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GIS MODELLING OF URBAN FLOOD PRONE AREAS

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Objective

- New Haven Harbor is one of the largest flood prone areas in the Connecticut coastal line.
- Our first goal is to simulate different flood scenarios (using FUNWAVE) and merge the results with Open Street Maps shapefiles (buildings and streets) and Geocoded shapefiles (Lifelines) to understand what features are going to be affected by different extreme flood events.
- The second goal is to simulate the same extreme flood event with and without flood control structures (using ADCIRC) and analyze how the number of affected roads and buildings is going to change.

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FUNWAVE: Nearshore Model

- High resolution wave model that simulates storm surge, waves and high tides.
- FUNWAVE-TVD: phase resolving wave model
- Advantage: model nonlinear coastal wave processes in complex environments
- Grid resolution is 2m (6.5ft). Open boundary conditions from CIRCA's FVCOM-SWAVE model
- Performed on New Haven Harbor

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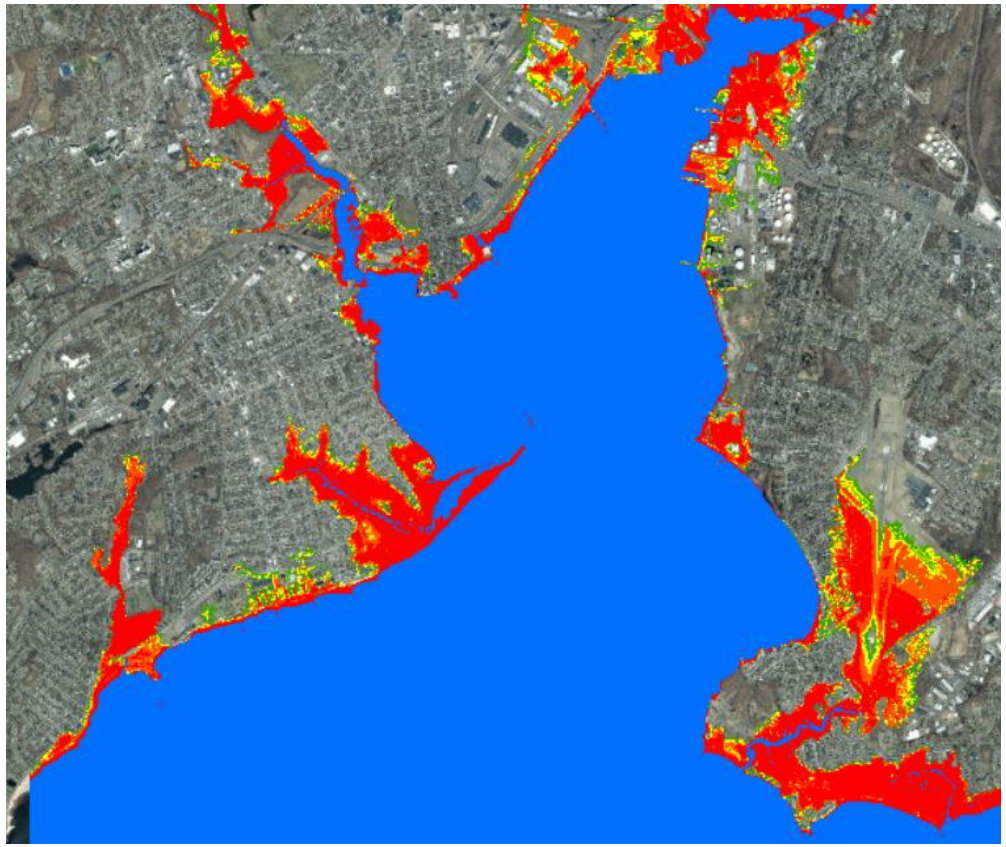
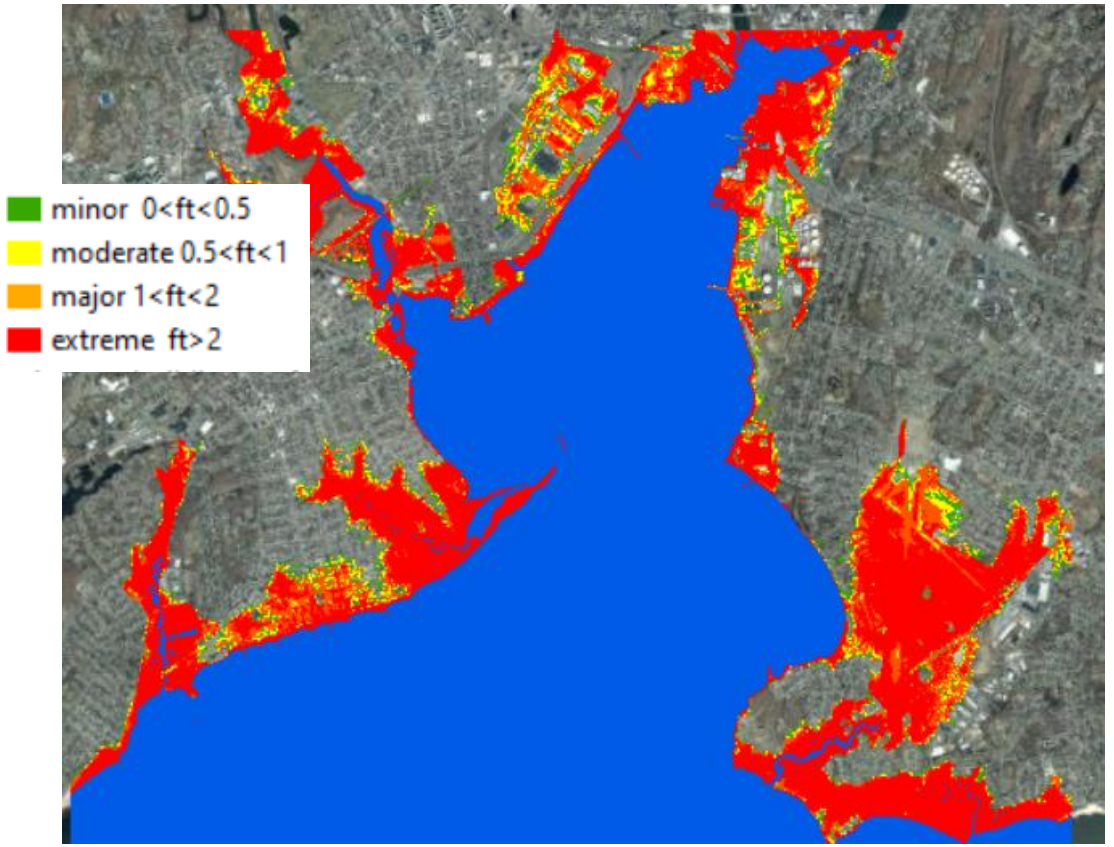
FUNWAVE Analysis

- The main goal of this project is to better understand how the New Haven Harbor Community is going to be affected by different flooding scenarios
- This study analyzed four different scenarios:
  - Scenario with a **return period** for a **10-year** flood event
  - Scenario with a **return period** for a **10-year plus 20 inches** flood event
  - Scenario with a **return period** for a **100-year** flood event
  - Scenario with a **return period** for a **100-year plus 20 inches** flood event
- For each scenario we will show which Roads, Buildings and Lifelines are going to be flooded and the flood severity for each feature





New Haven Harbor:
10yr+20inches VS 100yr+20inches

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FLOOD FACTS FOR DRIVING
- Six inches of water will reach the bottom of most passenger cars causing loss of control and possible stalling.
- A foot of water will float many vehicles.
- Two feet of rushing water can carry away most vehicles including sport utility vehicles (SUV's) and pick-ups.
pennsylvania
DEPARTMENT OF TRANSPORTATION

safe 0<ft<0.5
unsafe 0.5<ft<1
floating vehicles 1<ft<2
carry away vehicles ft>2

Roads:
10yr+20in VS 100yr+20in

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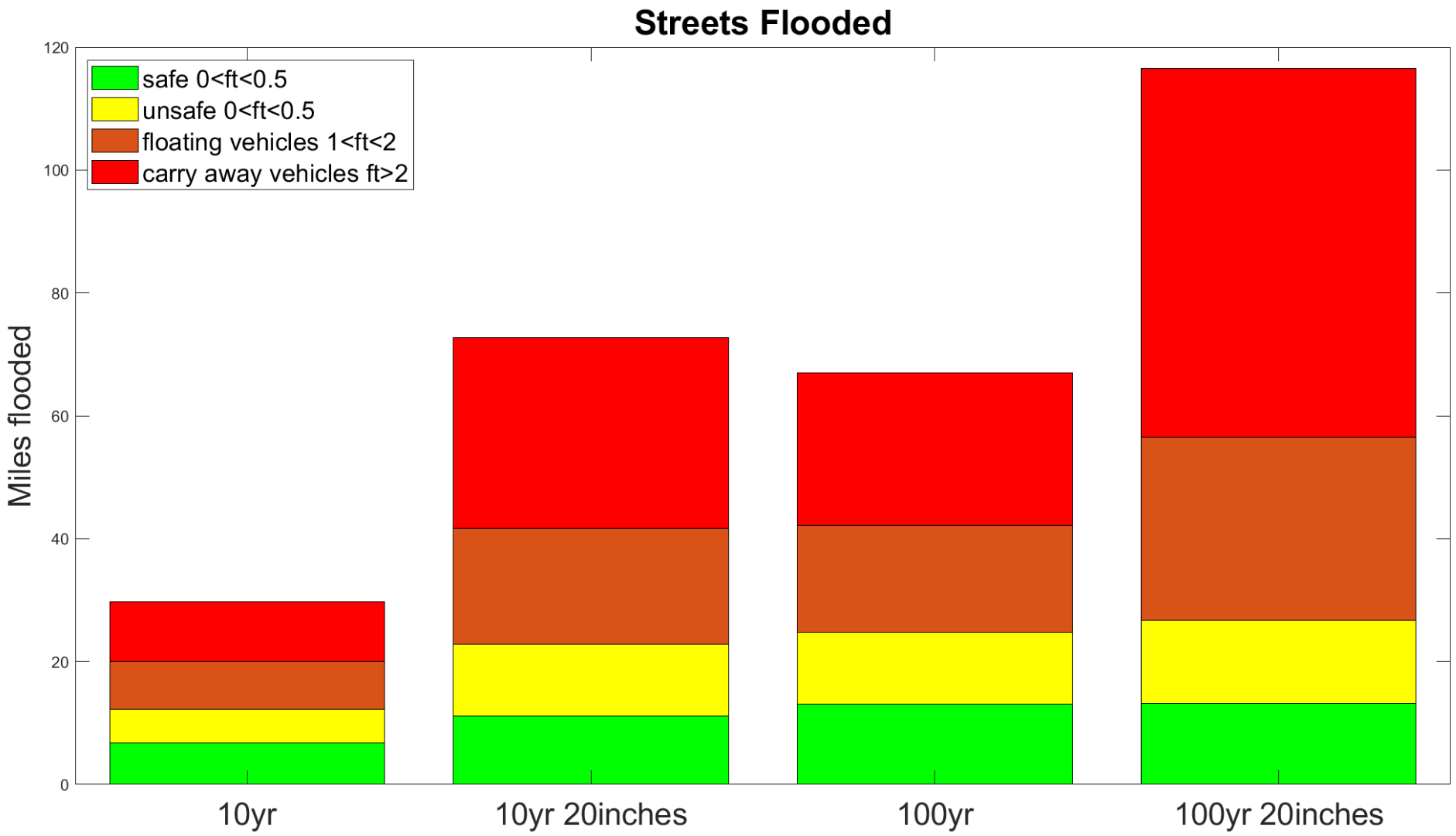
Streets Flooded
safe 0<ft<0.5
unsafe 0<ft<0.5
floating vehicles 1<ft<2
carry away vehicles ft>2
Miles flooded
120
100
80
60
40
20
0
10yr
10yr 20inches
100yr
100yr 20inches

Building:
10yr+20in VS 100yr+20in

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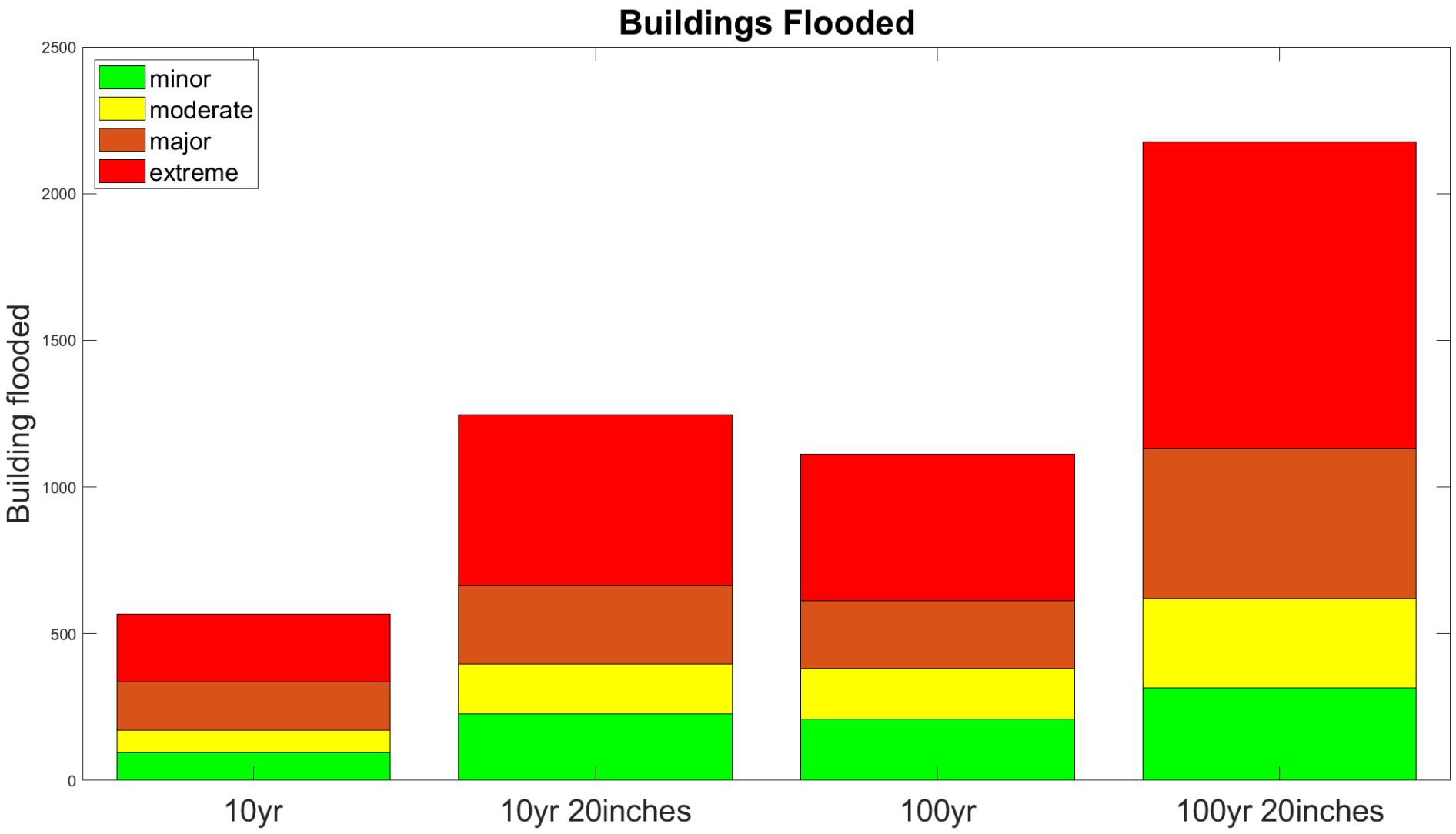
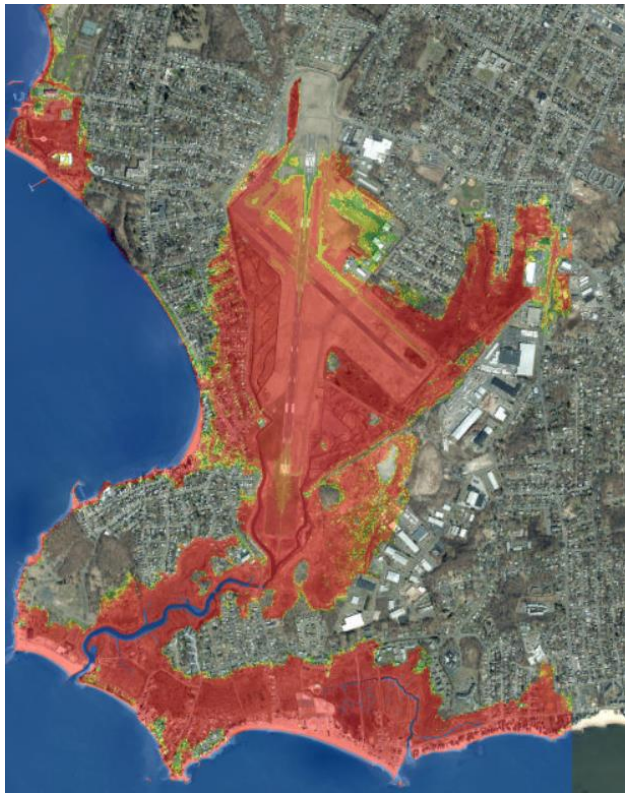

Buildings Flooded
minor
moderate
major
extreme
Building flooded
2500
2000
1500
1000
500
0
10yr
10yr 20inches
100yr
100yr 20inches



Zoom on New Haven Airport area : 10yr+20in VS 100yr+20in

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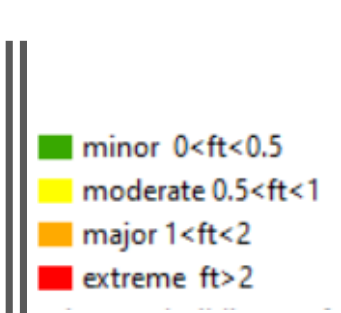
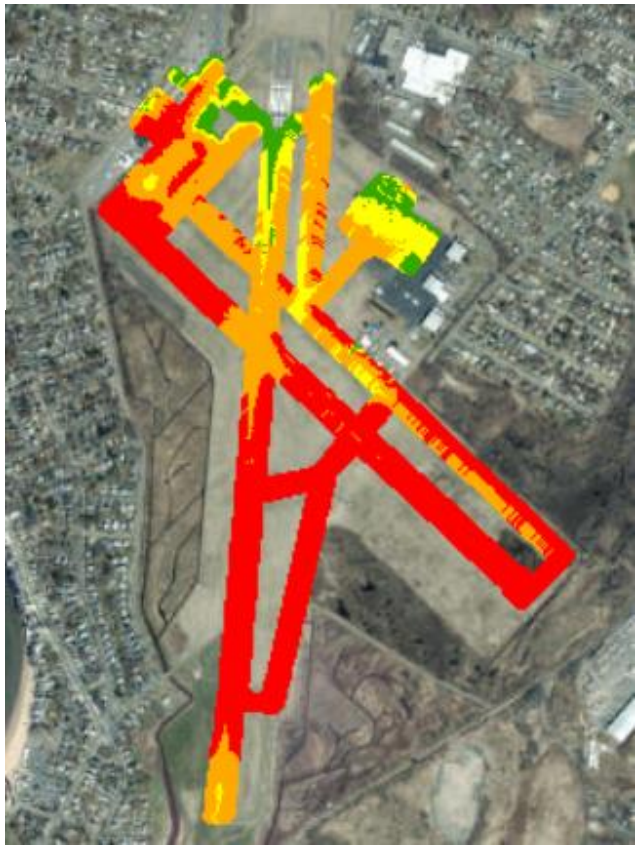
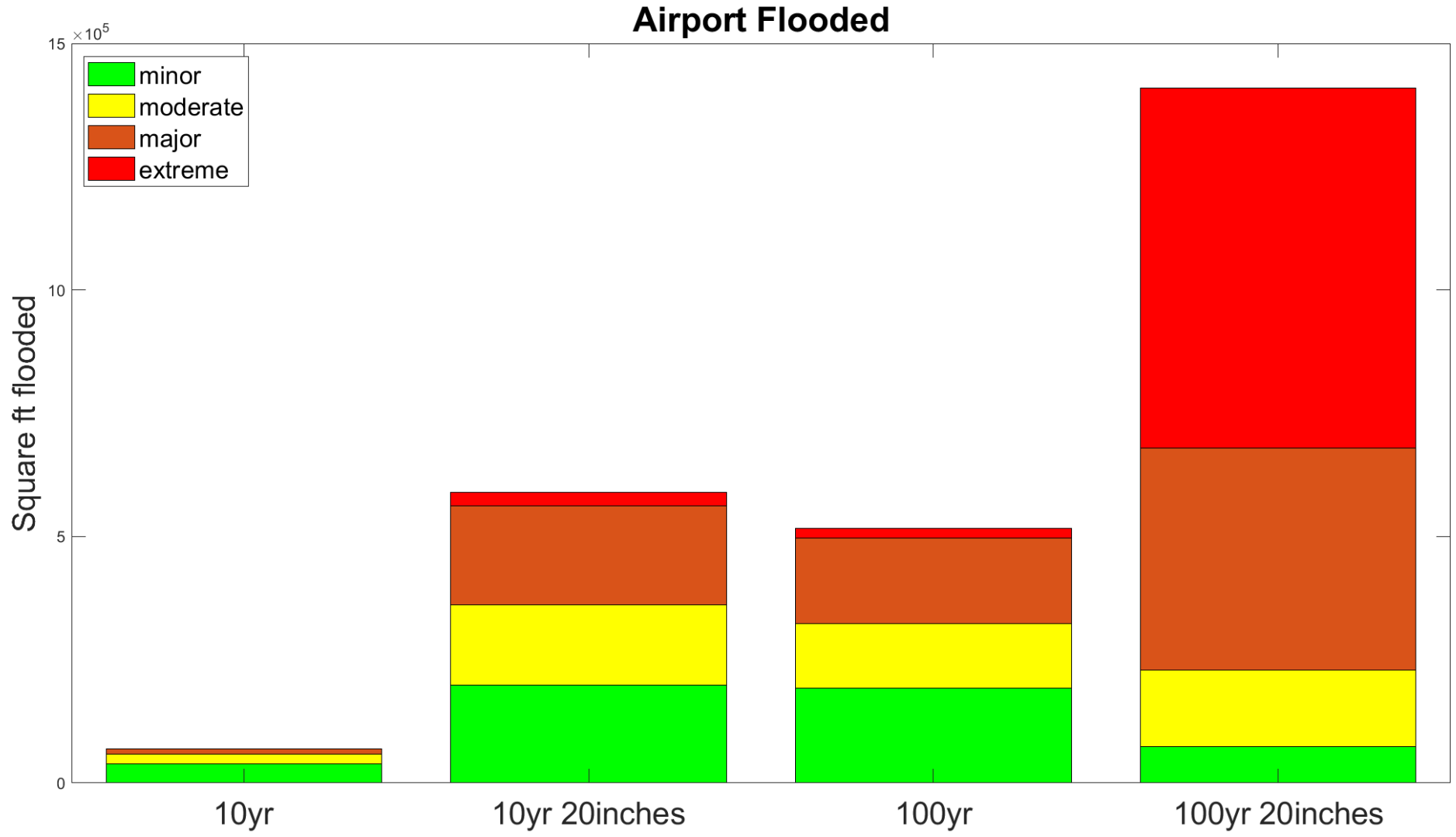




Tweed New Haven Airport: 10yr+20in VS 100yr+20in


Airport Flooded
×10^5
15
10
5
0
Square ft flooded
minor
moderate
major
extreme
10yr
10yr 20inches
100yr
100yr 20inches

A lifeline enables the continuous operation of **government functions** and **critical business** and is essential to **human health** and **safety** or **economic security**.

Description of the FEMA Community Lifeline Concept (FEMA, 2019).

The **Community Lifelines** concept was born as a result of the numerous unprecedented multi–billion-dollar disasters that occurred in 2017 and 2018. The Community Lifelines concept is a framework for incident management that provides emergency managers with a reporting structure for establishing incident stabilization. Introducing the Community Lifelines at the federal level was a necessary change, as it allows

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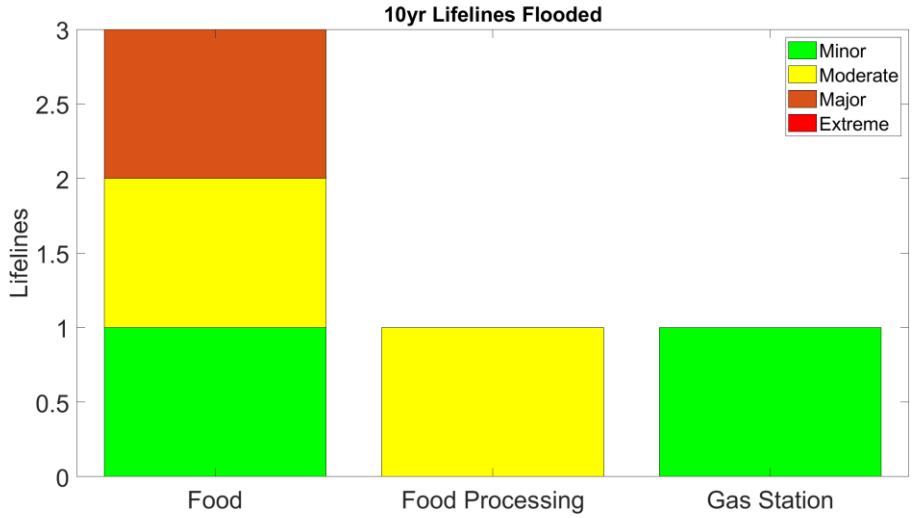

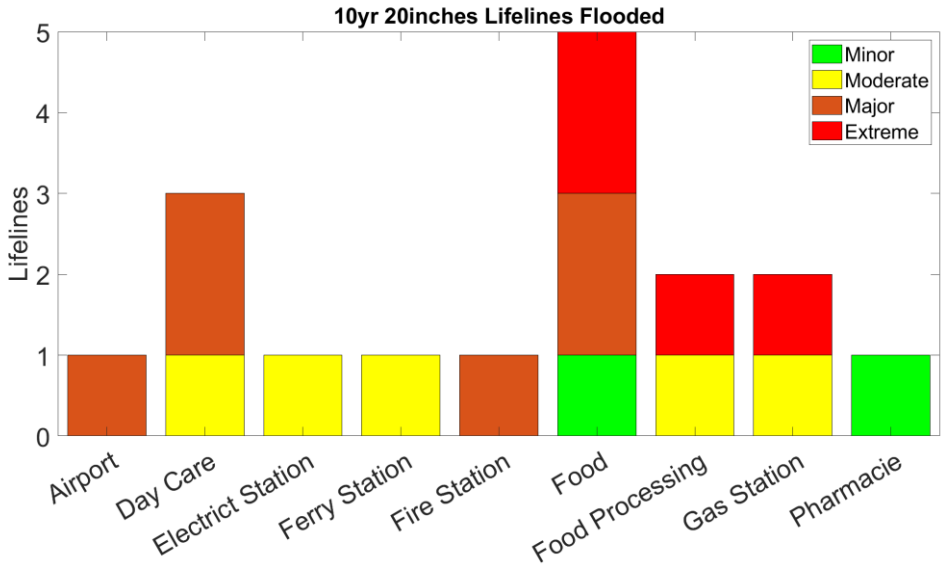

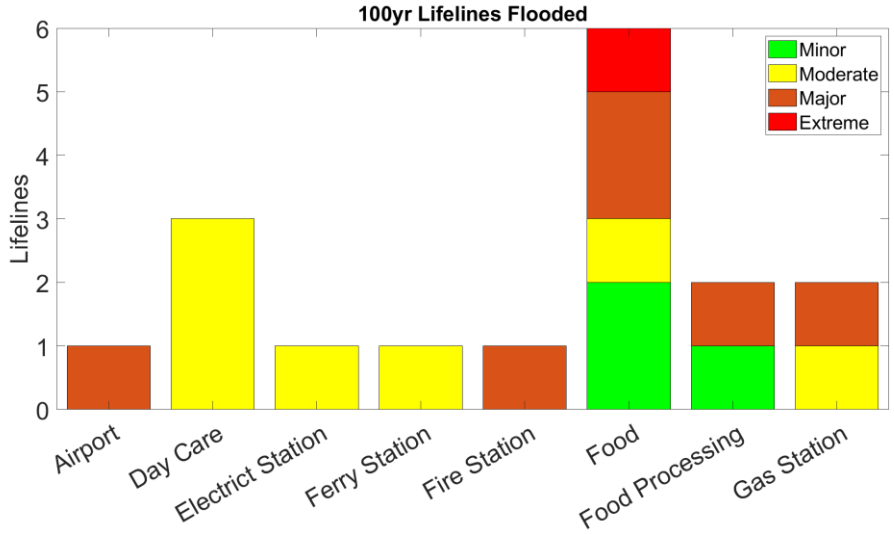

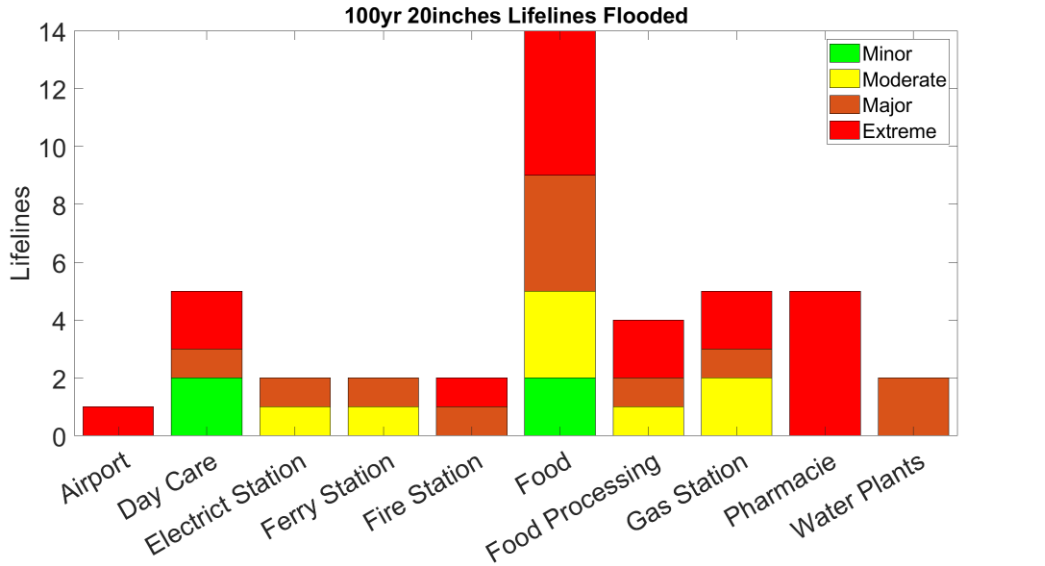

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FUNWAVE Analysis Results

- Increasing the severity of the flood event the number of features affected increases.
- The simulation with return period of 10-year plus 20 inches, which represents the sea level rise projection for 2050, shows destructive results.
- Different actions can be taken in order to protect the New Harbor Haven area.
- The following slides give an idea of how the Tweed Airport Area can be partially preserved.

ADCIRC MODEL

- ADCIRC model is used to compute storm surge and wave levels.
- Grid resolution 5m (16.4 ft). Open boundary conditions: water level from New Haven NOAA tide gauge and constant wave height from CIRCA's FVCOM-SWAVE model

ADCIRC Analysis

- The aim of this study is to show the difference impact on the community that a flood event could have implementing or not implementing a **flood control structure**. In the simulations we used the peak water level during Hurricane Sandy, 2.6 (m).
- Three different possible scenarios were analyzed:
  - Case0: current situation, **no flood control structure**
  - Case1: Flood control structure implemented across **Morris Creek** and **Farm River**
  - Case2: Flood control structure implemented across **Morris Creek**, **Farm River**, and along **Morris Cove**
- An estimation of the miles and type of streets flooded was computed as well as the number of flooded budlings.

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Secondary: Often link towns

Tertiary Often link smaller towns and villages

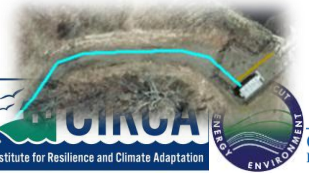
Residential: Roads which serve as an access to housing, without function of connecting settlements. Often lined with housing

Service: For access roads to, or within an industrial estate, camp site, business park, car park, alleys, etc.

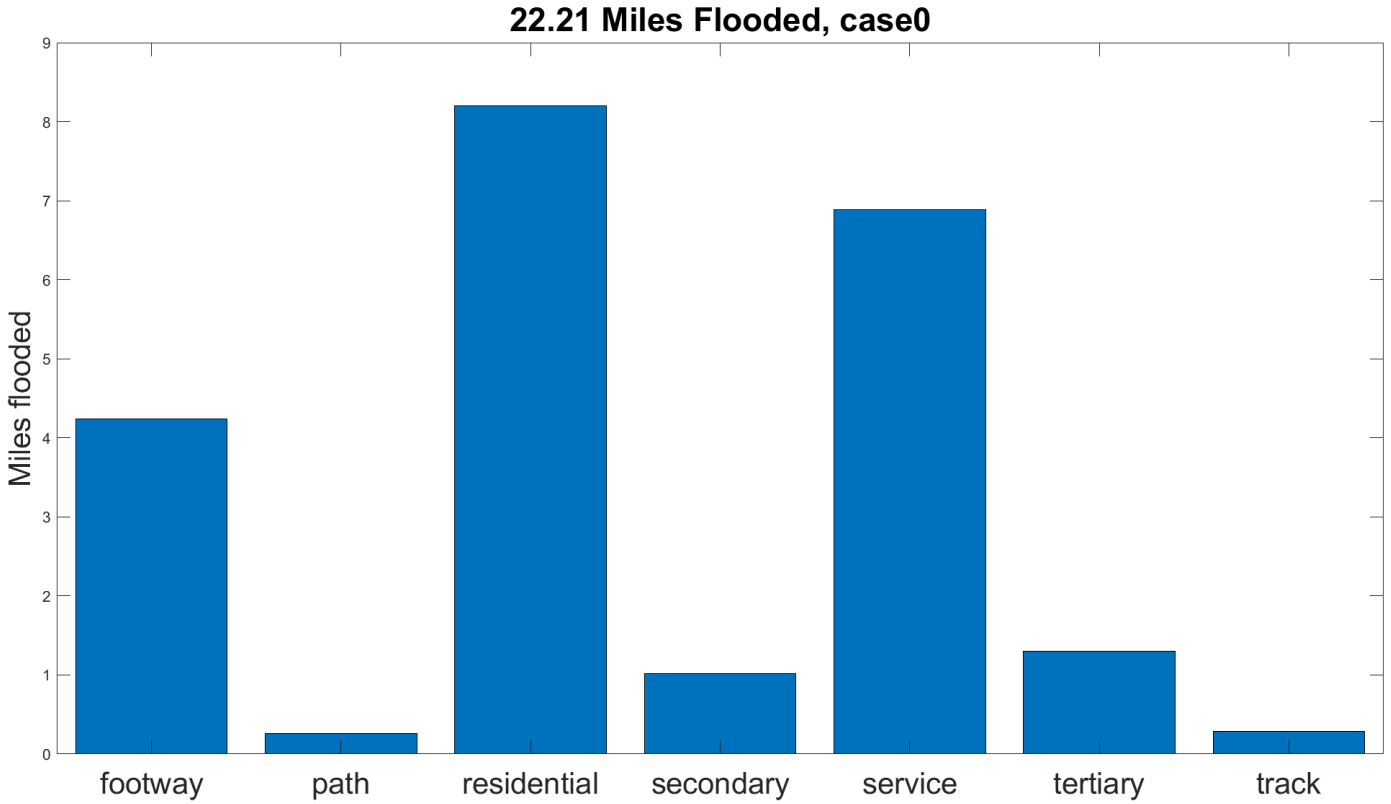
Footways: mainly/exclusively for pedestrians

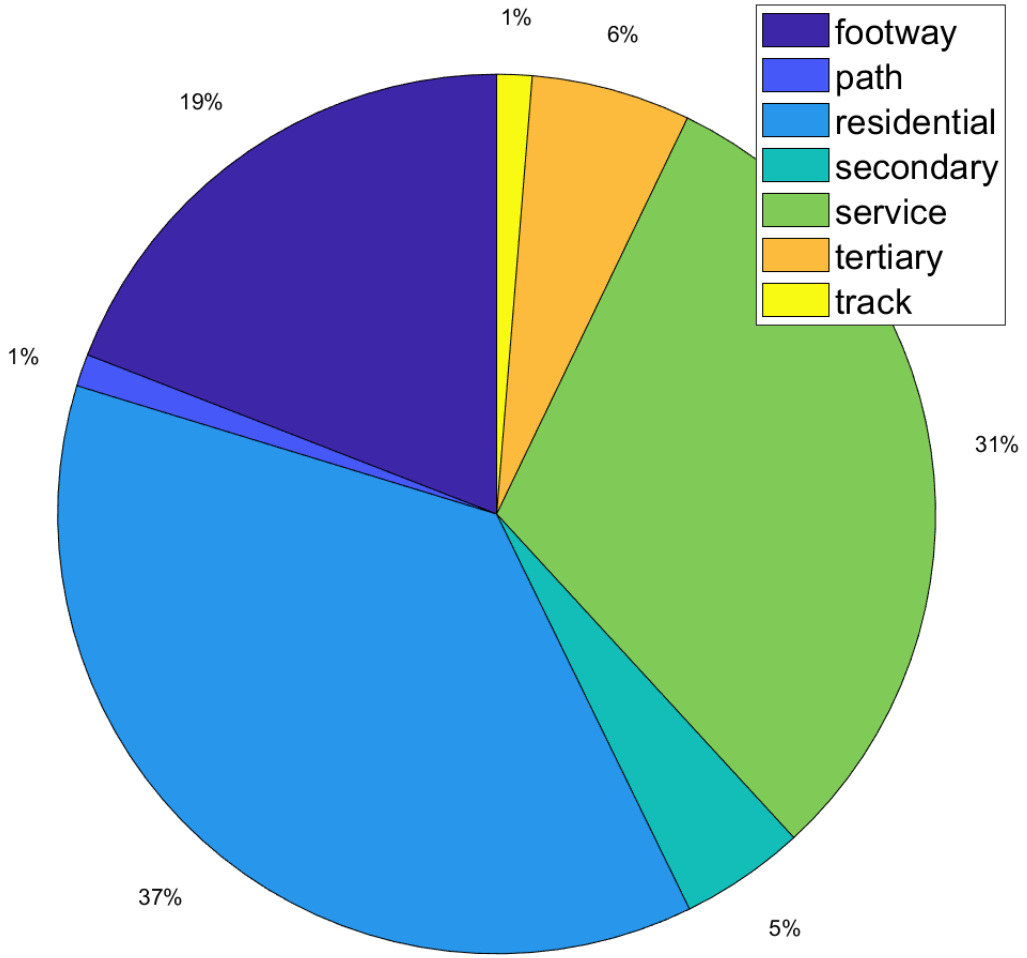
Path: A non-specific path.

Track: Roads for mostly agricultural or forestry uses



Case 0





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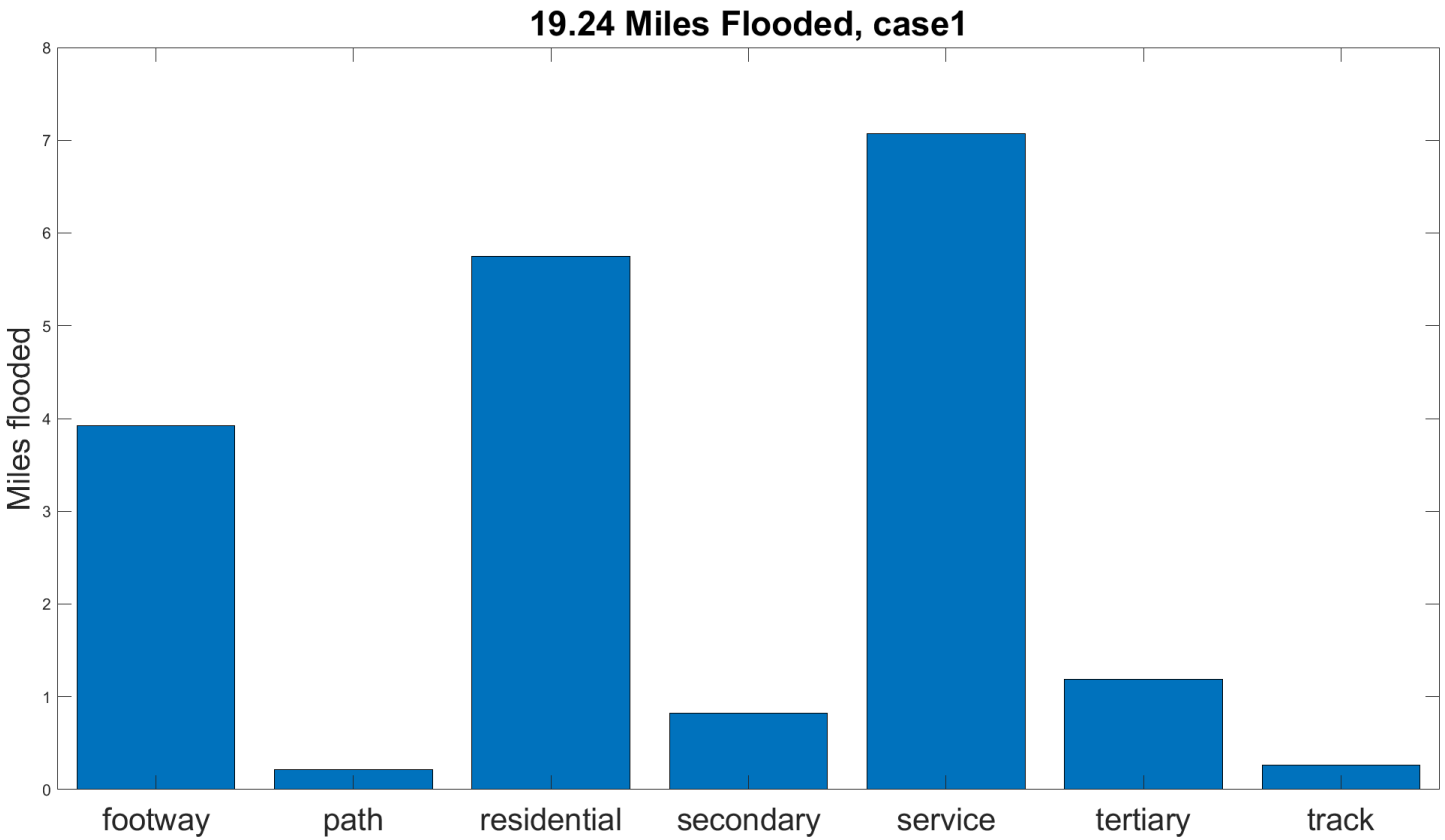
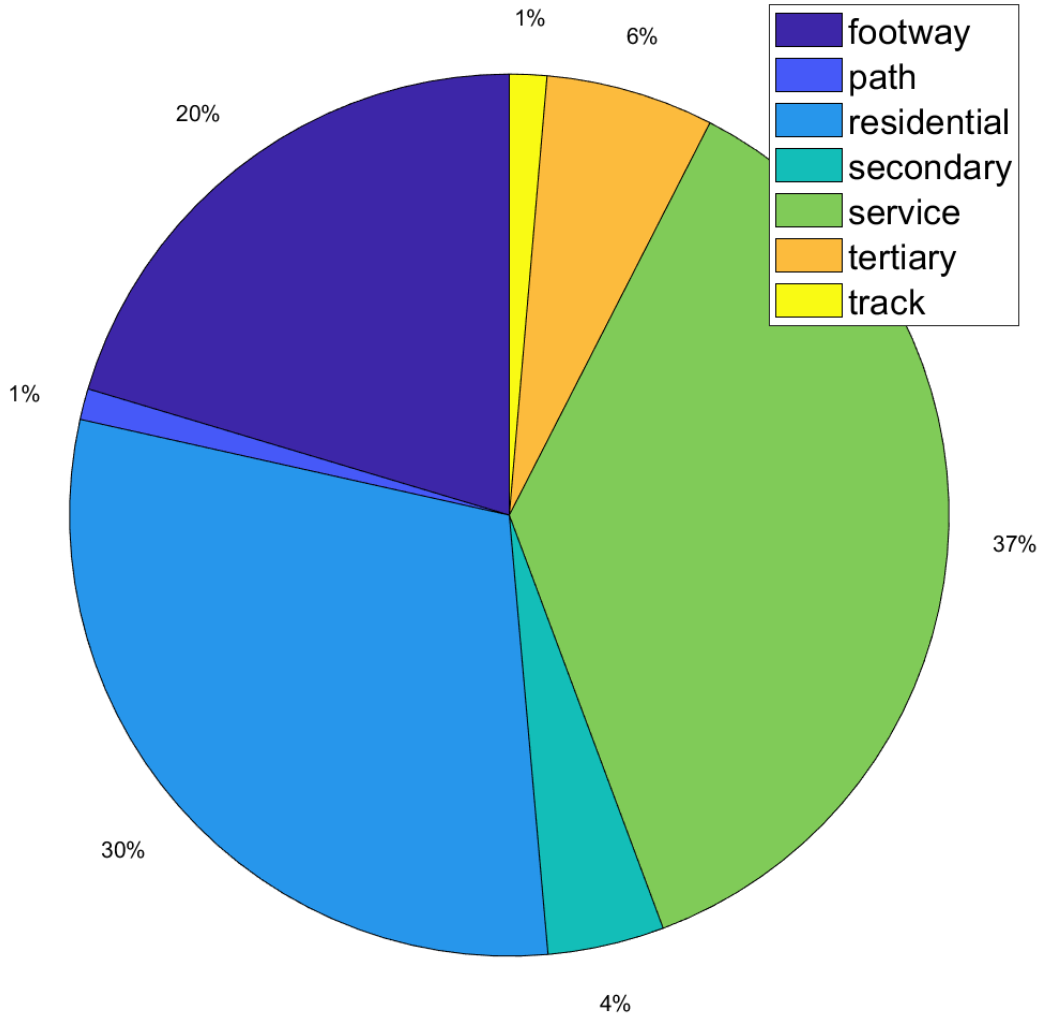
Case 1





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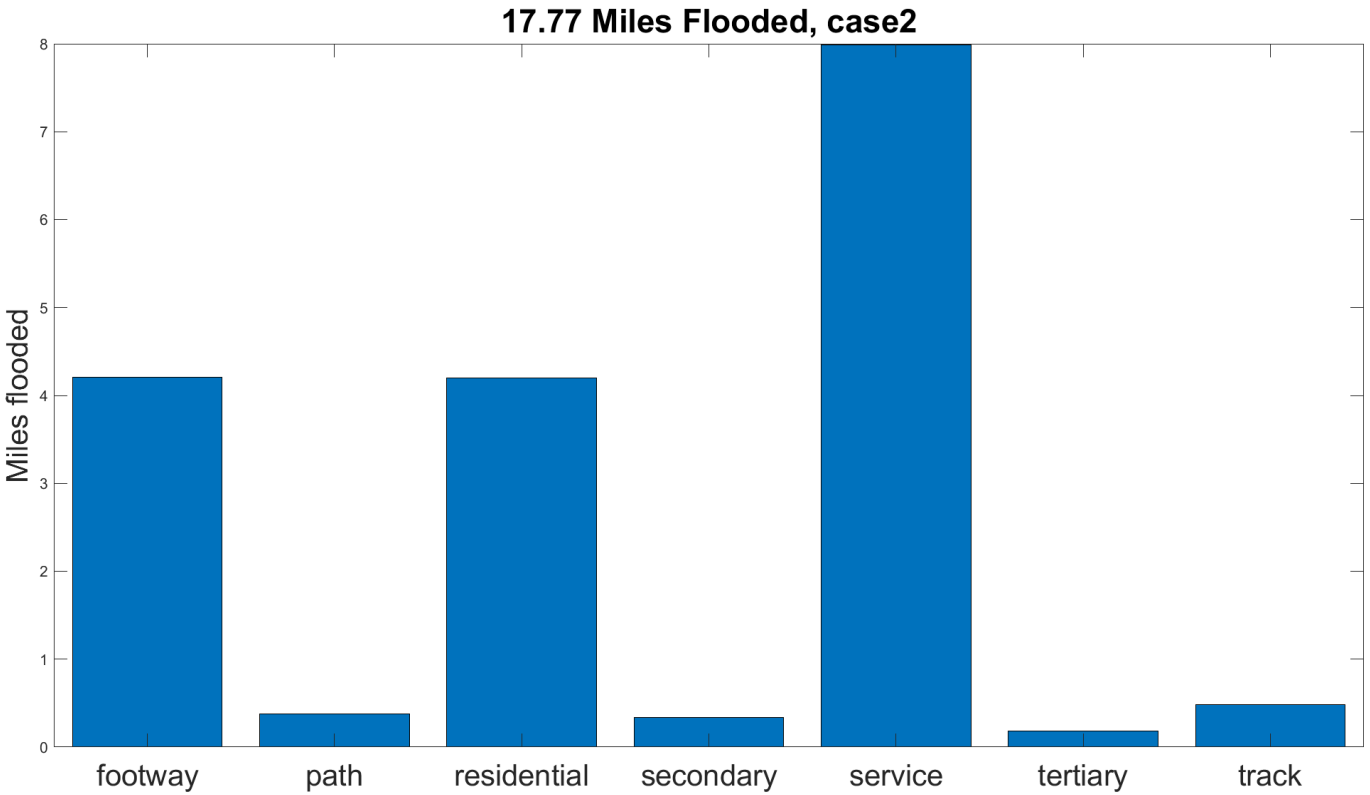
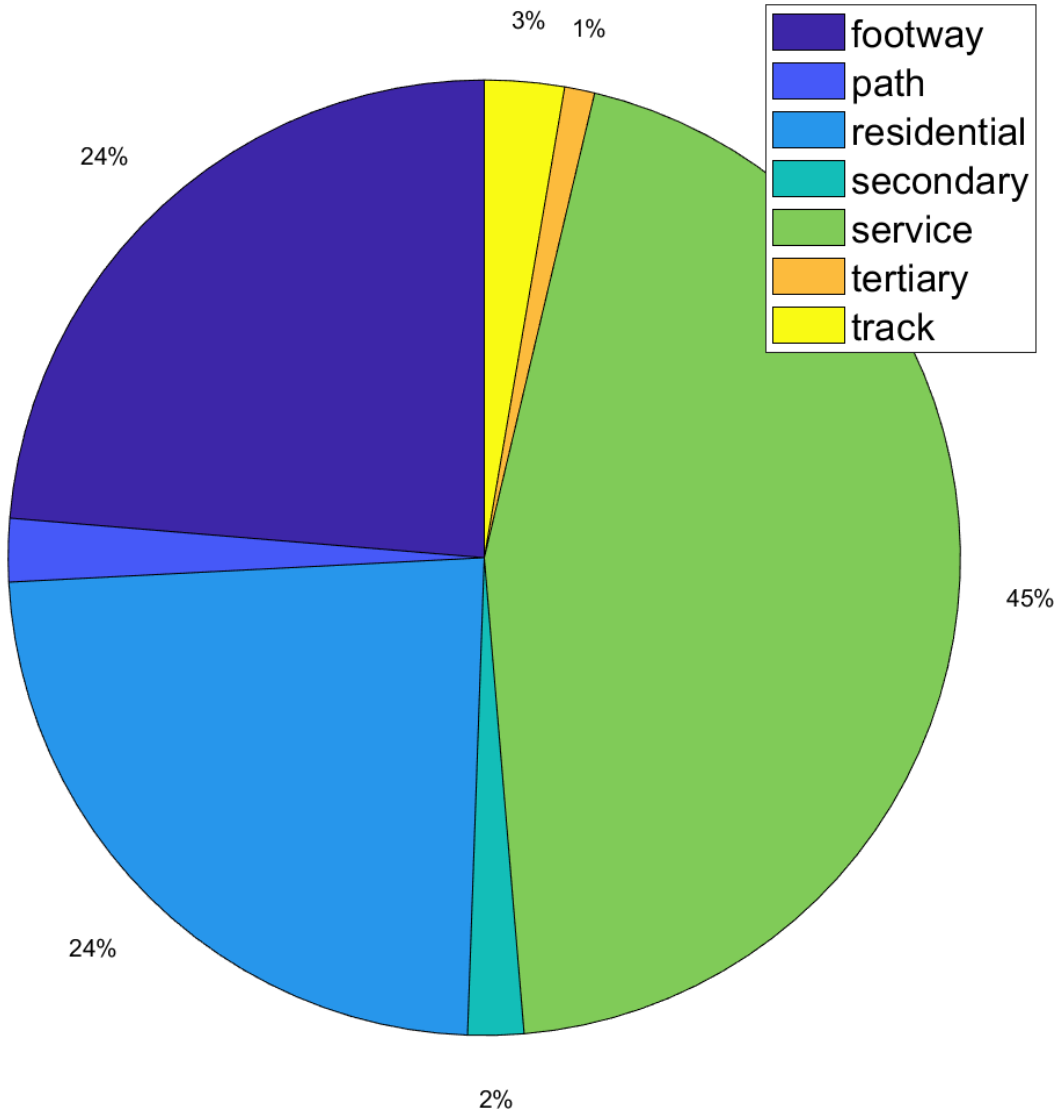
Case 2





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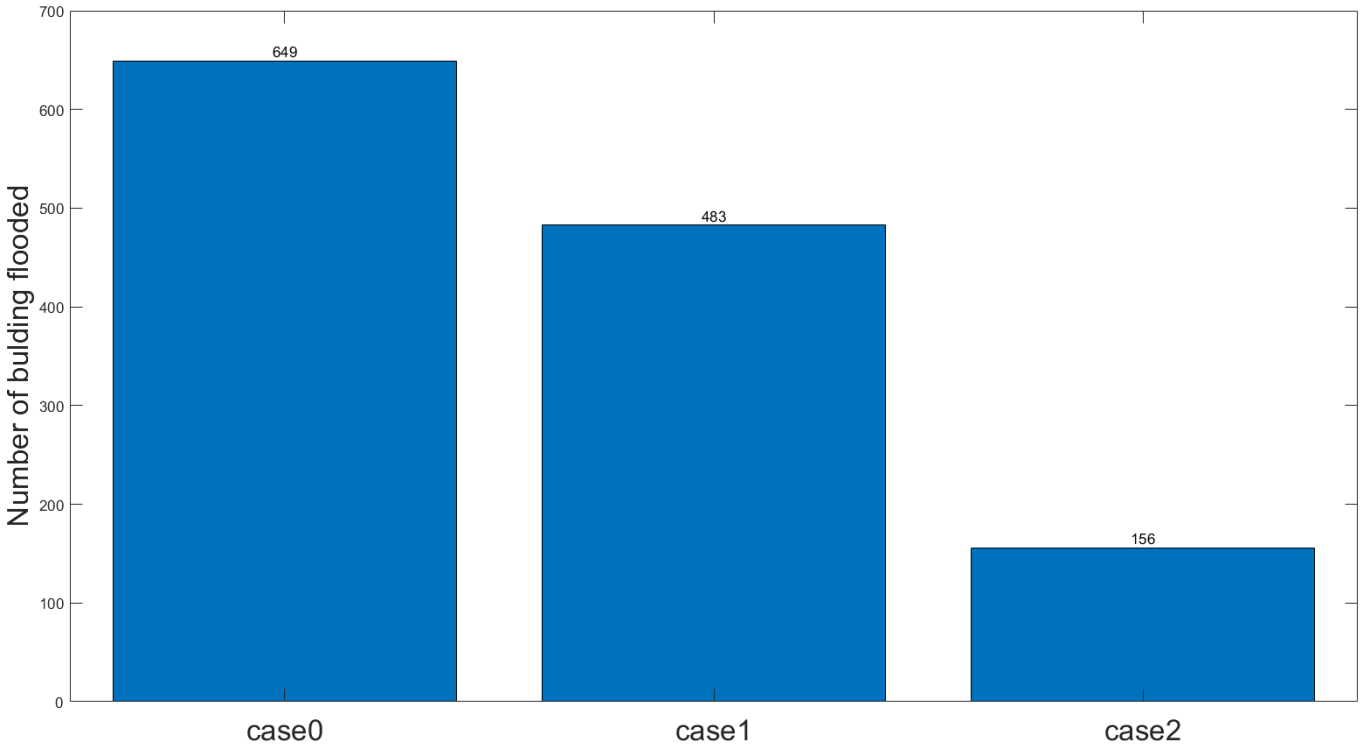
Building flooded in each scenario



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ADCIRC Analysis Results

- The results of this study shows that the implementation of a flood control structure could help New Haven airport area in cushioning a flood event.
- Implementing Case 1 there would be 25.5% less of buildings and 13.4% less of roads flooded.
- Implementing Case 2 there would a 76% decreasing of flooded buildings and decreasing of almost 20% of road flooded.