# Salem Coastal Vulnerability

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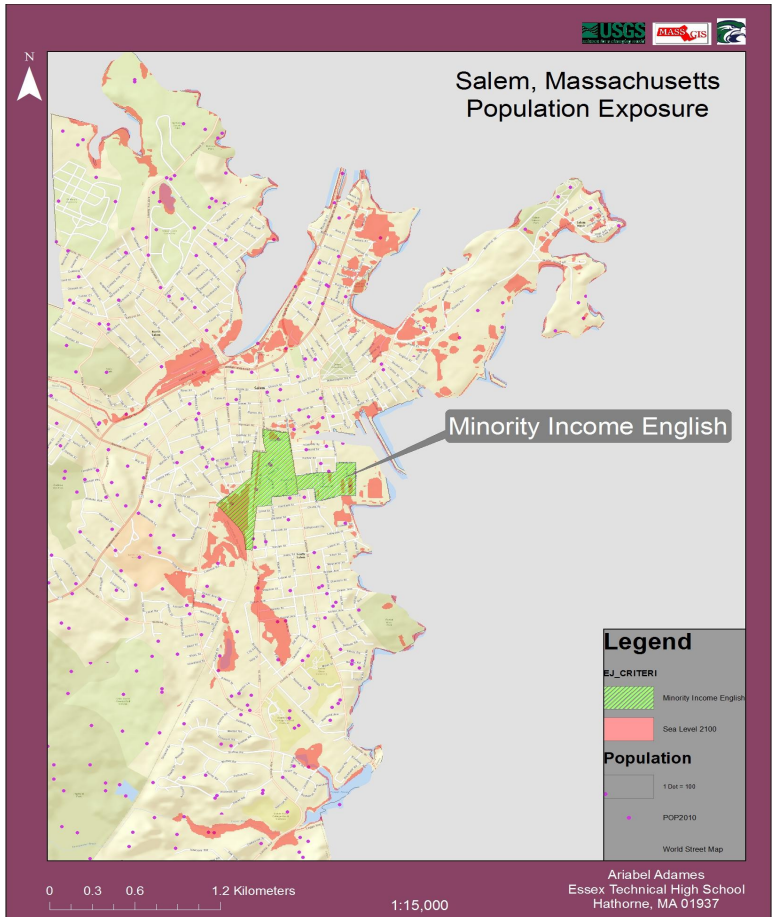
# Total Population: 42,544

**Sea level Rise**: 10,700
**Worst Case Storm Surge**: 22,560
**Minority Income English**: 1,289

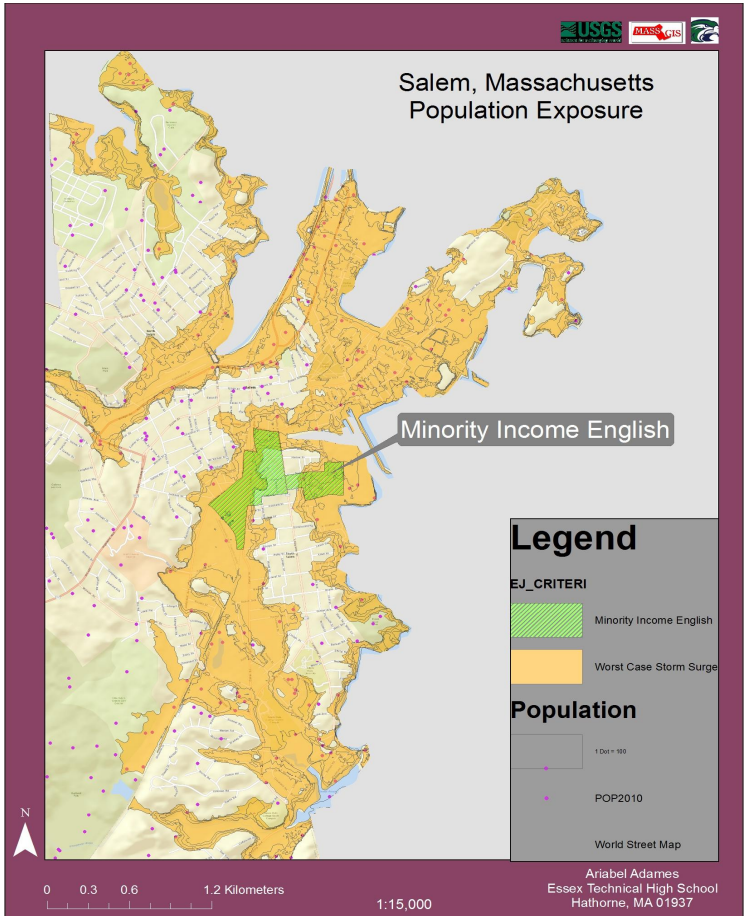
These next two maps represent the total population of Salem, MA. The map to the left of the screen shows the amount of people that will be affected by sea level rise in 2100, and the map to the right shows the amount of people that will be affected by a worst case storm surge. Featured in both of these maps is the Minority Income English layer, or Environmental Justice population.

# Population Exposure: Total Population

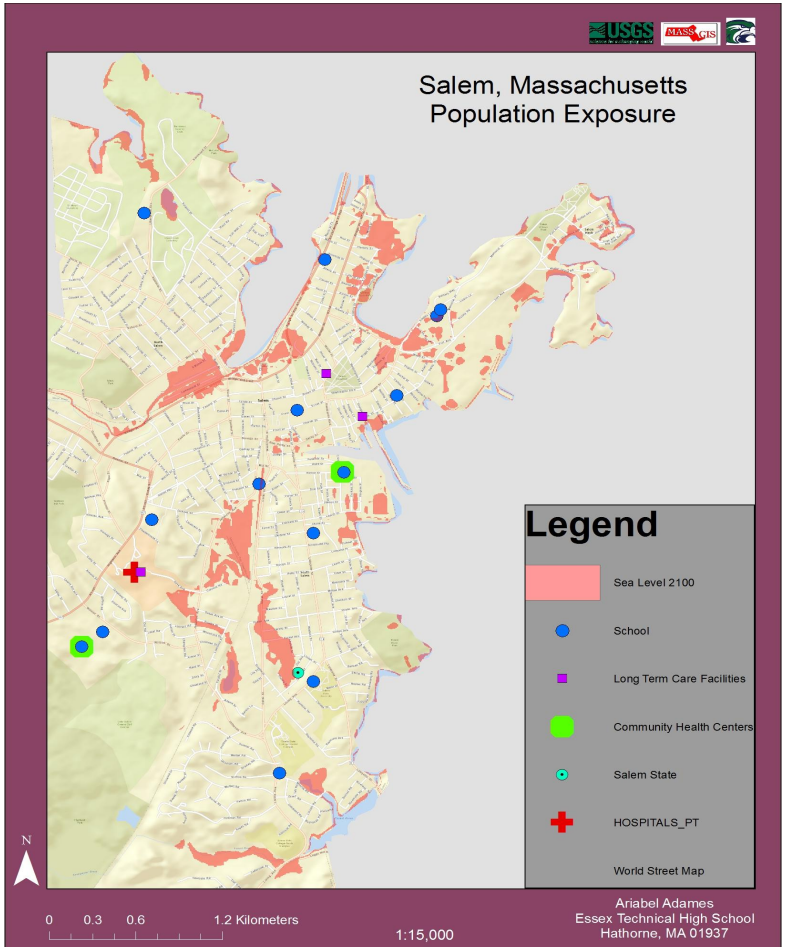



Sea Level Rise In 2100

Worst Case Scenario Storm Surge

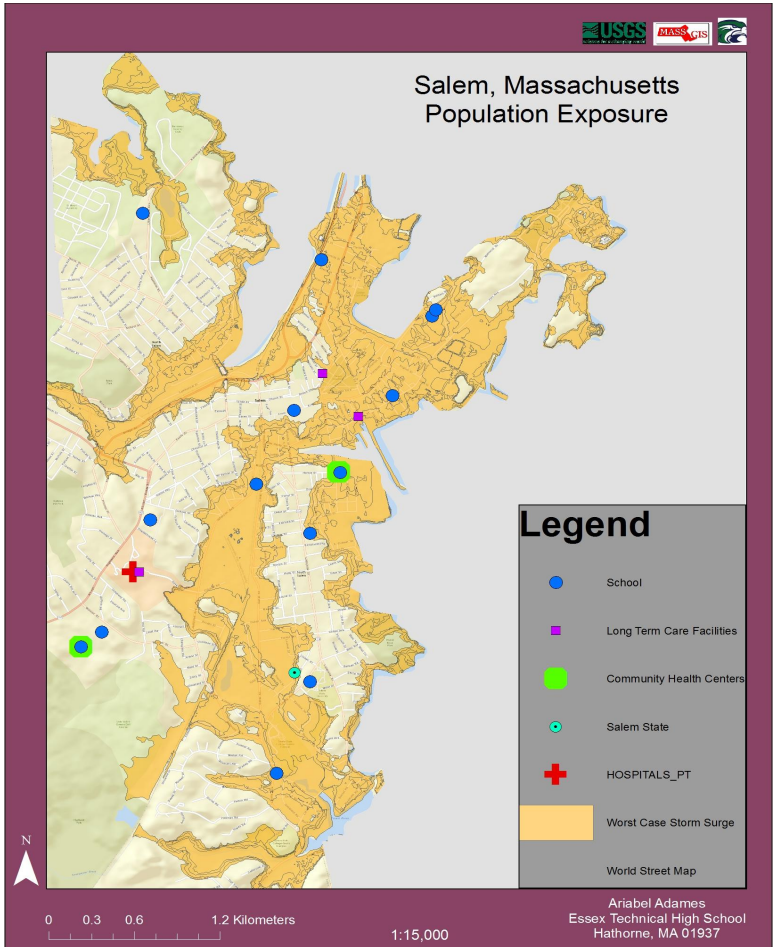


# Population Exposure: Education and Health Areas




Sea Level Rise In 2100

Worst Case Scenario Storm Surge



# Education and Health Areas

## Sea Level Rise

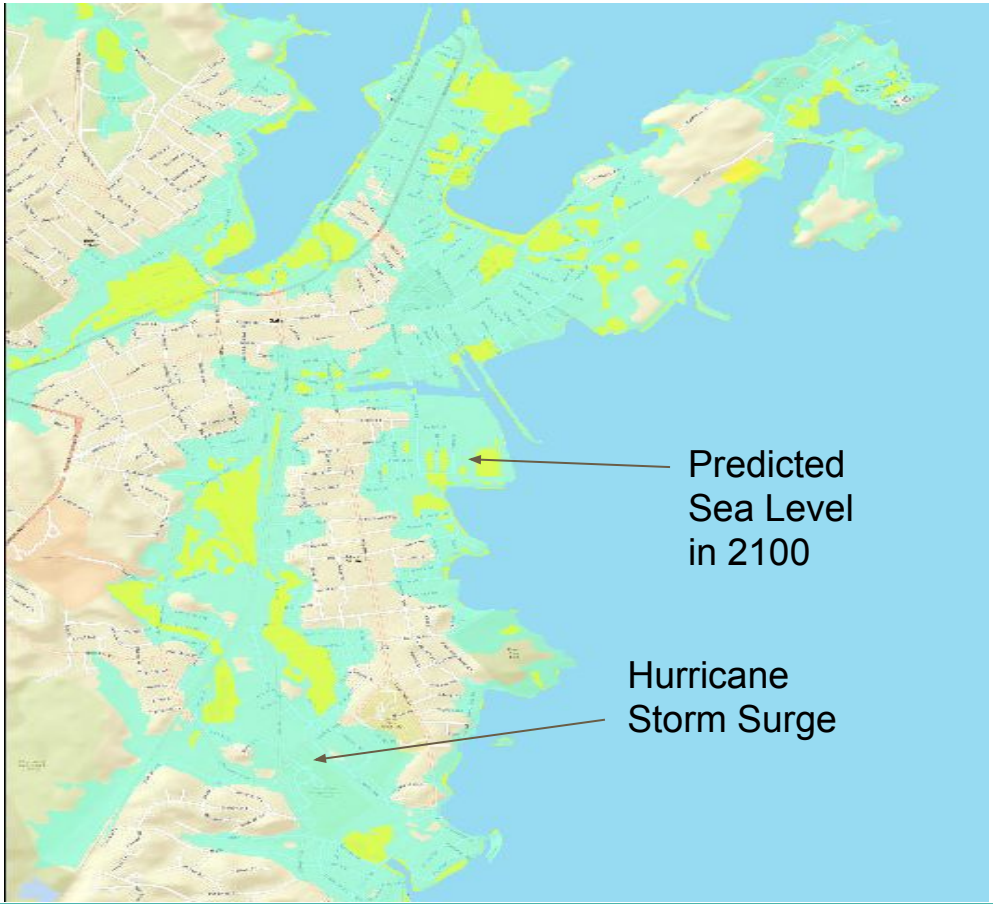
- ★ **School:** Phoenix School
- ★ **Long Term Care:** Brookhouse Home
- ★ **Community Health Center:** North Shore Community Health
- ★ **Colleges:** Salem State

## Worst Case Storm Surge

- ★ **School:** Carlton School
  - Salem Prep HS
  - Salem Community Charter School
  - Saltonstall School
  - Greenhouse School
- ★ **Long Term Care:** John Bertram House

These two maps represented the affected education and health areas, during the 2100 sea level rise and a worst case scenario storm surge, in Salem. This is vital information because we have to have a plan to get the children, elderly, and the sick, out of the city if an issue were to occur.

# Storm Surge Elevations

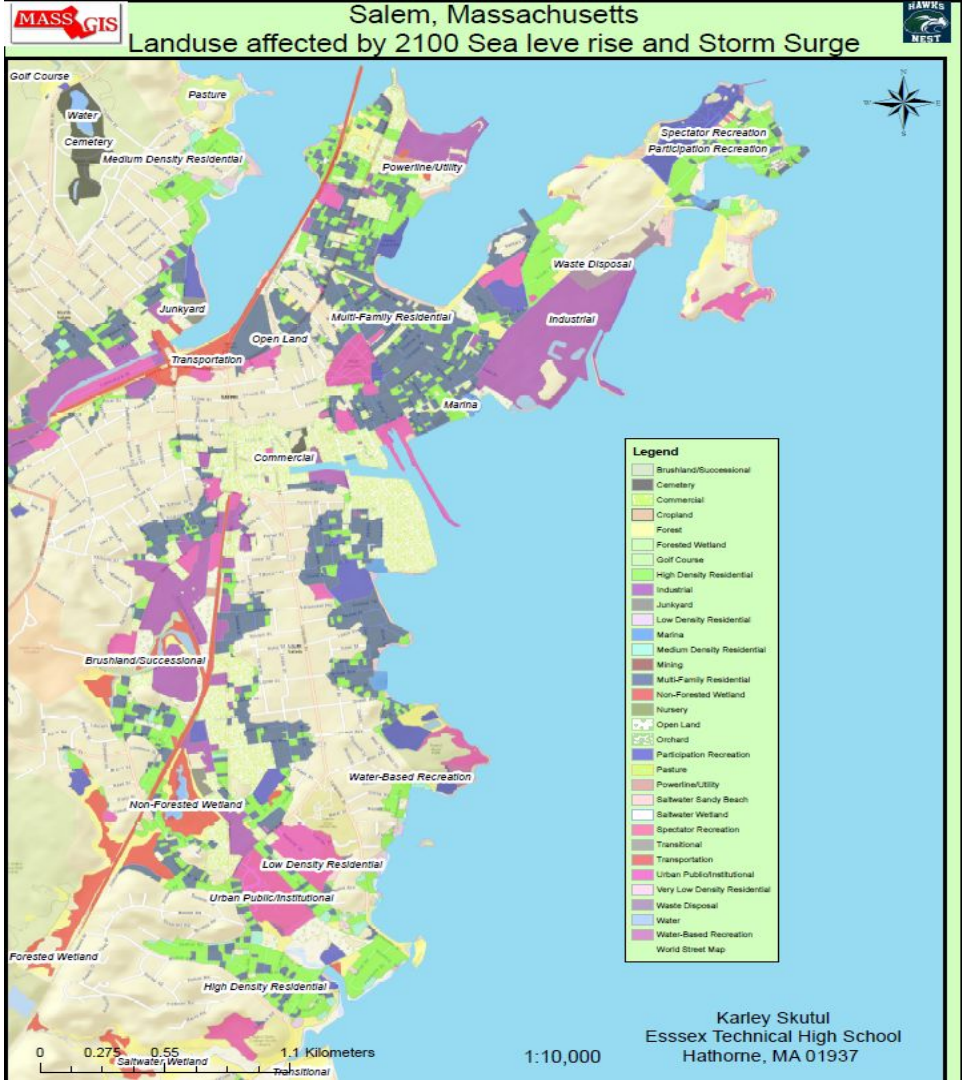



In addition to the predicted flooding in 2100 (light yellow), this map shows also shows the worst case hurricane storm surge flooding  (light blue) drawn over the predicted flooding in 2100.

# Land Use Exposure

This map shows  a clip of all the land use in Salem Massachusetts that will be affected by the  predicted floods and storm surges. All the colored areas on the map represent the different  categories of Land Use.

The major Land Use categories that would be underwater due to heavy flooding and storm surges would be Transportation, Forestry/Agriculture, Developed Land, and high, medium and low Density housing.



# Critical Facilities and Lifeline Exposures

Facilities that will be flooded with sea rise by 2100:

- The Police Station
- 1 of 4 Fire Stations
- All 3 Train Routes
- All 5 Bus Routes

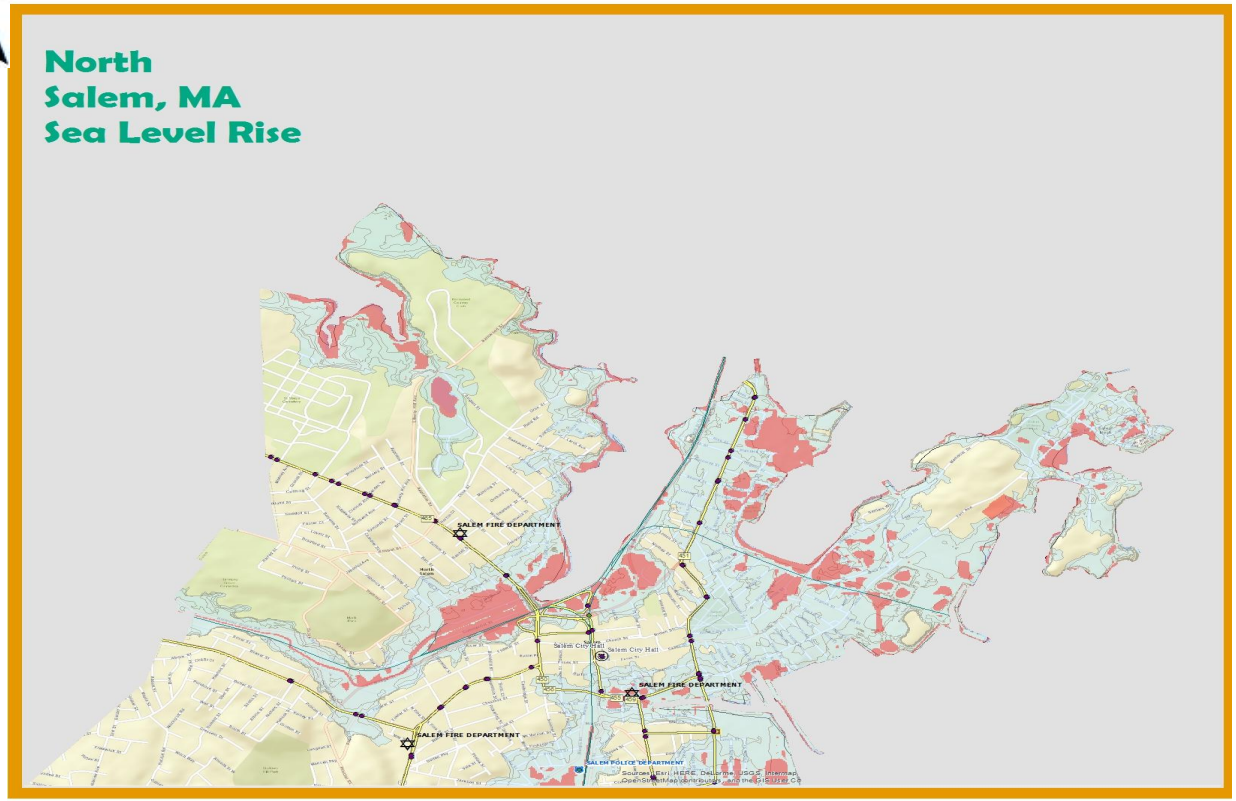
Facilities that will be flooded during a worst case storm surge:

- The Police Station
- 2 of 4 Fire Stations
- All 3 Train Routes
- All 5 Bus Routes
- North Shore Community Health Center

What this means:

- The police and firefighters would be unable to help.
- People who rely on public transportation will be stranded.
- Injured people may not be able to attend their local health center.

# Critical Facilities and Lifeline Exposures




**Legend**

- Town and City Halls
- Prisons

**Police Stations**

**Jurisdiction**

- Local Police
- State Police
- County Sheriff

- Health Center
- Health Center, Hospital
- Administrative Location
- Health Center
- Health Center, Hospital
- Health Center, School
- Health Center, Homeless Shelter
- Health Center, Prison

- Fire Stations
- MBTA Bus Stops (small scale)
- MBTA Bus Routes
- TRAINS_ARC

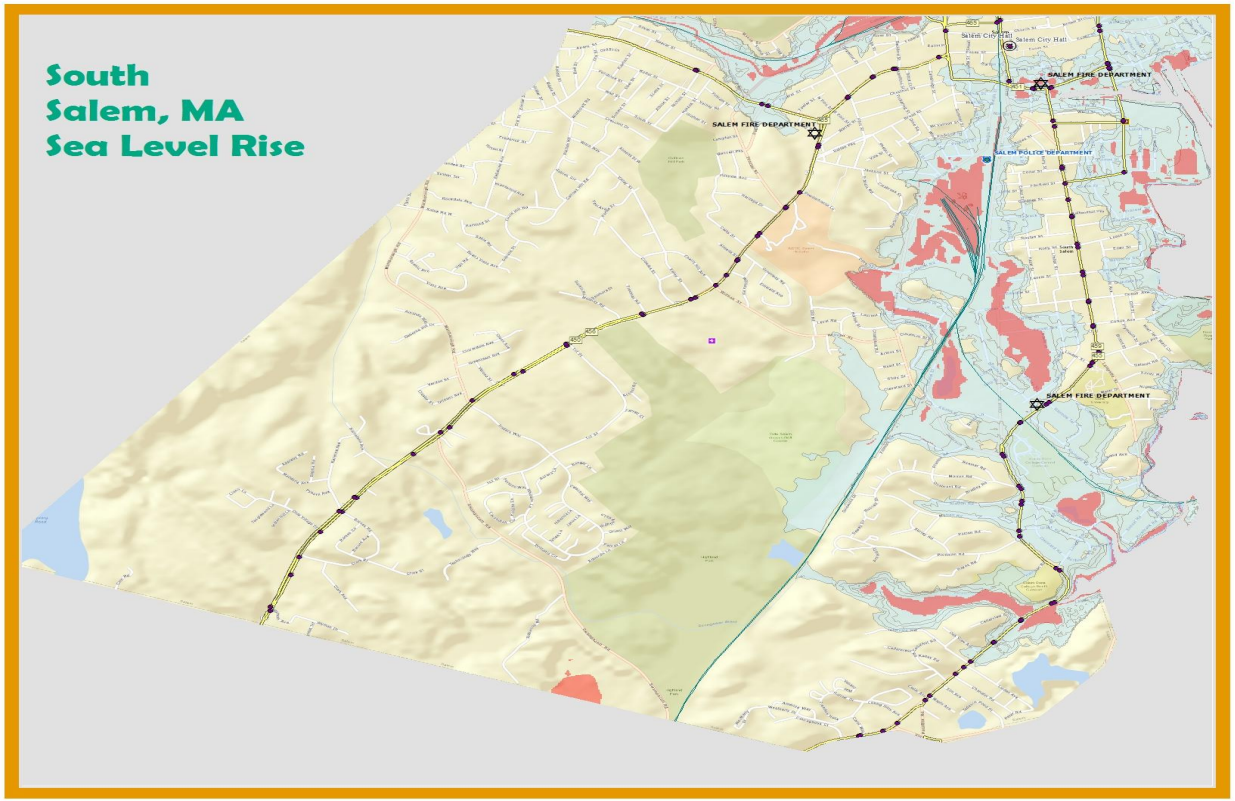
0 0.5 1 2 Kilometers

1 cm= 250 m

- This map shows the northern part of Salem. The elevation is low, and it is right on the water.
- A worst case storm surge would flood the majority of the land on this map, and in 2100 a moderate amount due to sea level rise would be under water.
- This is the section of Salem that has more critical facilities, such as the police and fire stations, which would be affected.
- Also, the train and bus routes all go through a flood zone at some point.

- **Represents areas that will be underwater by 2100.**
- **Represents areas that will be underwater during worst case storm surge.**

# Critical Facilities and Lifeline Exposure

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**Legend**

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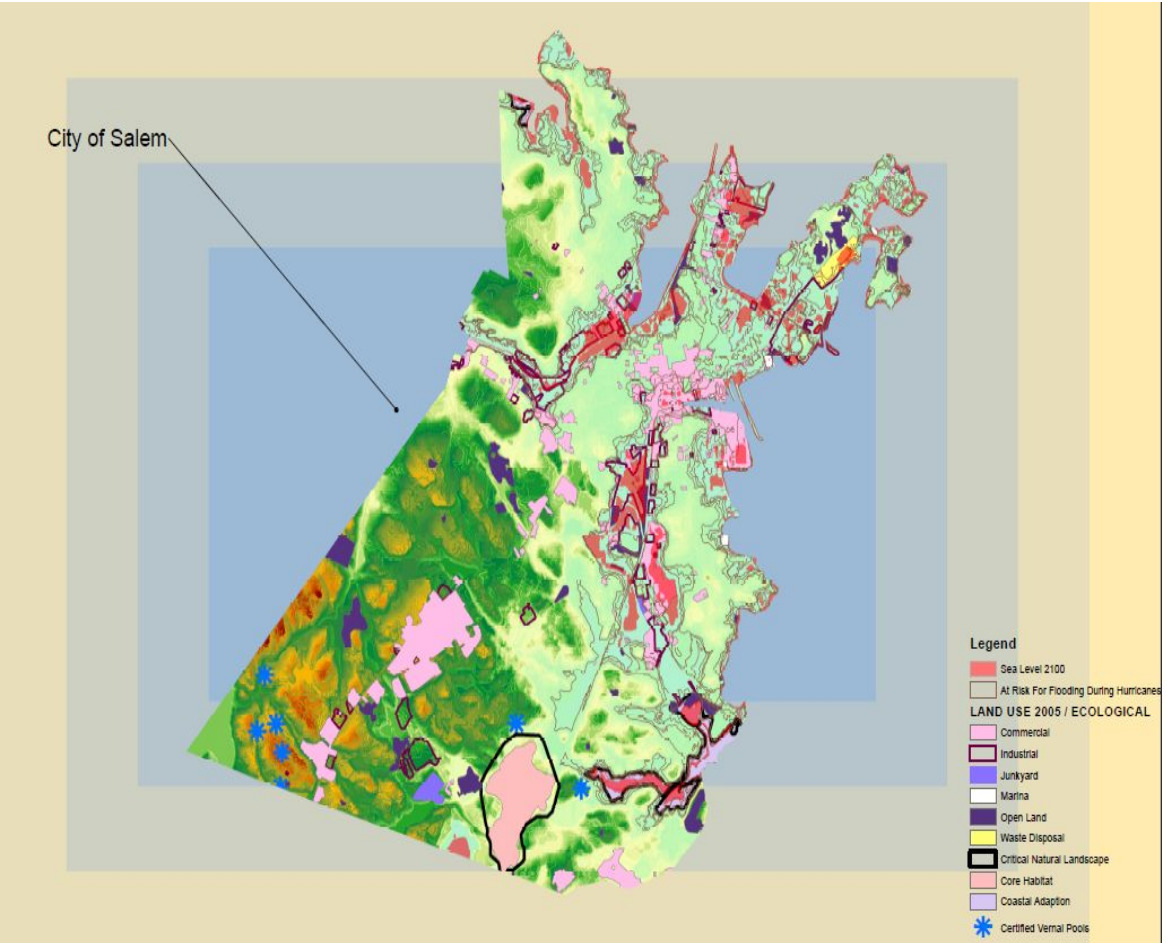
0 0.5 1 2 Kilometers

1 cm= 250 m

- This map shows the critical facilities and lifeline exposures for the Southern portion of Salem. It is more inland.
- A lot less critical facilities are located in Southern Salem.
- Trains and buses run everywhere. Southern Salem is way less vulnerable.

- **Represents areas that will be underwater by 2100.**
- **Represents areas that will be underwater during worst case storm surge.**

# Ecological Exposure




**The ecological exposure of Salem, Massachusetts for future sea level rise of 2100 and worse case storm surge.**

- Red areas - these areas will flood when the sea level has risen in 2100.
- Brown boundaries - worse case storm surges will flood the land.
- Most of the sea level rise will flood junkyards, marinas, and waste disposal (allowing all of the trash and waste to openly flow to the ocean).
- The commercial building and industrial buildings would also be flooded, allowing whatever is in those buildings to contaminate the water and flow into the ocean.
- Worst case storm surges will affect areas even further back into homes, businesses, and getting uncomfortably close to conservative vernal pools.

# Threatened Areas

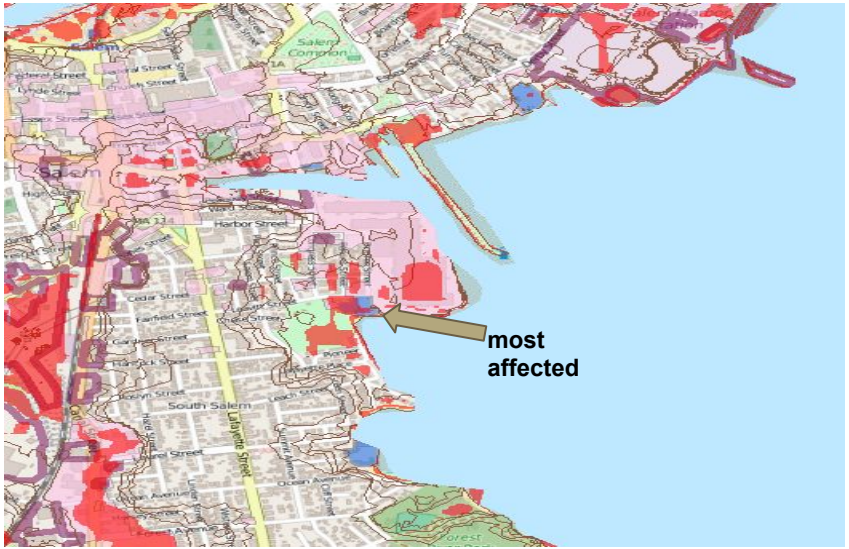
2100 Sea Level Rise Risk of Flooding:

- ❏ Junkyards (high)
- ❏ Marinas (high)
- ❏ Waste Disposal (medium)
- ❏ Commercial (medium)
- ❏ Industrial (medium)
- ❏ Critical Natural Landscape (high)

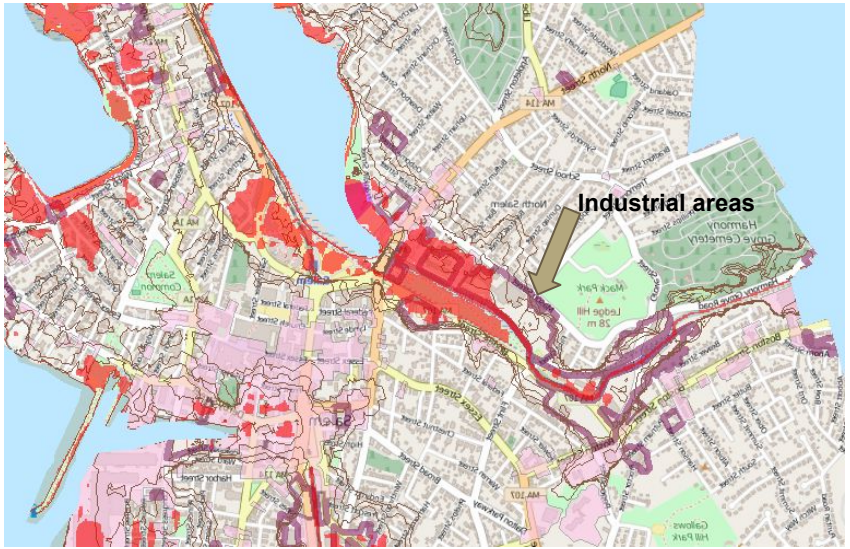
2100 Worst Case Storm Surges Risk of Flooding:

- ❏ Junkyards (high)
- ❏ Marinas (high)
- ❏ Waste Disposal (high)
- ❏ Commercial (high)
- ❏ Industrial (high)
- ❏ Critical Natural Landscape (high)

# Ecological Exposure Continued

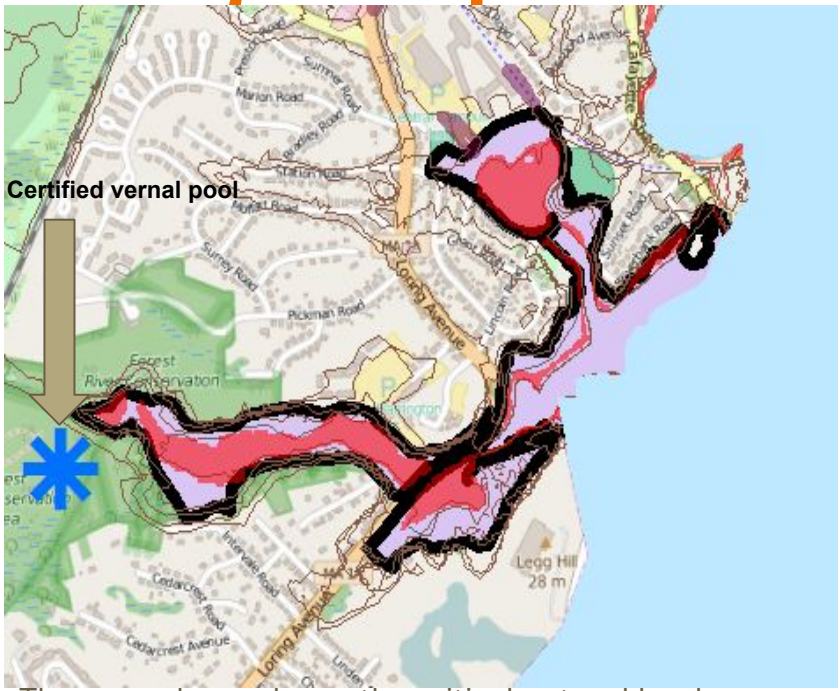



The map above shows the marina's (blue areas) being covered in water during the storm surges and sea level rise.




The map above shows the industrial areas (purple outline) being completely under water for the sea level rise of 2100.

# Ecological Exposure Continued

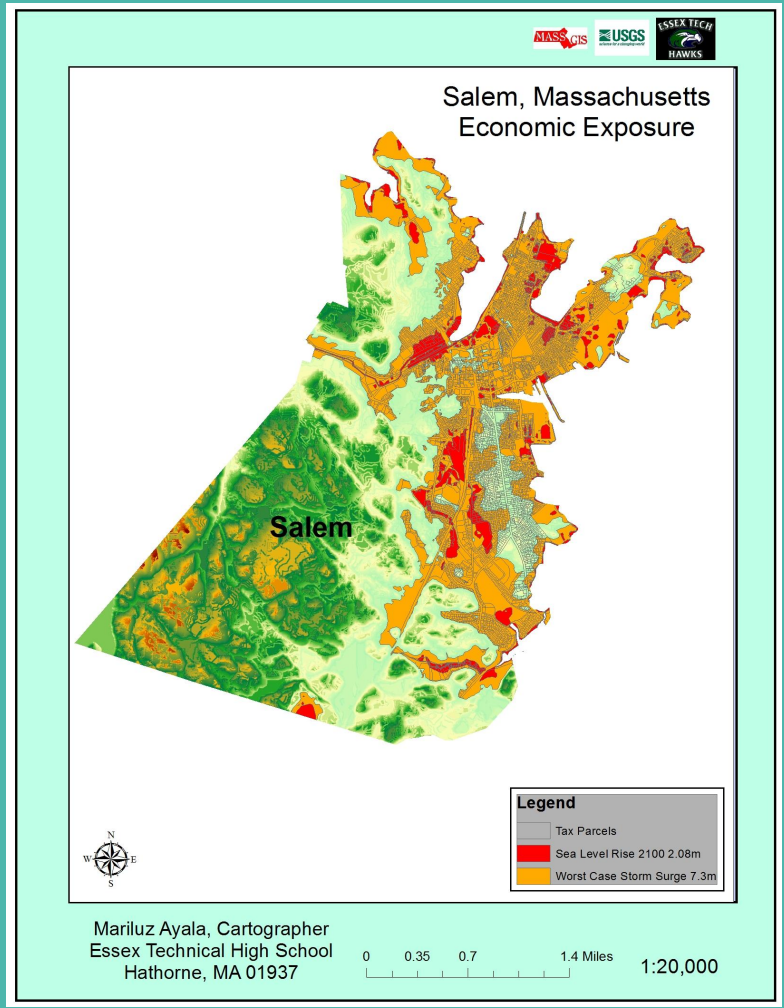



The map above shows the critical natural landscape (outlined in black) and coastal landscape (light purple) under water for the sea level rise. It also shows the vernal pool being very close to sea level rise and storm surge.

This map above is showing the waste disposal (yellow on the right side) with the sea level rise on it and the storm surge lines around it.

# Economic Damage: Land & Building Value

- This map shows the areas that will be affected by sea level rise in 2100 (red) and the worst case storm surge (orange).
- We totaled the dollar value of the land and building parcels under each flooded layer.
- ***Sea level rise = $665,046,434 loss of land and building values.***
- ***Worst case storm surge = $2,918,273,467 loss of land and building values.***



# Solutions!

- Identify flood evacuation routes for all areas of Salem.
- If you're house is at risk, we recommend relocating or at least being properly insured.
- For schools, we highly suggest having an evacuation plan.
- For minority-income english areas, have information available in other languages, establish storm evacuation procedures with transportation, and create safe community shelters for these emergencies.
- Trains and buses should have "in case of emergency" plans.
- Start cleaning up sites so that all chemicals and toxins are off the ground and away from possible flooding areas.
- Possibly build a high storm surge wall to protect the threatened wetlands.