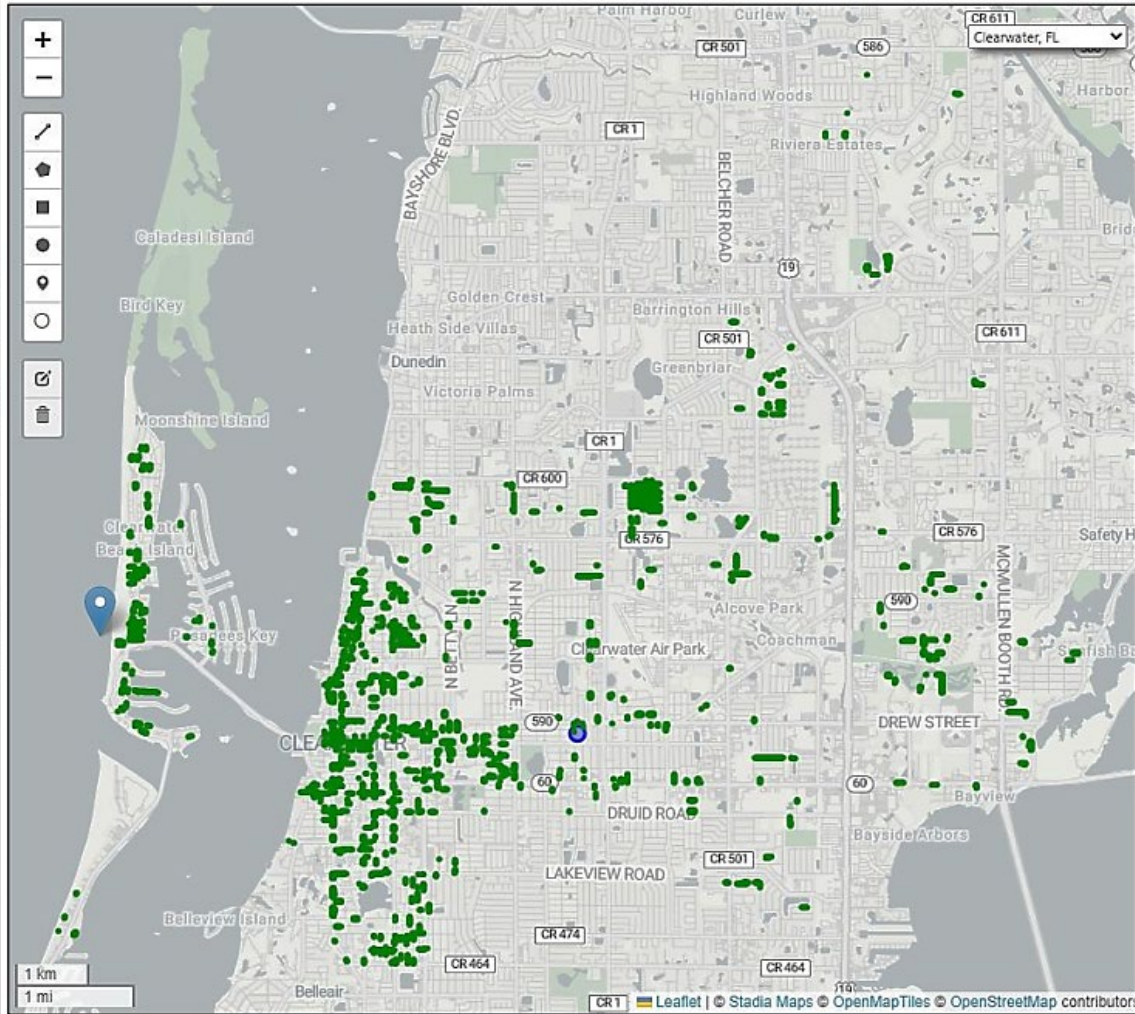
- Cost of implementation: \$35,000,000
- Number of Projects: 7 Projects

25% of Project Costs

- Cost of implementation: \$16,000,000
- Number of Projects: 3 Projects

Graphics and scenarios shown are not meant to imply that the City would take these actions. This is a planning-level tool that lets the City select adaptation actions and geographies of interest to help inform future strategic actions that may be considered.

Scenario 2: Citywide – Increase Tree Coverage



Full Cost Estimate

- Cost of implementation: \$3,620,000
- Number of Projects: 7,248 Projects
- Total Loss Avoided: \$5,080,000

Tremendous social wellbeing benefits including human health, air quality, shading/cooling, habitat and biodiversity improvements etc.

Graphics and scenarios shown are not meant to imply that the City would take these actions. This is a planning-level tool that lets the City select adaptation actions and geographies of interest to help inform future strategic actions that may be considered. For example, some tree plantings may not be physically possible in locations, and some locations may not be recommended for plantings per advice of landscape architects.

Future Actions to Consider



Recommended Adaptation/Mitigation Actions

The following portfolio of actions could be considered to minimize the flooding and heat vulnerabilities identified within the vulnerability assessment.

Increase Awareness

- Resilience Awareness Campaign
- Public Surveys
- Additional Sensors in Flood-prone Areas
- Obtain Finished Floor Elevations
- Neighborhood Programs
- **Encourage/Purchase Flood Insurance**

Policy/Planning

- Clearwater 2045
- Reduce Building in Floodplain
- Reduce Building in Coastal Buffer
- Land Acquisition
- Resiliency Bond Financing
- Position for Grants
- Incentivize DIY Flood Protection
- Improve Community Rating System Score

General Infrastructure Improvement

- **Improve Stormwater Quality**
- Add Stormwater Park
- **Apply Greenprint 2.0**
- **Add Rain Gardens**
- **Add Native Plants**
- **Living Shorelines**
- **Reduce Pollutant Loading to Waterways**
- Constructed Wetlands
- **Permeable Pavements**
- **Urban Forestation**
- **Rooftop Runoff Storage**

Physical Countermeasures to Climate Change

- **Elevate Buildings**
- Acquire Flood-prone Structures
- Raise Streets
- **2nd Floor Conversion**
- **Add Living Shoreline/Seawall**
- **Raise Seawall**
- **Floodproofing**
- Improve Culvert/Bridge
- **Tree Plantings**

***Bold green text** represents actions that could potentially be performed by the public as well*

Benefits

- Data-driven process
- Able to support grant processes and requirements
- Incorporates how the community functions (traffic, housing, job occupations, etc.)
- Provides a planning tool to stress test the city for expected climate impacts



Staff have access to data afterward



Related Programs and Further Information

Greenprint 2.0

Home / Sustainability & Greenprint 2.0 / Clearwater Greenprint

Clearwater Greenprint

- Executive Summary
- Sustainability
- Community Resiliency
- Measuring Our Greenhouse Gases
- 2007 GHG Emission Levels
- Target Timelines
- How to Read Clearwater Greenprint 2.0
- Green Glossary
- Credits & Acknowledgements
- Appendices and Other Resources
- Navigate to Other Greenprint Sections

Policies and recommendations supporting the City's sustainability vision.

Clearwater 2045

Home / Business & Development / City Projects / Comprehensive Plan

Comprehensive Plan

Plan Documents

View the Comprehensive Plan documents and maps by chapter:

- Full Plan (PDF, 62MB)
- Executive Summary (PDF, 2MB)
- Introduction (PDF, 3MB)
- Quality Places (PDF, 18MB)
- Mobility (PDF, 9MB)
- Parks & Public Places (PDF, 5MB)
- Conservation & Coastal Management (PDF, 13MB)
- Support Services (PDF, 6MB)
- Plan Implementation (PDF, 6MB)

CLEARWATER 2045

A bright and beautiful future.

After a multi-year and -departmental effort, the Planning and Development Department is pleased to announce that City Council approved Clearwater 2045 at its January 18, 2024 meeting.

What is a Comprehensive Plan?

Policy document with a 20-year vision that guides decisions on the future growth and sustainability of the city.

Floodplain Management

Home / My Government / City Departments / Public Works / Floodplain Management

Floodplain Management

The Federal Emergency Management Administration updated the Flood Insurance Rate Map (FIRM) for the coastal areas of Pinellas County, and changes were effective in August 2021.

Property owners are encouraged to [find out if their flood zone or base flood elevation has changed by](#)

Supporting Maps/Figures

- Clearwater Landmass Including Special Flood Hazard Area (PDF, 191KB)
- FEMA SFHA with Stormwater Drainage Basins (PDF, 204KB)

Resources to help residents and businesses understand flood risk.

Email: Sustainability@myclearwater.com

Vulnerability Assessment Project Website:
myclearwater.com/vulnerability

Scan QR code
to visit project
website

