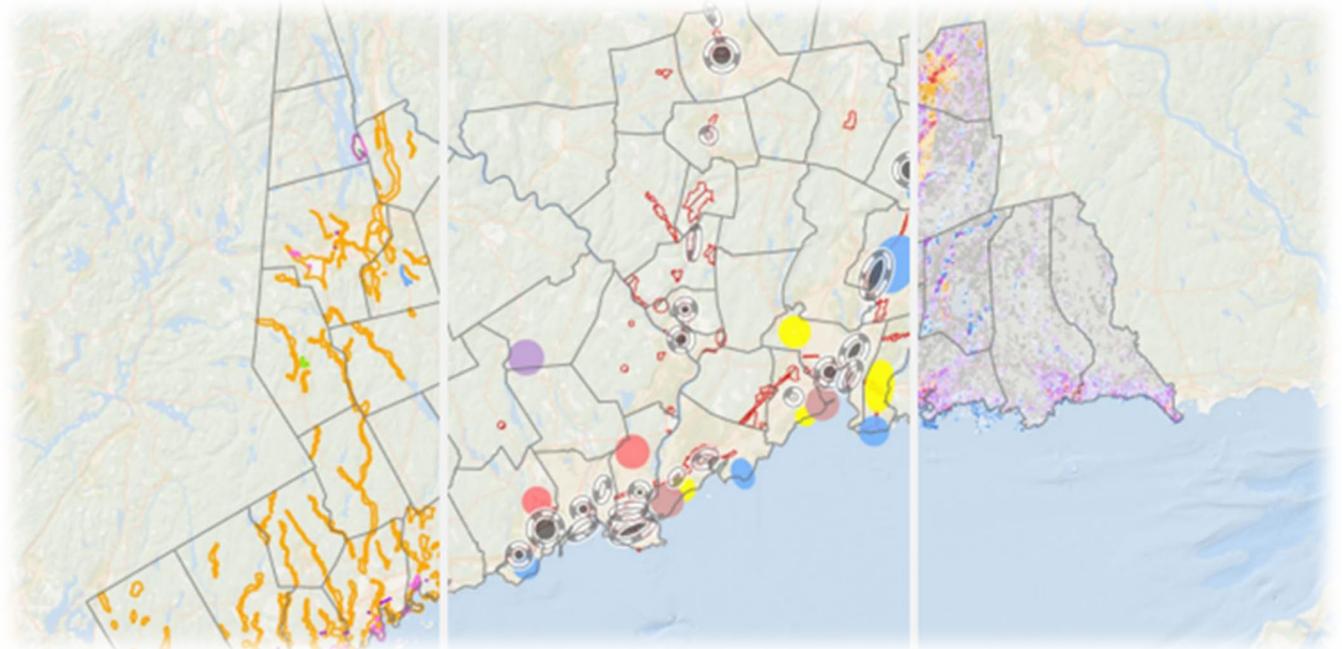


Resilient Connecticut Phase II

From Regional Vulnerabilities to Resilience Opportunities

**Update for the Connecticut
Association of Flood Managers
(CAFM) Conference
December 8, 2021**

**David Murphy, PE, CFM
Director of Resilience Engineering
Connecticut Institute for Resilience and
Climate Adaptation (CIRCA)**



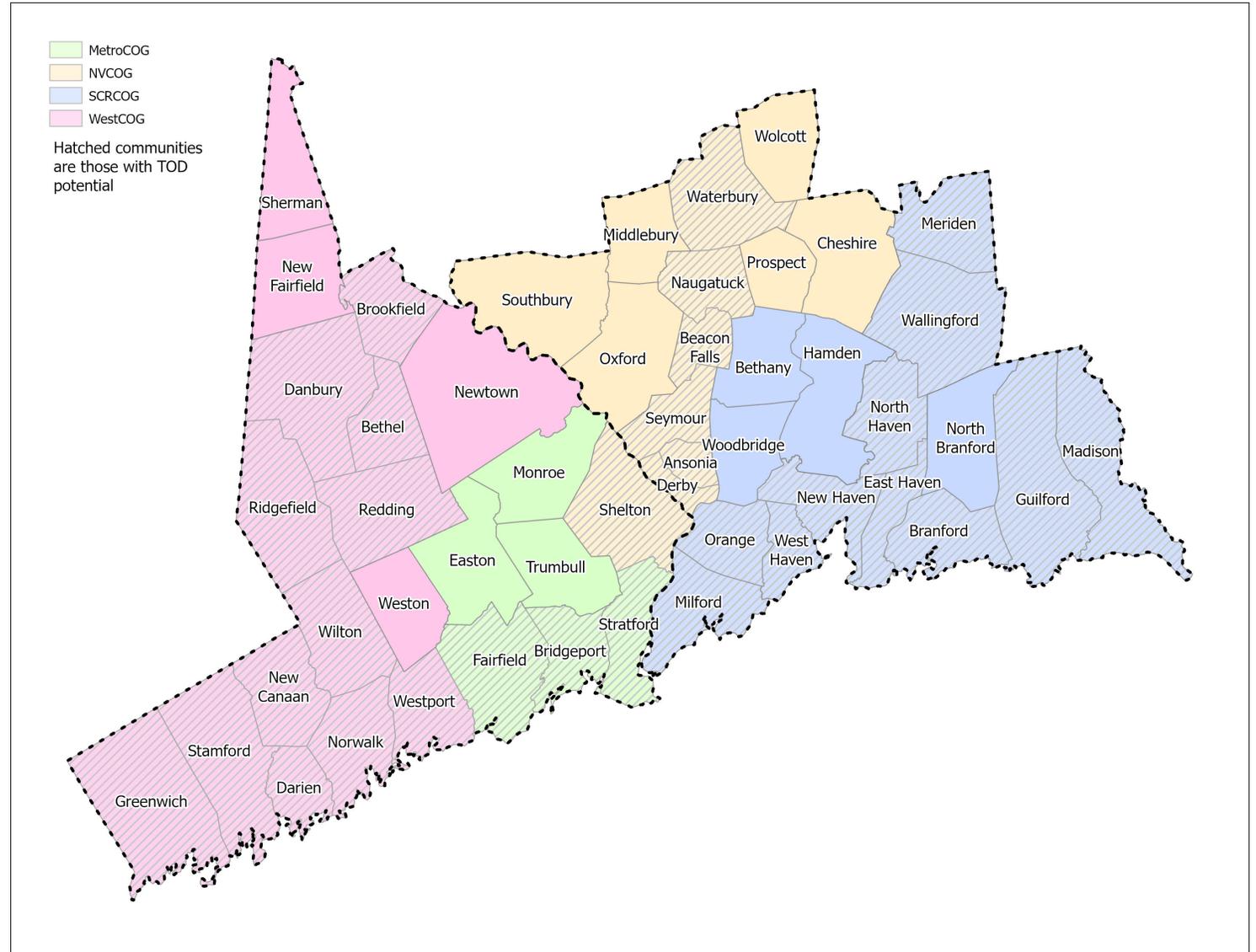
Resilient Connecticut Phase II

From Regional Vulnerabilities to Resilience Opportunities

Getting Oriented

Area of Focus

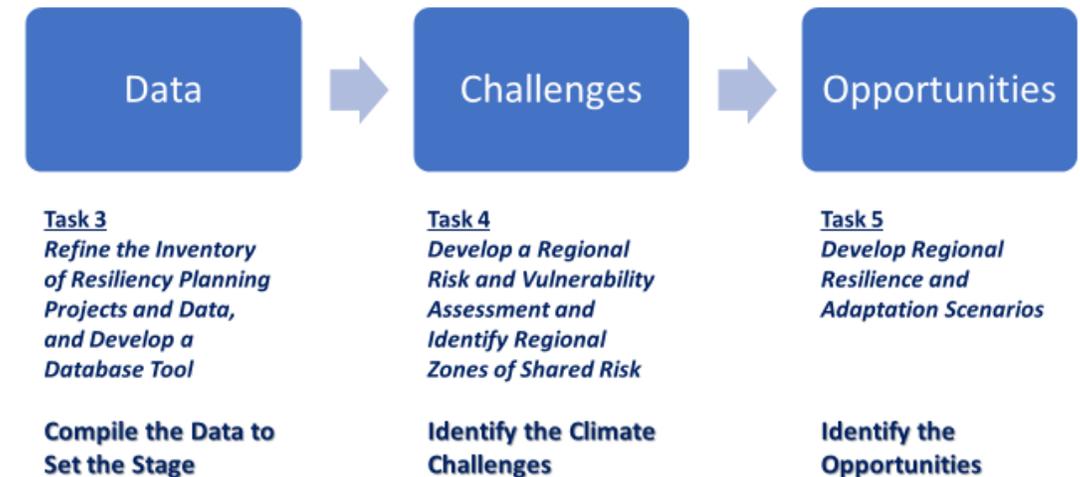
- Fairfield and New Haven Counties
- Communities with Transit-Oriented Development (TOD) Potential
- Communities with “Resilience Corridor” Potential



Getting Oriented

How Did We Get Here? Recap of Discussion Opportunities

- **Summit of November 2020**
 - ✓ Presented Resilient Connecticut Phase I
 - ✓ Transition to Phase II of Resilient Connecticut
- **COG-Based Meetings – fall 2020 through 2021**
 - ✓ Monthly updates to COGs and COG committees
- **January/February 2021 Workshops**
 - ✓ Vulnerability assessment and zones of shared risk
- **Webinar of March 2021**
 - ✓ Update on the vulnerability assessment
- **May 2021 Workshops**
 - ✓ Review of preliminary opportunity areas
- **October 2021**
 - ✓ Release of vulnerability assessment report and webinar to present the report content



Resilient Connecticut Phase II

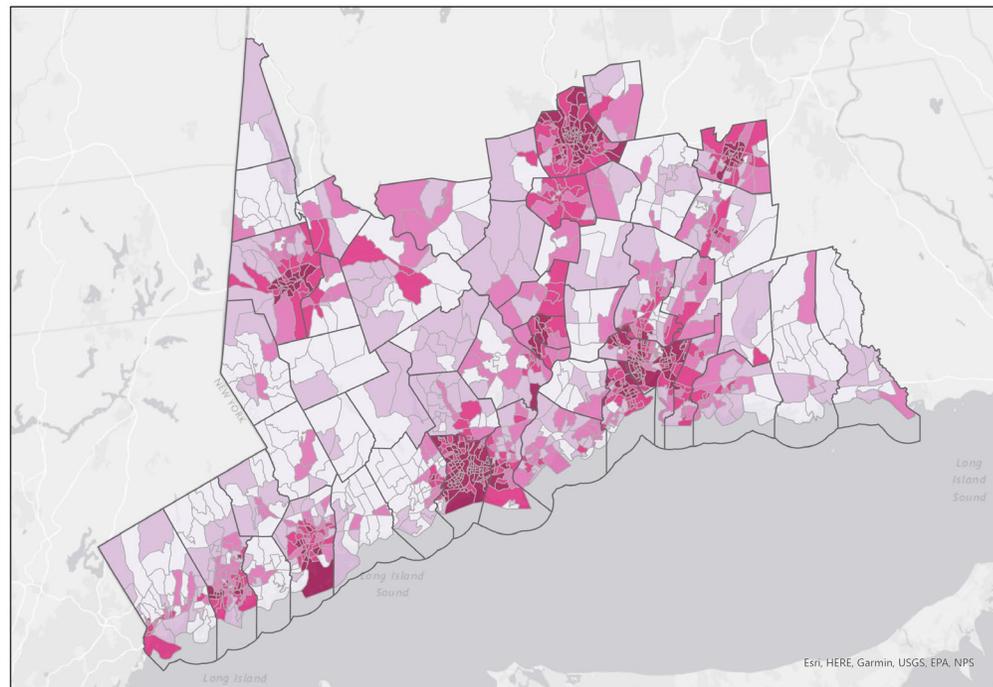
From Regional Vulnerabilities to Resilience Opportunities

Social Vulnerability Index (SVI) Mapping

- Methodology & subgroups
- High-level regional findings

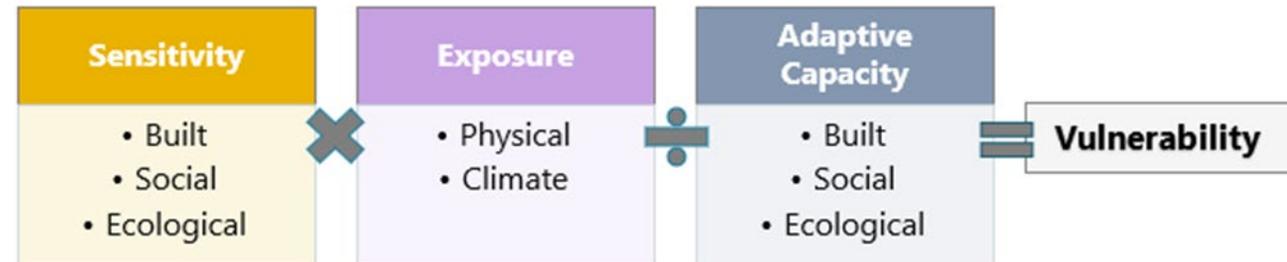
Climate Change Vulnerability Index (CCVI)

- Methodology & index “pieces”
- Why flood and heat



Social Vulnerability
Overall Vulnerability

0 - 0.20	0.41 - 0.61	0.82 - 1.00
0.21 - 0.40	0.62 - 0.81	

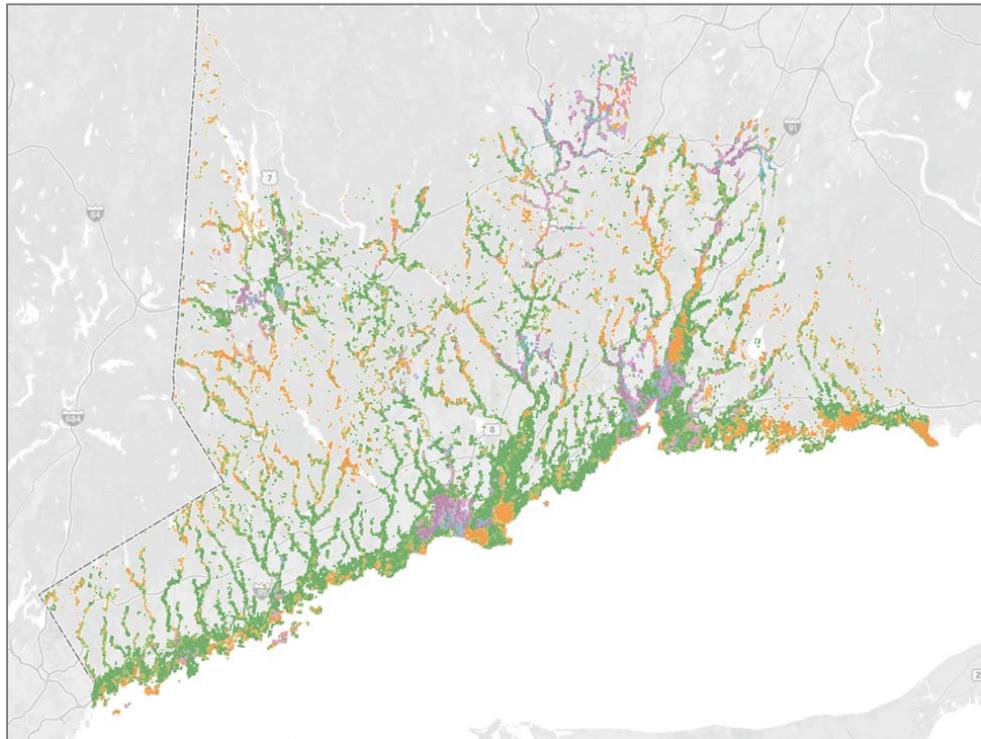


Resilient Connecticut Phase II

From Regional Vulnerabilities to Resilience Opportunities

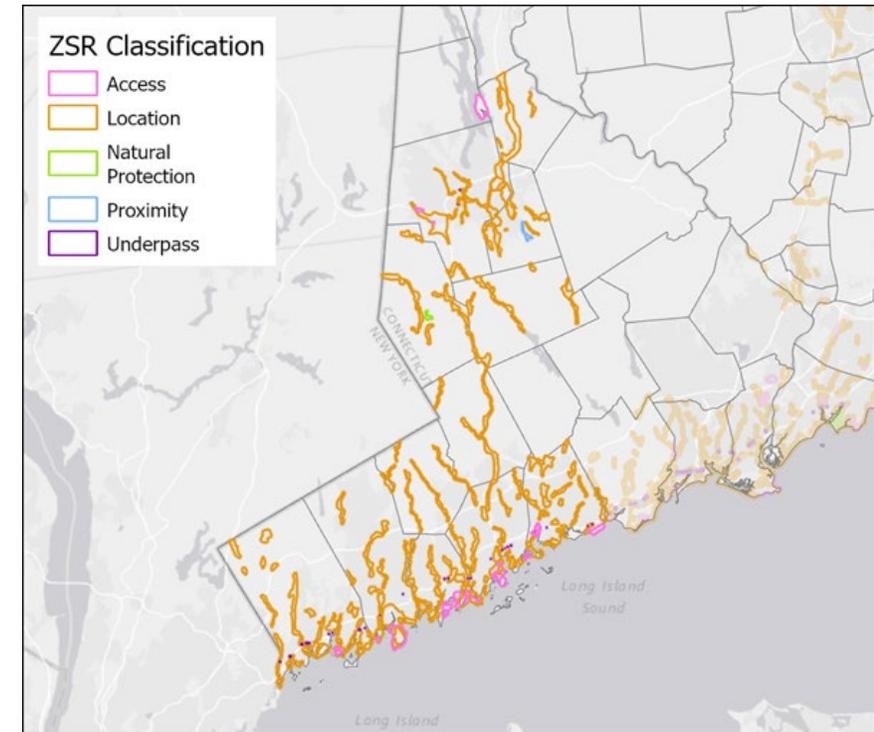
Flood and Heat Combined

- Combined vulnerabilities that can lead to cascading impacts



Zones of Shared Risk (ZSRs)

- Four types of ZSR
 - Access, location, proximity, natural protection



Overlay Process for Identifying Opportunities in TOD Communities

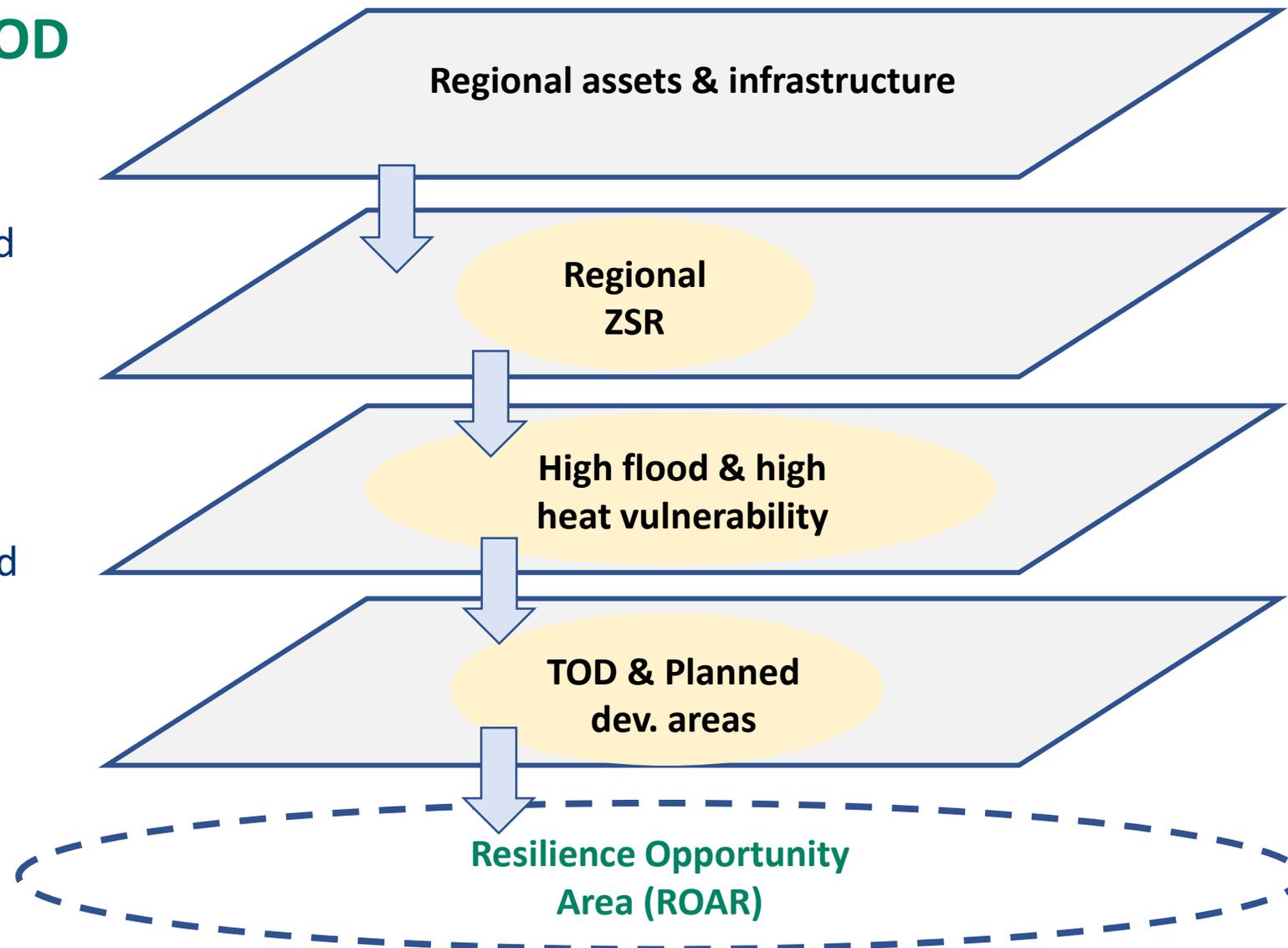
- Remember that the NDRC grant emphasizes identifying regional assets and infrastructure
 - ✓ Where are these regional assets and infrastructure densely located?
 - ✓ Where are they co-located with high flood and heat vulnerabilities?
 - ✓ Where are they located within “zones of shared risk”?
 - ✓ Where do all of these intersect with planned development areas and TOD opportunities?
- Can be applied to inland and coastal settings and communities

Resilient Connecticut Phase II

From Regional Vulnerabilities to Resilience Opportunities

Overlay Process for TOD Communities

- Opportunity areas followed an overlay method beginning with regional assets and infrastructure
- Next were zones of shared risk, flood vulnerability, and heat vulnerability
- Planned development and TOD areas were used to refine area positions and boundaries



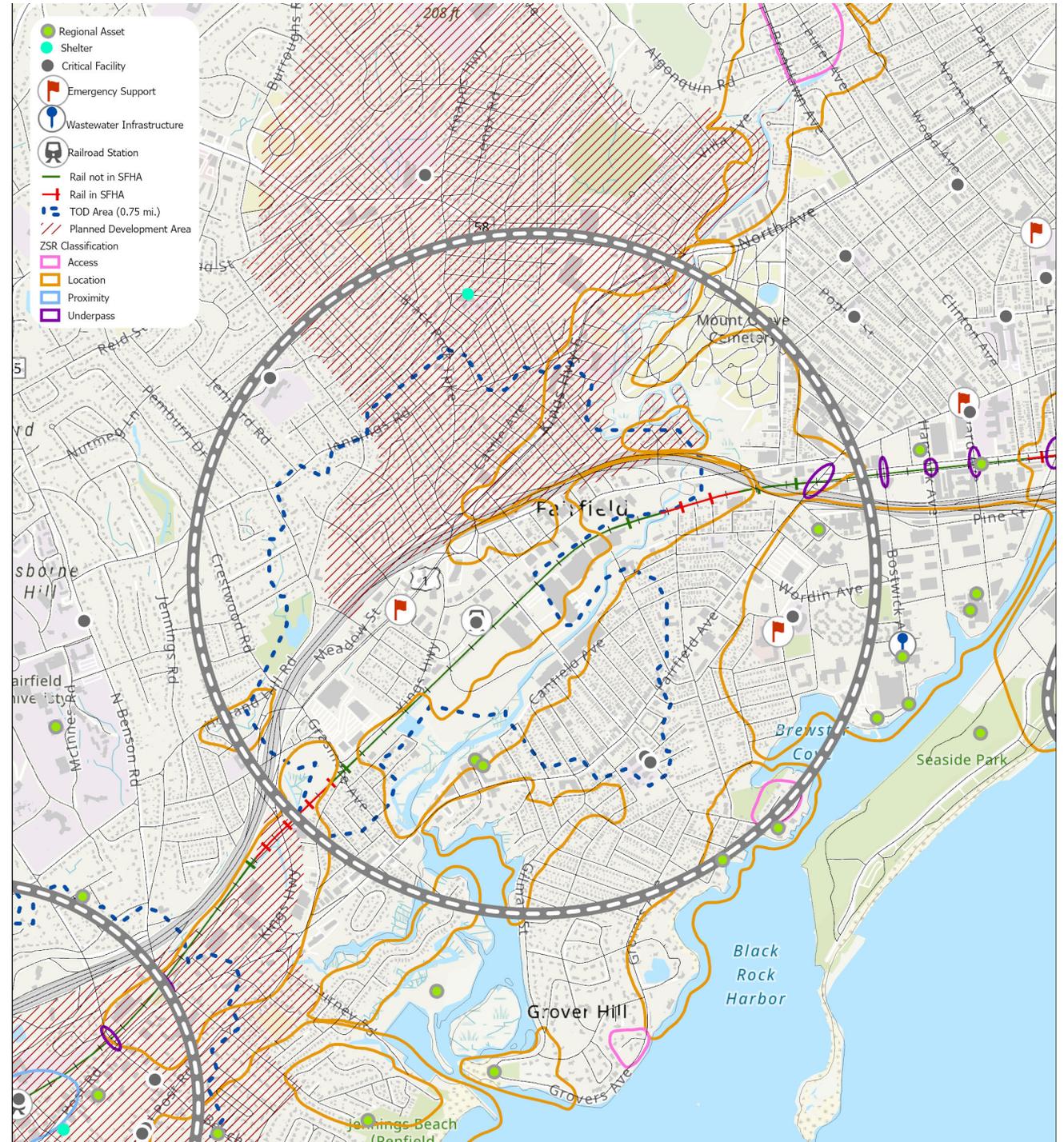
Resilient Connecticut Phase II

Regional Adaptation/Resilience Opportunity Areas

Name: Fairfield Metro

Location: Fairfield

Considerations	Characteristics of Area
Flood Vulnerability	● ● ● ● ●
Heat Vulnerability	● ● ● ● ●
Social Vulnerability	● ● ● ● ●
<p>Fairfield and Bridgeport meet along the Ash Creek and Rooster River watershed. The Rooster River presents significant riverine flood risk to both communities, and Ash Creek is subject to storm surge flooding as occurred during SuperStorm Sandy. Fairfield supports TOD around the Fairfield Metro train station west of Ash Creek, and Bridgeport supports flood-resilient economic development in the Lower West End along Cedar Creek. Railroad underpasses have flooded many of the roads in the Lower West End. Although some distance is located between Fairfield Metro and the Lower West End, increasing pedestrian and transit connectivity across Ash Creek will join these areas, elevating their importance in the region. Large amounts of impervious surfaces from commercial development, dense residential development, with little green/open space contribute to increased heat vulnerability.</p>	
West End Fire Station Co. #7 & #11 American Medical Response Rail Station	Four Schools Biodiesel plant Substation Coastal access



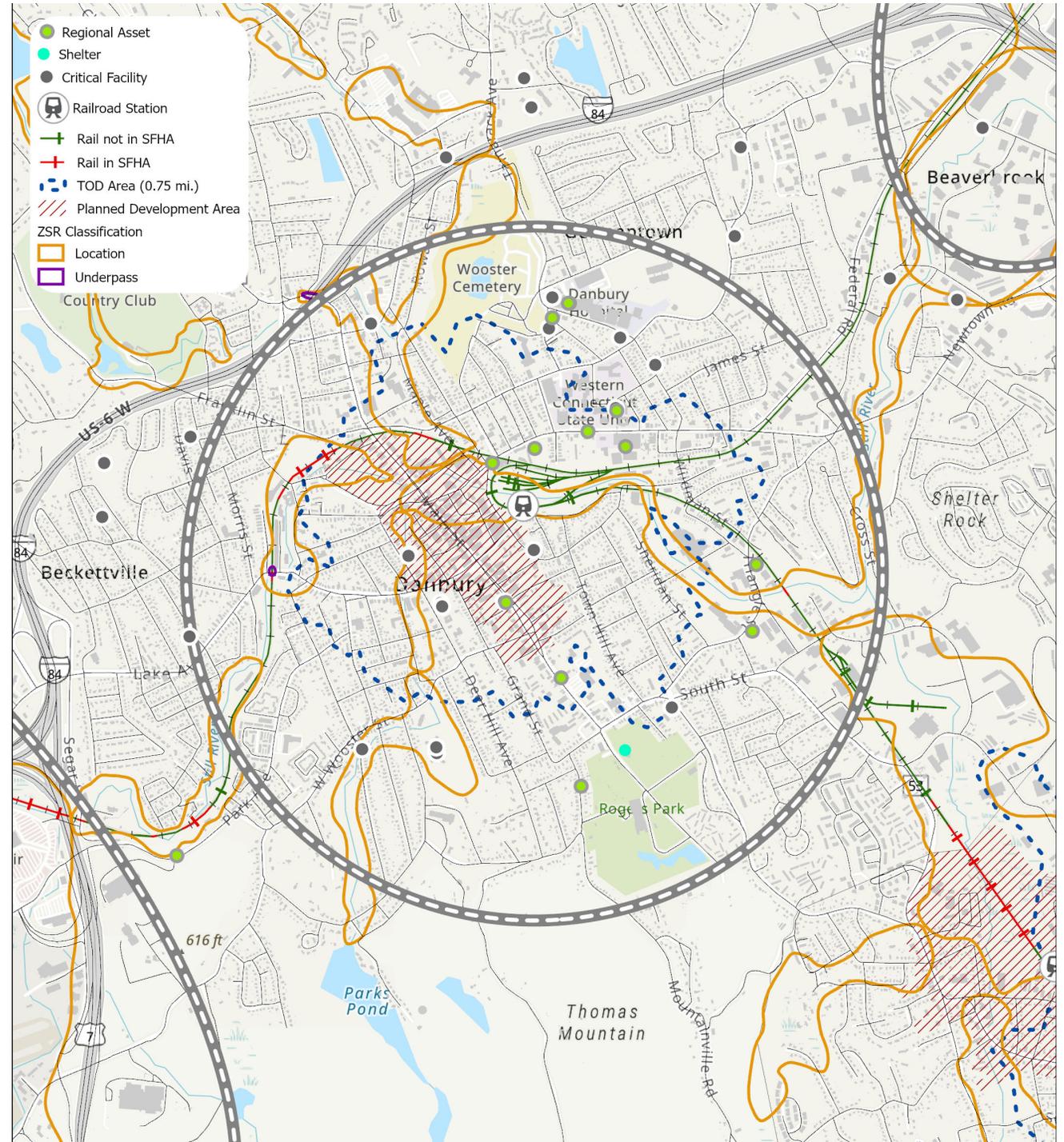
Resilient Connecticut Phase II

Regional Adaptation/Resilience Opportunity Areas

Name: Downtown Danbury

Location: Danbury

Considerations	Characteristics of Area
Flood Vulnerability	● ● ● ● ●
Heat Vulnerability	● ● ● ● ●
Social Vulnerability	● ● ● ● ●
<p>The center of Danbury is characterized by zones of shared risk associated with the confluence of Padanarum Brook, Kohanza Brook, and the Still River. Despite many flood risk reduction projects undertaken over decades, TOD and planned development areas are located in close proximity to – or within – these zones of shared risk. Numerous critical facilities, historic resources, and the terminus of the MetroNorth Danbury line are also located in the area. Downtown Danbury is a regional center for northern WestCOG.</p> <p>Almost all of the downtown area is moderately vulnerable to heat, with the highest vulnerable area concentrate along route 53 commercial properties. Presenting few opportunities for shade or street trees, the area has high heat emittance. In addition, there is high social sensitivity throughout the area.</p>	
<p>City Hall Fire headquarters Hose Co. 5, 6, 7, and 9 Danbury Hospital Danbury Health and Housing Dept. Western CT State College Police</p>	<p>Assisted living facilities War Memorial Substation Power plant Museums</p>



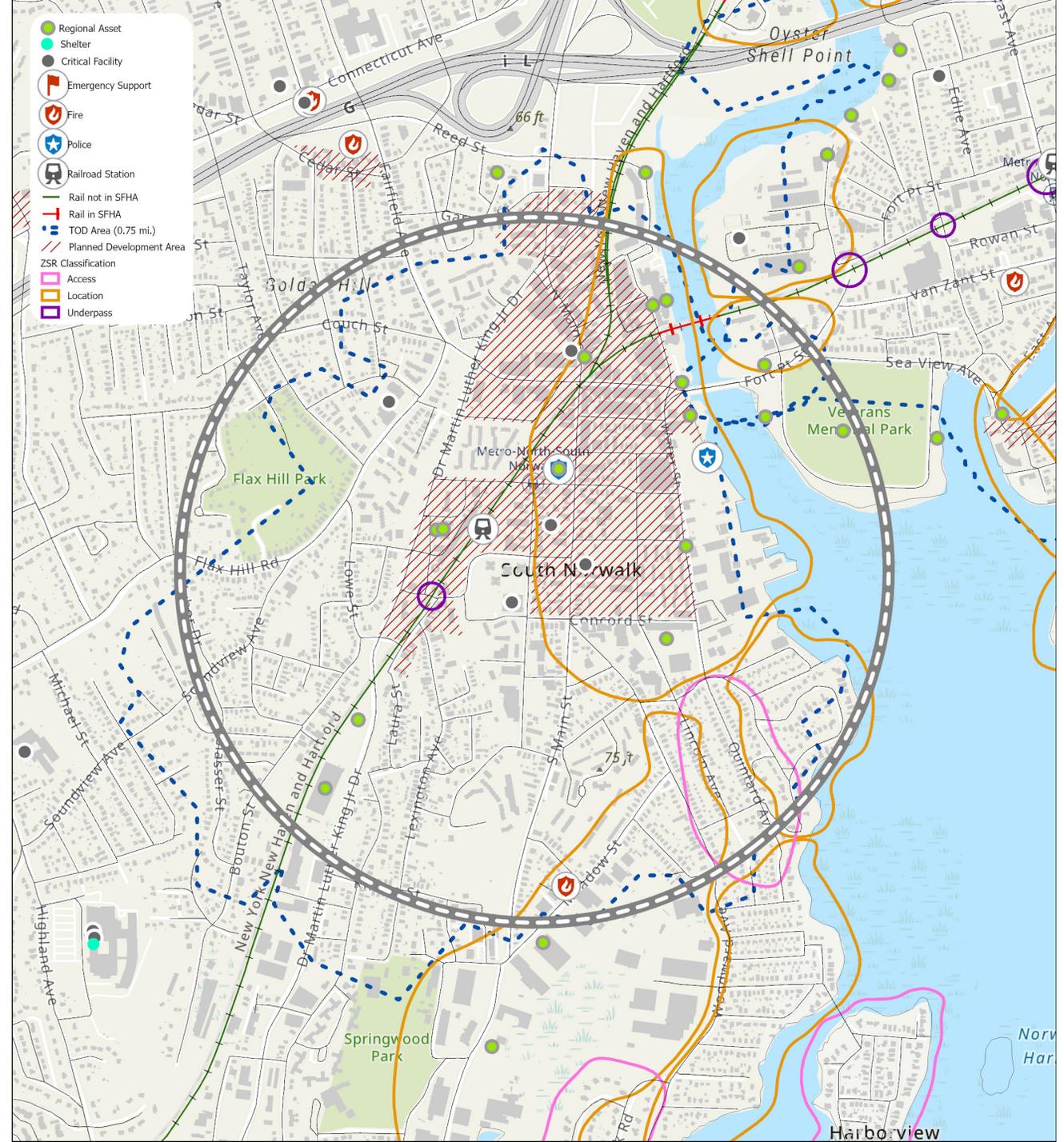
Resilient Connecticut Phase II

Regional Adaptation/Resilience Opportunity Areas

Name: South Norwalk

Location: Norwalk

Considerations	Characteristics of Area
Flood Vulnerability	○ ● ● ● ● ○
Heat Vulnerability	○ ● ● ● ● ○
Social Vulnerability	○ ● ● ● ● ○
<p>The South Norwalk area contains a major railroad station, numerous critical facilities and historic resources, regional tourist attractions, flood risk associated with the Norwalk River estuary and Norwalk Harbor, and key connections to areas to the south that can be isolated by coastal flooding. The City is evaluating challenges and opportunities associated with commercial and water-dependent properties along Water Street, all in the coastal flood zone.</p> <p>All of the SoNo area is high heat with dense commercial/industrial coverage along the waterfront with high impervious surfaces, and dense but green residential west of the railroad. This area is however high for social sensitivity contributing to the vulnerability.</p>	
<p>Fire station 5 Police dept. Marine patrol Two schools Medical care facilities</p>	<p>Coastal access Substation Commerce Shipping</p>



Resilient Connecticut Phase II

Regional Adaptation/Resilience Opportunity Areas

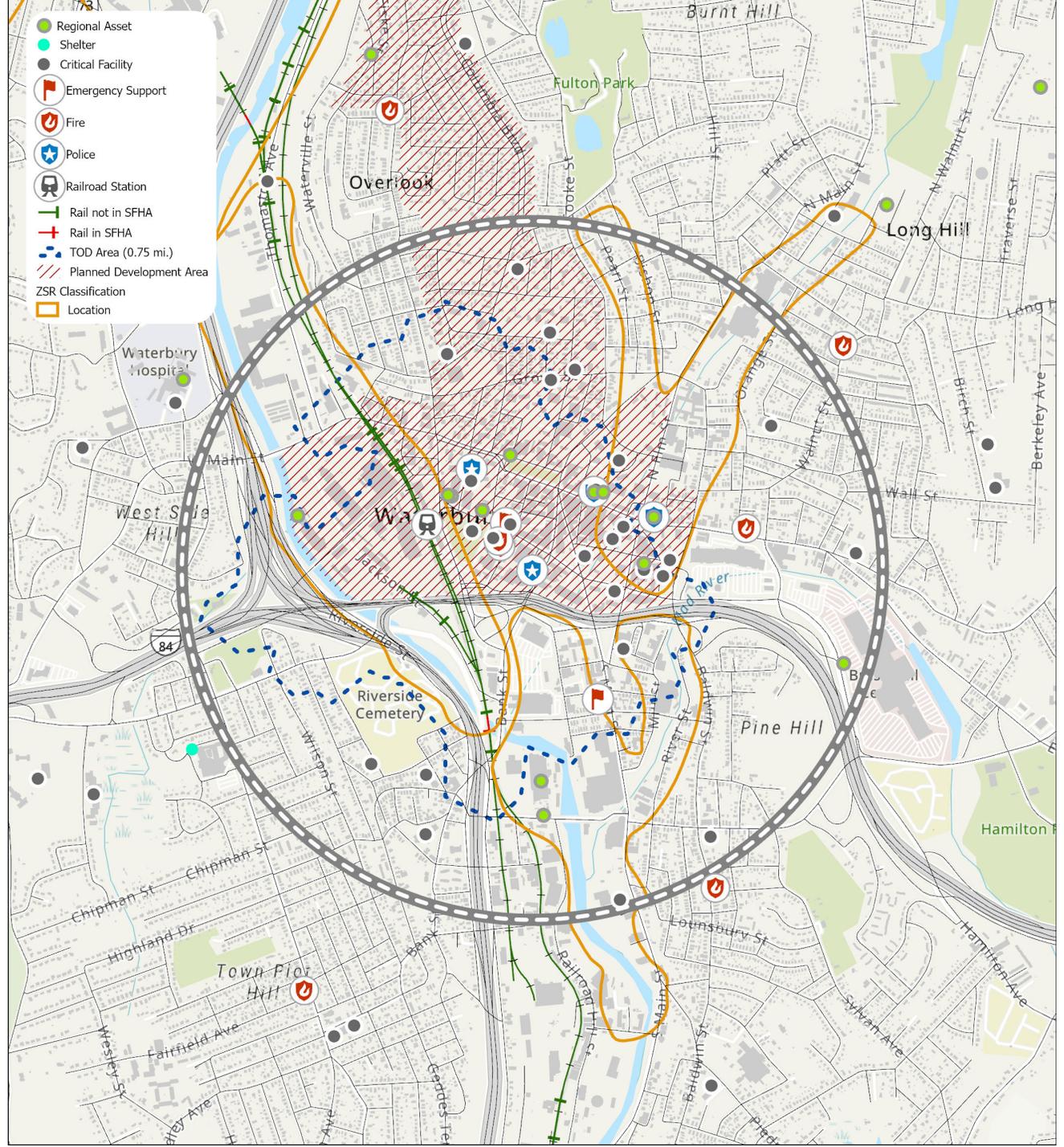
Name: Downtown Waterbury

Location: Waterbury

Considerations	Characteristics of Area
Flood Vulnerability	○ ● ● ● ● ○
Heat Vulnerability	○ ● ● ● ● ○
Social Vulnerability	○ ● ● ● ● ○

Several zones of shared risk merge in downtown Waterbury including the Naugatuck River corridor, Mad River watershed, Great Brook, and stream below the Fulton Park Ponds. Flood risks vary from riverine to the challenges associated with streams buried in culverts below buildings. TOD is desired in the Freight Street area, capitalizing on enhancements to the Waterbury line of MetroNorth. Numerous critical facilities and historic resources are located throughout the area. High heat vulnerable areas are concentrated along I-84 and Route 8. A high percentage of impervious surface with few green space and streets drives heat vulnerable in addition to a strong correlation with heat related social sensitivity.

Police dept., sub-station, annex New Haven County Marshal Campion Ambulance City Hall/EOC	Fire Dept. Station 10 & 2 St. Mary's Hospital Silas Bronson Library 14 schools City Offices	Assisted living facilities Electric substations Museums
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Resilient Connecticut Phase II

Regional Adaptation/Resilience Opportunity Areas

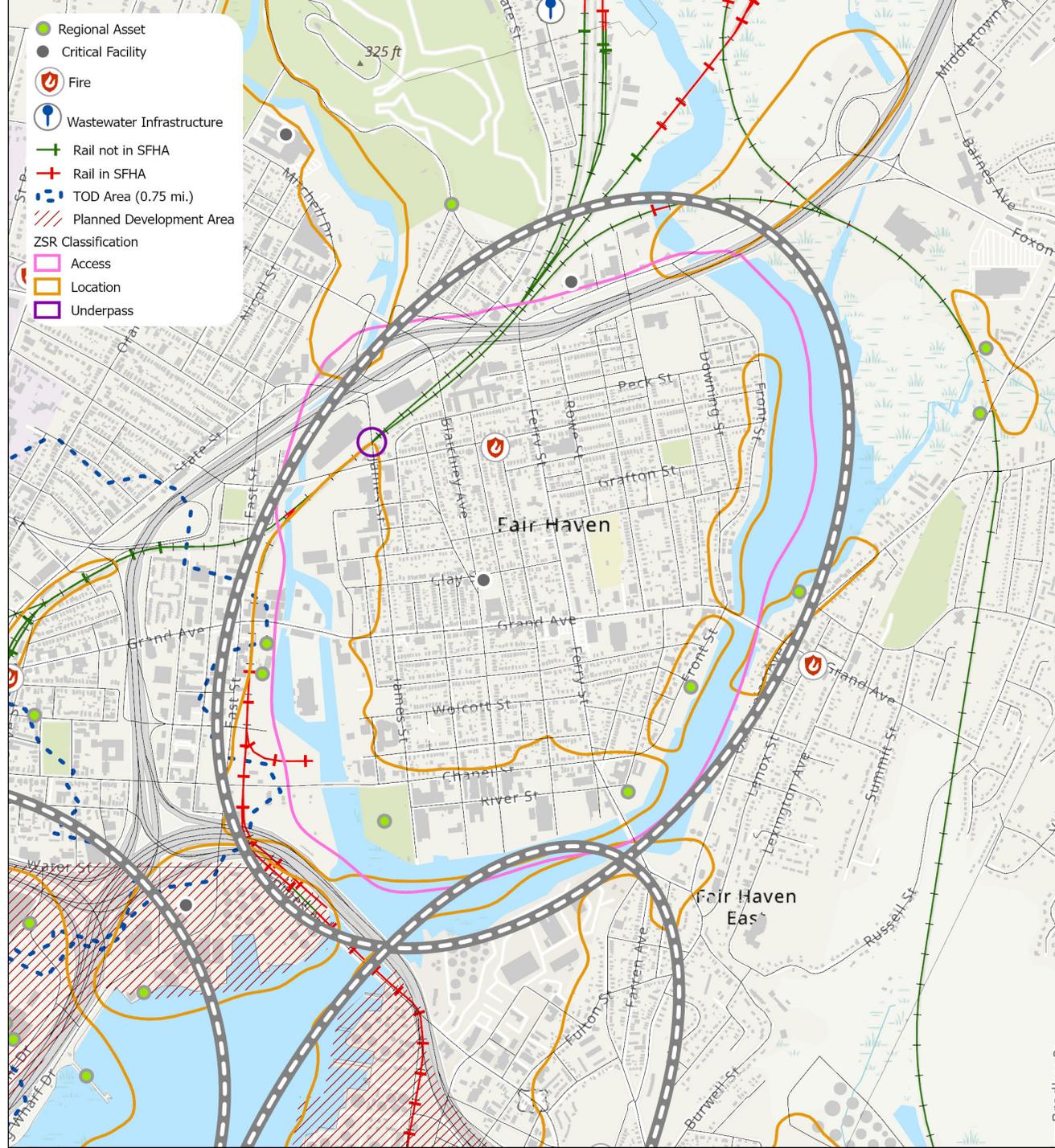
Name: Fair Haven/Mill River
 Location: New Haven

Considerations	Characteristics of Area
Flood Vulnerability	● ● ● ● ●
Heat Vulnerability	● ● ● ● ●
Social Vulnerability	● ● ● ● ●

Zones of shared risk along the Mill River and Quinnipiac River merge with a zone of shared risk drawn around Fair Haven (for isolation risks) to highlight an opportunity area centered on Fair Haven. While TOD does not overlap with Fair Haven, it is present just west of the Mill River. Numerous resilience opportunities may be available as the City promotes and supports redevelopment in the Mill River and Fair Haven areas. Care should be taken to enhance livability in Fair Haven and connectivity to surrounding areas.

Fair Haven is entirely high heat vulnerable. This is attributed primarily to the high social sensitivity present here, combined with dense housing, high amounts of pavement, and disconnected green space for shade.

Fire station	Substation
Public works	Coastal access
School	



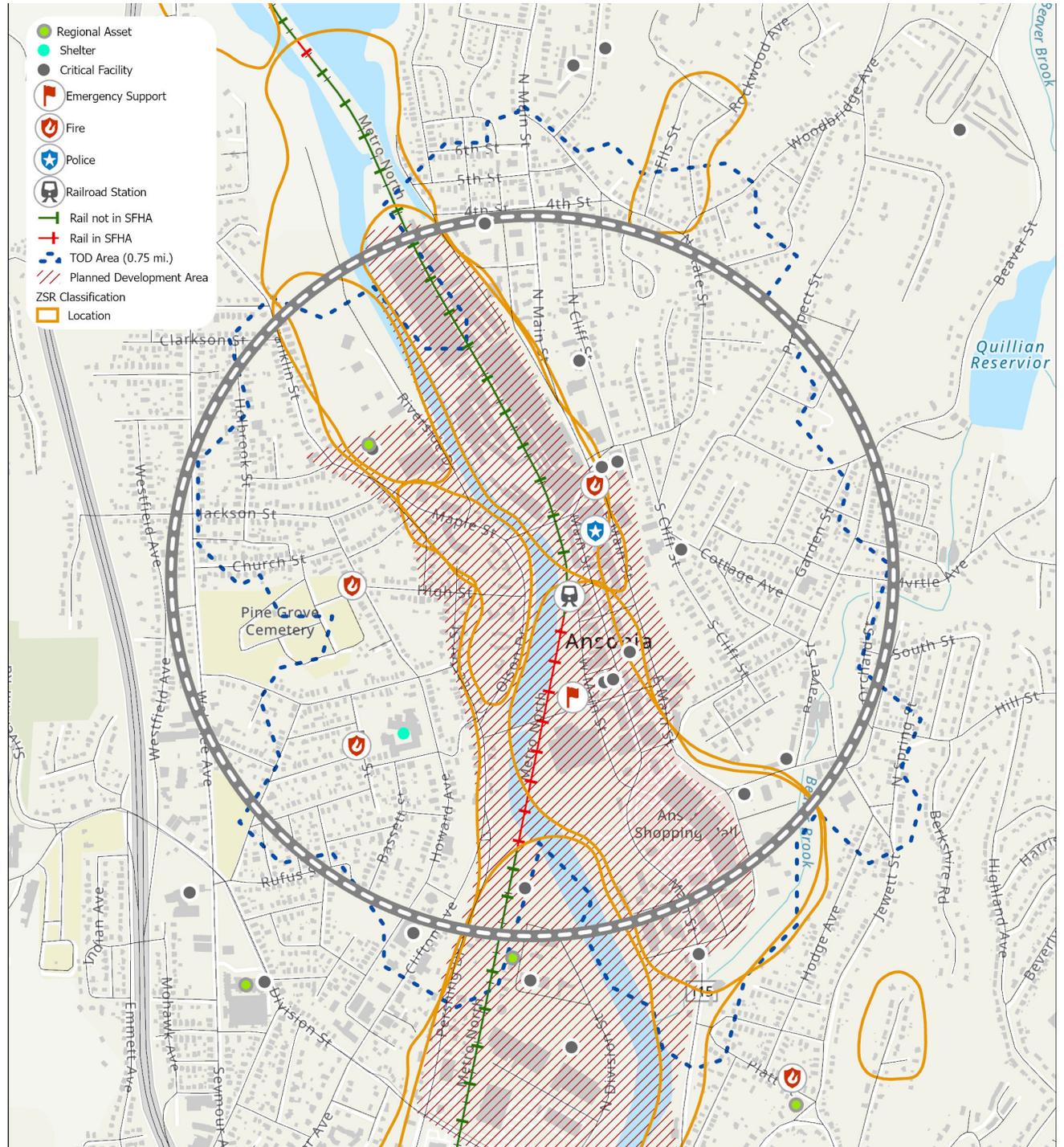
Resilient Connecticut Phase II

Regional Adaptation/Resilience Opportunity Areas

Name: Ansonia

Location: Ansonia

Considerations	Characteristics of Area
Flood Vulnerability	● ● ● ● ●
Heat Vulnerability	● ● ● ● ○
Social Vulnerability	● ● ● ● ○
<p>Several riverine zones of shared risk merge in Ansonia where significant redevelopment is planned, ranging from the Ansonia Brass & Copper site to the downtown area between West Main Street and East Main Street, to the Olsen Drive area on the west side of the river. With all the TOD and redevelopment planned along with new transportation corridors, the City has opportunities to incorporate resilience into many projects. The west bank of the Naugatuck River is heavily developed with high density of impervious surfaces and dark roofed structures. In addition, the area has high heat related social sensitivity which is a strong component of the heat vulnerability in the area.</p>	
<p>Hose co. 1, 4, and 6 Armory City Hall Rescue and medical services Valley YMCA</p>	<p>Two schools Substation Police department Ansonia Community Action Elderly housing</p>



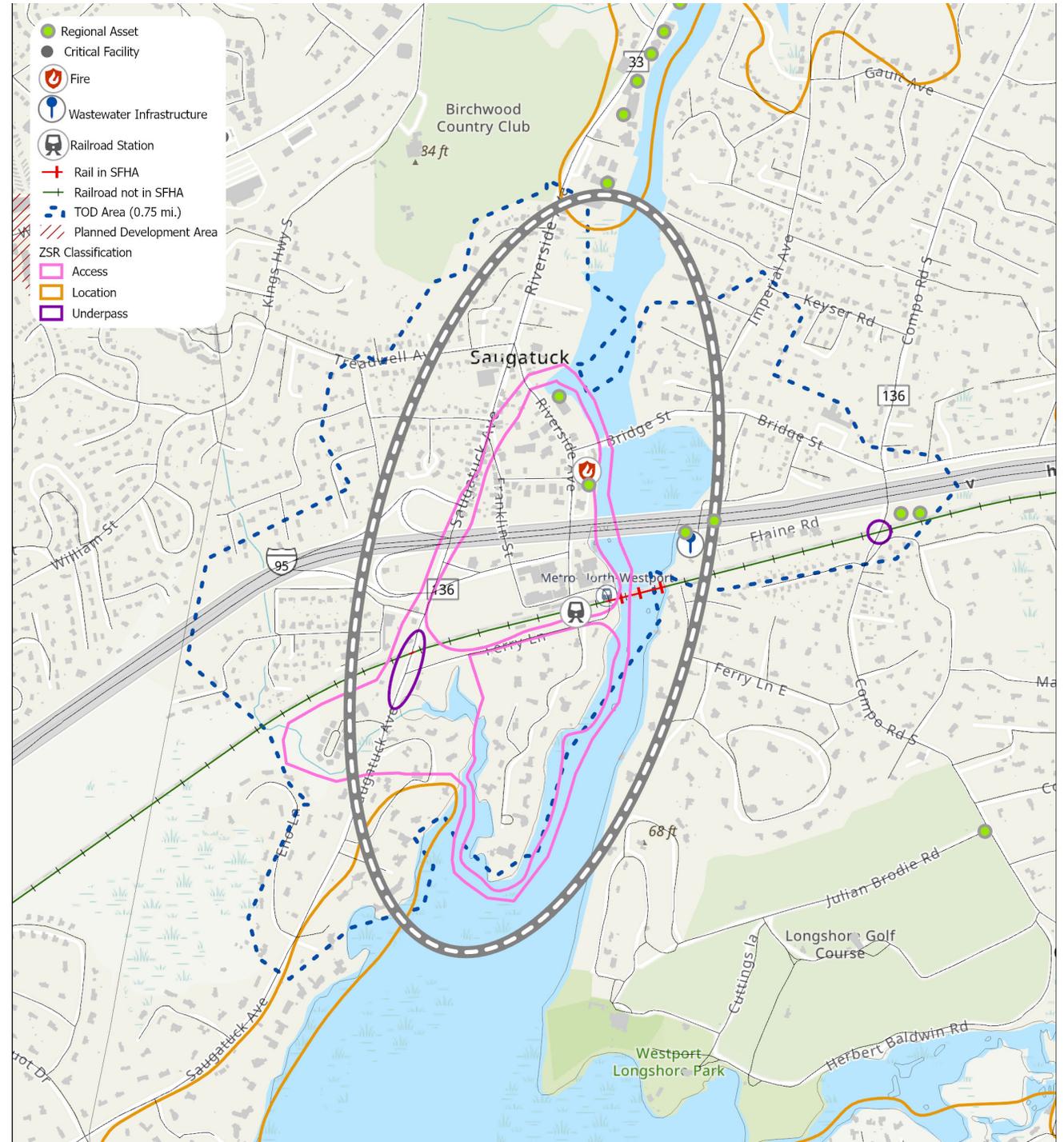
Resilient Connecticut Phase II

Regional Adaptation/Resilience Opportunity Areas

Name: Saugatuck

Location: Westport

Considerations	Characteristics of Area
Flood Vulnerability	○ ● ● ● ● ● ● ● ○
Heat Vulnerability	○ ● ● ● ● ○ ○ ○ ○ ○
Social Vulnerability	○ ● ○ ○ ○ ○ ○ ○ ○ ○ ○
<p>The Saugatuck station part of Westport faces coastal flood risk from the Saugatuck River estuary and Indian River estuary. Due to the topography of the area, the train station and surrounding development (residential, commercial, critical facilities, and historic resources) have an isolation risk. Interstate 95 passes through the area.</p> <p>The moderately heat vulnerable area does have significant tree coverage, however, some areas lack tree coverage reducing vegetative adaptive capacity, while others are high for social sensitivity.</p>	
<p>Saugatuck fire dept. Town sewer treatment Coastal access</p>	



Resilient Connecticut Phase II

Regional Adaptation/Resilience Opportunity Areas

Name: Branford Center

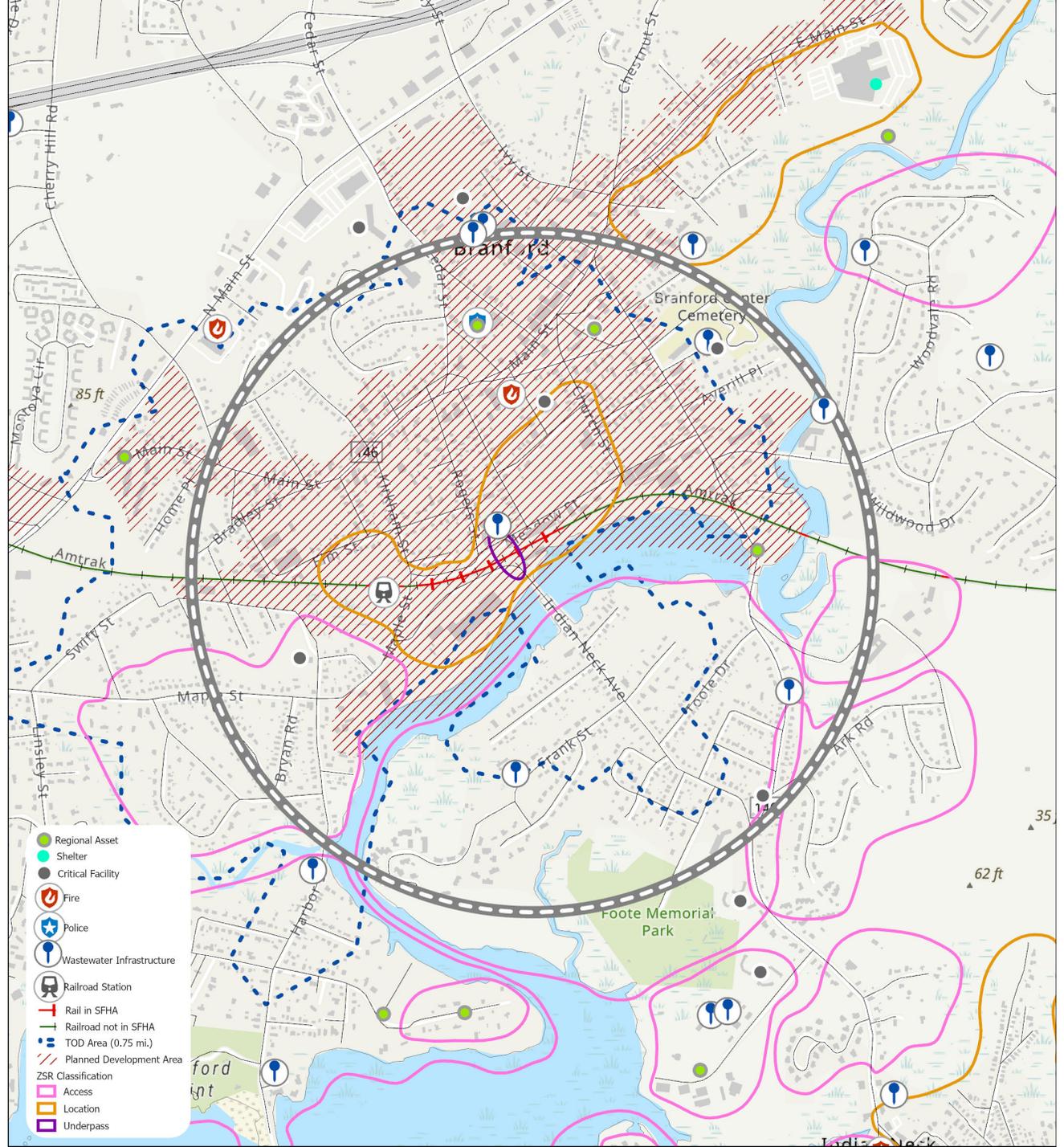
Location: Branford

Considerations	Characteristics of Area
Flood Vulnerability	○ ● ● ● ● ○
Heat Vulnerability	○ ● ● ○ ○
Social Vulnerability	○ ● ● ○ ○

The area immediately south of downtown Branford is characterized by residential properties, commercial properties, historic resources, and transit-related land uses all within a TOD area along the Branford River. Coastal flood risks are significant, and floodwaters have entered the Meadow Street/Hammer Field area several times in the past decade. The Town wishes to pursue resilient development and flood risk reduction in this area. Branford center heat vulnerable areas are sporadic. This is mainly due to the mixed-use nature of the area. Vegetative adaptive capacity is inconsistent throughout the area, with some commercial areas providing little shade relief.

Town Hall
Police Dept.
State Armory
Pump stations

Fire headquarters
Slincy School
Coastal access

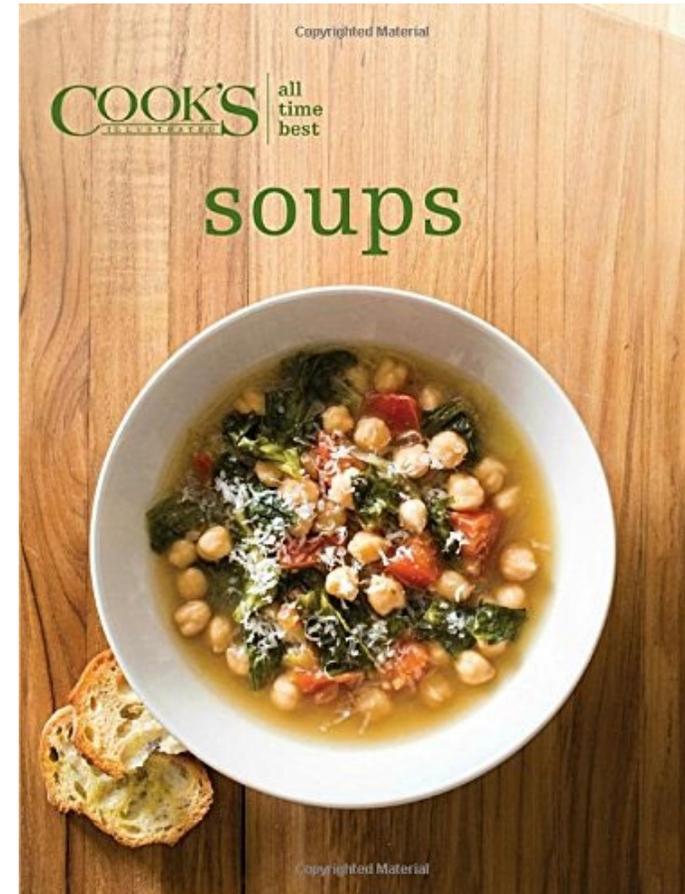


Resilient Connecticut Phase II

From Regional Vulnerabilities to Resilience Opportunities

Additional ROAR “recipes”

- Micro-step beyond grant obligations
- Inform state programs & policies
- Links Vulnerability to Local Planning
- Addresses stakeholder comments from RCC, regional workshops, SAFR
- GIS analysis and technical review
- *Limited by available data (e.g. no widely available evacuation routes of affordable housing) at this moment*
- Can add on additional priorities to sort



Example Concept - Housing



Resilient Connecticut Phase II

Regional Adaptation/Resilience Opportunity Areas

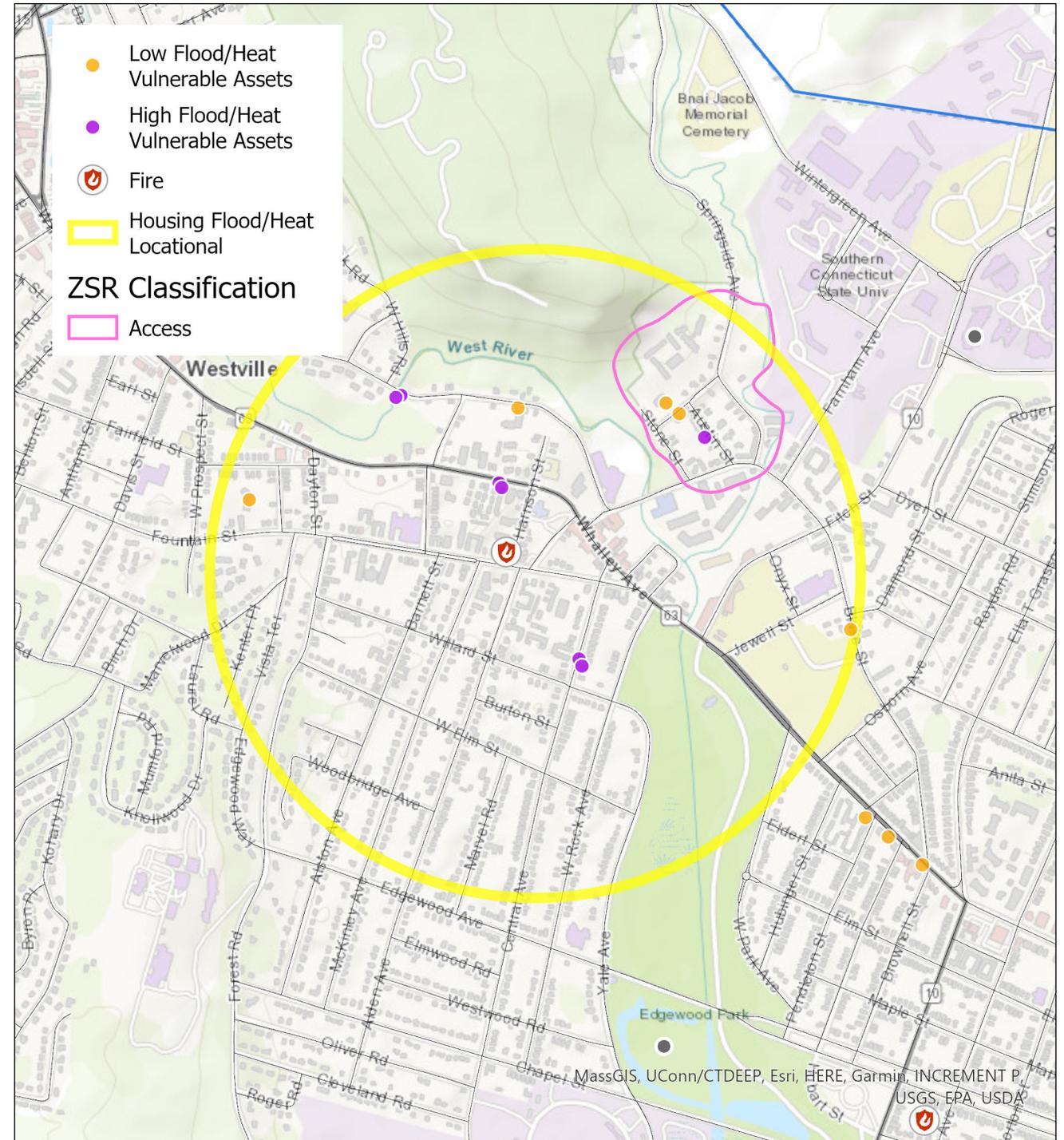
Name: Westville

Location: New Haven

Considerations	Characteristics of Area
Flood Vulnerability	○ ● ● ● ○ ○
Heat Vulnerability	○ ● ● ● ● ○
Social Vulnerability	○ ● ● ● ● ○

This Westville opportunity area encompasses the West River corridor in New Haven, multiple parks, SCSU, and commercial areas. The area contains several affordable housing assets, with some more vulnerable to flood and extreme heat than others. The housing assets are potential candidates for flood protection, flood mitigation during redevelopment, and energy efficiency and heat mitigation upgrades depending upon specific structural needs.

Affordable housing assets located in high flood and high heat vulnerable areas



Resilient Connecticut Phase II

Regional Adaptation/Resilience Opportunity Areas

Name: Fairfield Reef Road Corridor

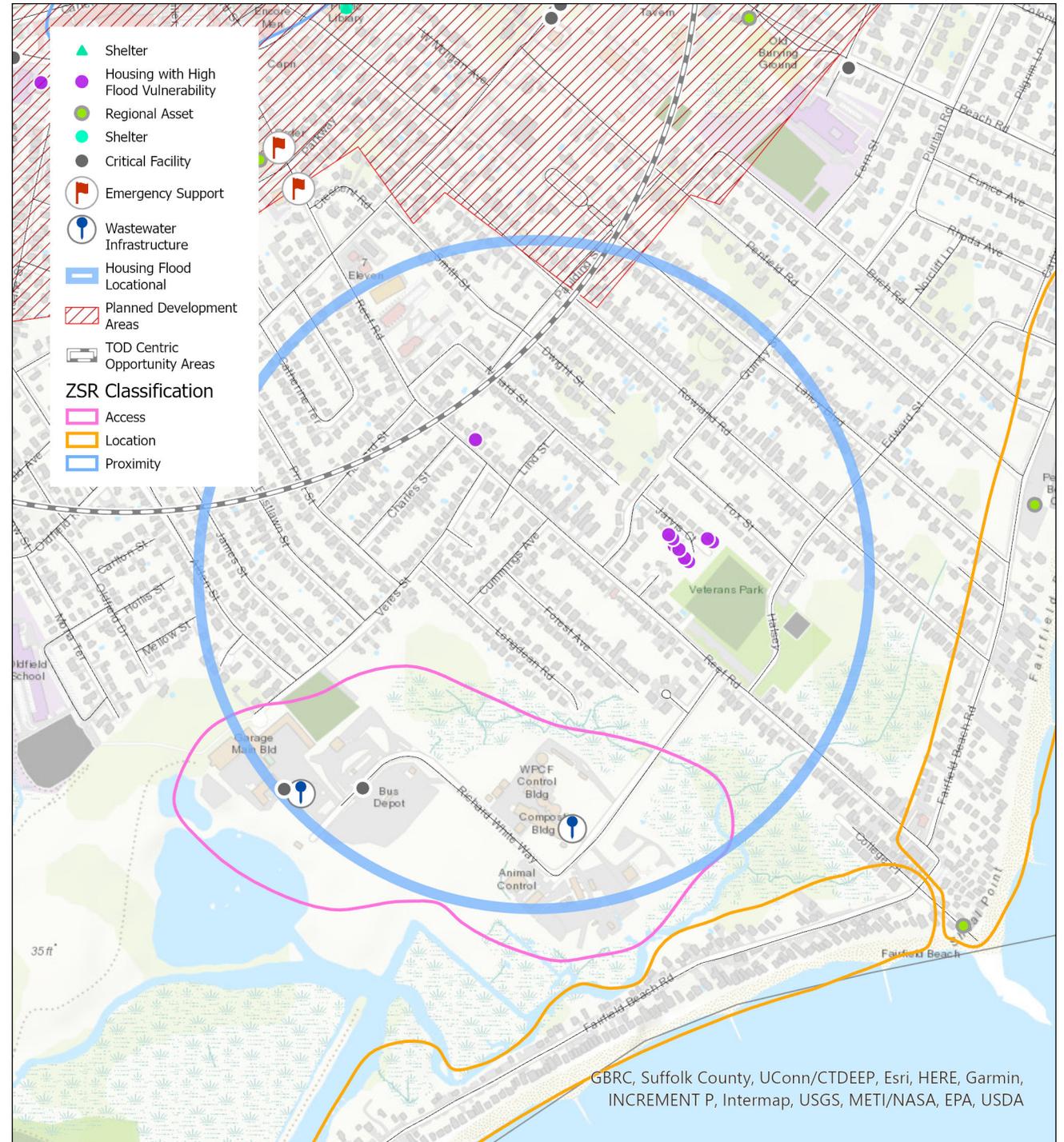
Location: Fairfield

Considerations	Characteristics of Area
Flood Vulnerability	○ ● ● ● ● ○
Heat Vulnerability	○ ● ● ○ ○
Social Vulnerability	○ ● ○ ○ ○

This opportunity area spans the broad coastal floodplain in the Reef Road area Morningside and the Calf Pen tidal marshes, including several affordable housing assets and critical facilities at a municipal services campus. The coastal area is at risk of flooding. Flooding may result from storm surge and high tide events, becoming more severe over time due to sea level rise. Numerous homes in the area have been elevated, but the entire area will be at increasing risk over time.

The downtown Fairfield opportunity area described previously intersects with this affordable housing-centric opportunity area.

Affordable housing assets located in high flood vulnerable areas



GBRC, Suffolk County, UConn/CTDEEP, Esri, HERE, Garmin, INCREMENT P, Intermap, USGS, METI/NASA, EPA, USDA

Resilient Connecticut Phase II

Regional Adaptation/Resilience Opportunity Areas

Name: Putney Area

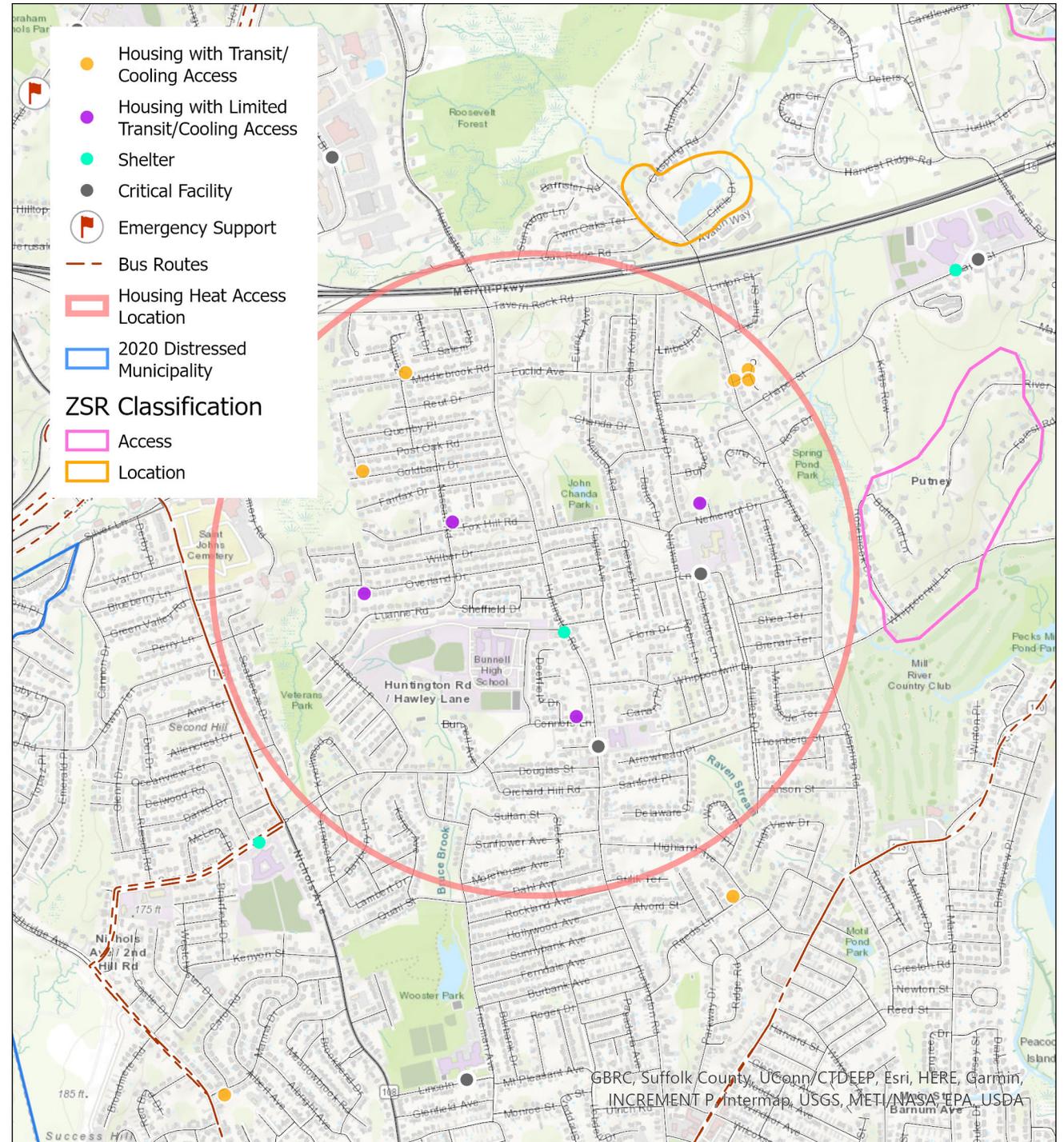
Location: Stratford

Considerations	Characteristics of Area
Flood Vulnerability	
Heat Vulnerability	
Social Vulnerability	

The Putney area in Stratford is characterized by residential development and several affordable housing assets. In addition, a municipal shelter and critical facilities are located within the area.

Some affordable housing assets, which are also in a high heat vulnerable area, are not located within proximity to a bus route or cooling center. While street trees may provide cooling respite throughout the area, these locations may require structural upgrades or additional access to cooling locations or public transportation.

Affordable housing assets in high heat vulnerable areas with limited transit or cooling center access



Resilient Connecticut Phase II

Regional Adaptation/Resilience Opportunity Areas

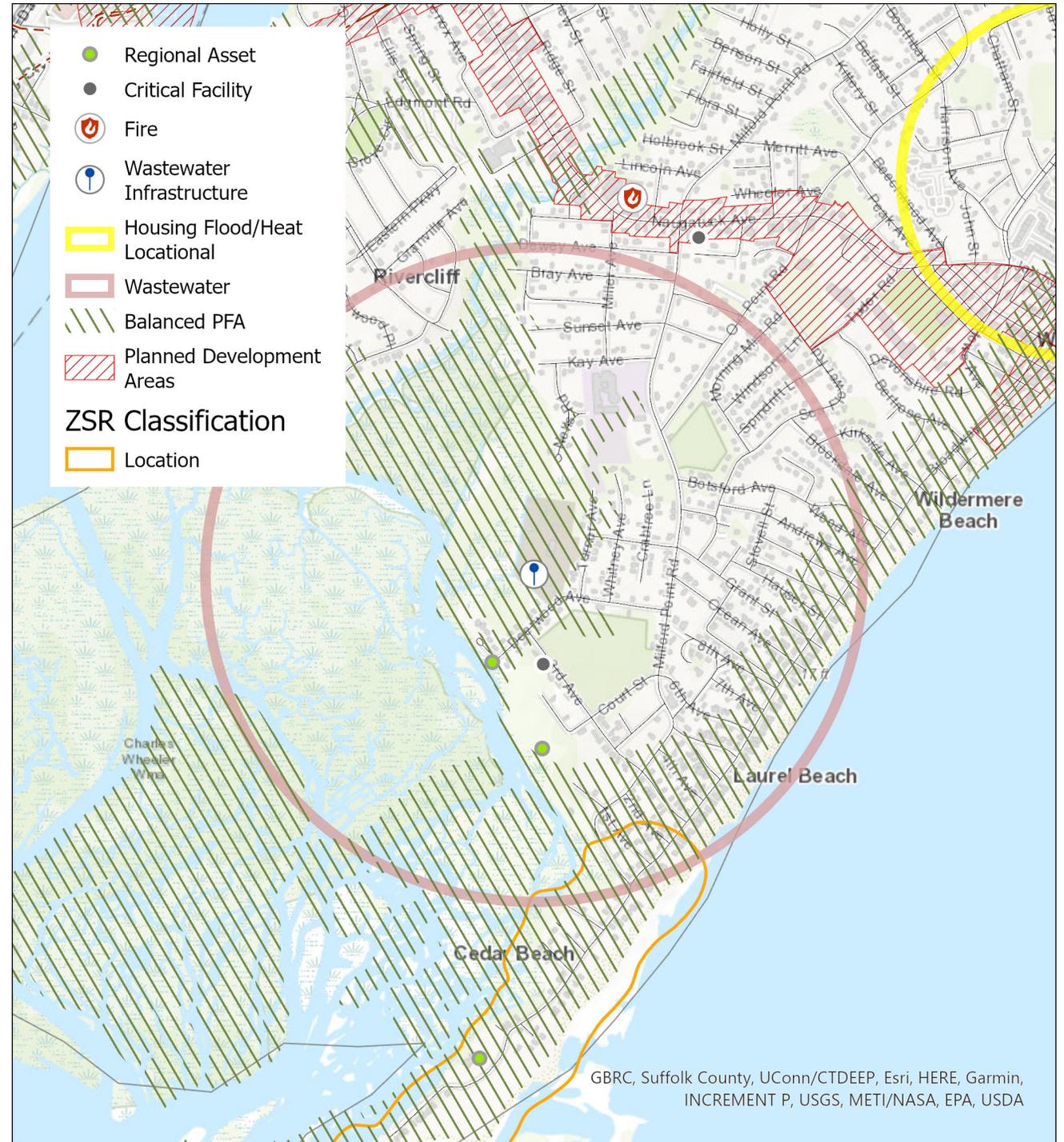
Name: Beaver Brook Area

Location: Milford

Considerations	Characteristics of Area
Flood Vulnerability	
Heat Vulnerability	
Social Vulnerability	

Even with a large buffering marsh adjacent to the flood-vulnerable Beaver Brook Wastewater Treatment Plant, flood vulnerability at the plant is present from storm surge and extreme high tide events. The potential opportunity area spans from Beaver Brook and the Wheeler Marsh to Laurel Beach and Wildemere Beach, where considerable effort has been focused on beach nourishment for moderate flood protection.

Wastewater treatment in a high flood vulnerable location and a State-designated “balanced priority funding area.”



Resilient Connecticut Phase II

Regional Adaptation/Resilience Opportunity Areas

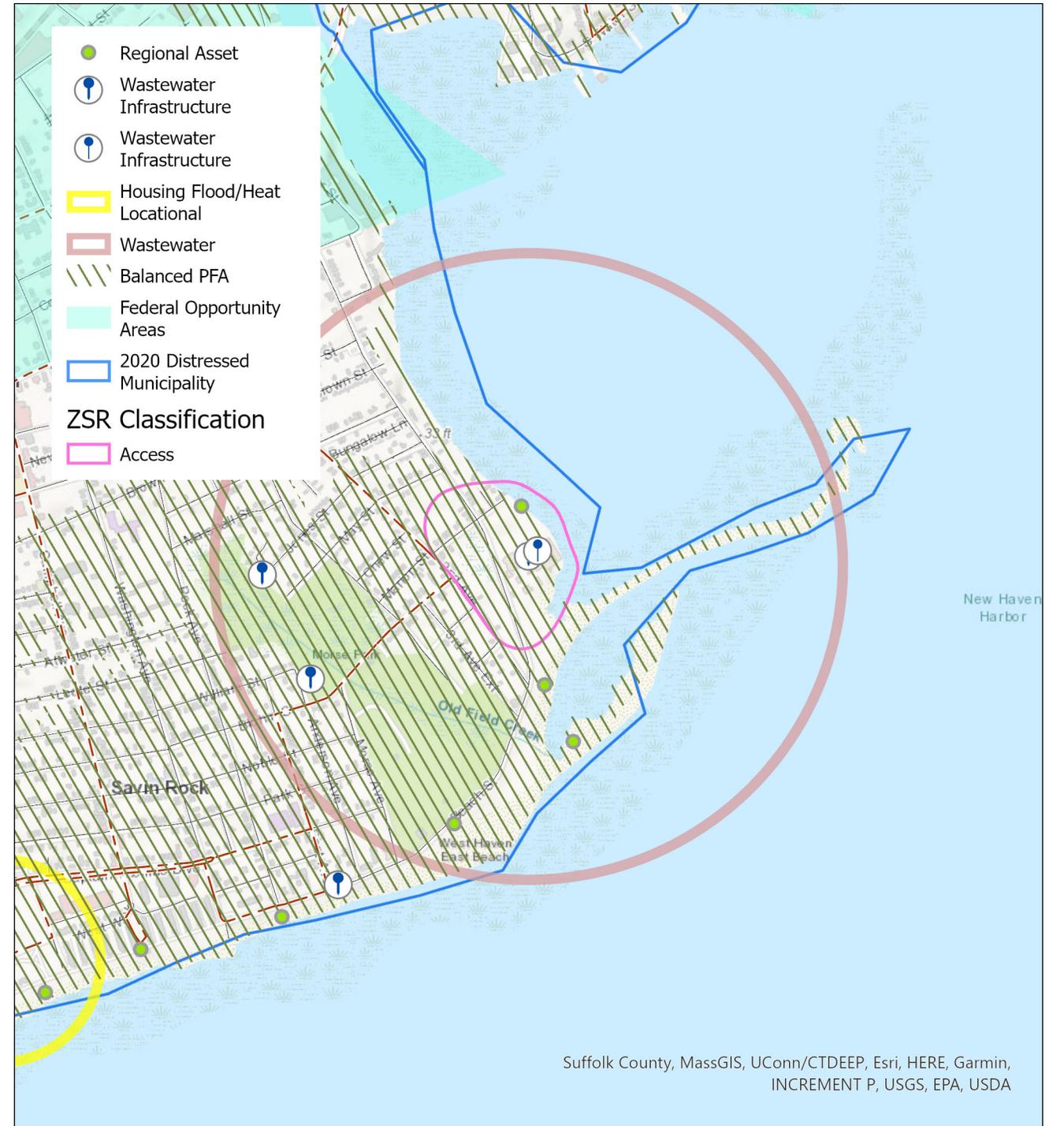
Name: Old Field Creek and Sandy Point

Location: West Haven

Considerations	Characteristics of Area
Flood Vulnerability	○ ● ● ● ● ○
Heat Vulnerability	○ ● ● ● ● ○
Social Vulnerability	○ ● ● ● ● ○

The City of West Haven has invested considerable municipal, state, and federal resources in this area, from tide gate upgrades and sediment removal along Old Field Creek, to acquisition and removal of numerous homes that suffered repeated coastal flooding using NRCS funds. The City has recognized the need to invest in the sewer pumping stations and wastewater treatment plant to continue providing sanitary sewer service to the entire West Haven community.

Wastewater treatment in a high flood vulnerable location and a State-designated “balanced priority funding area.”



Resilient Connecticut Phase II

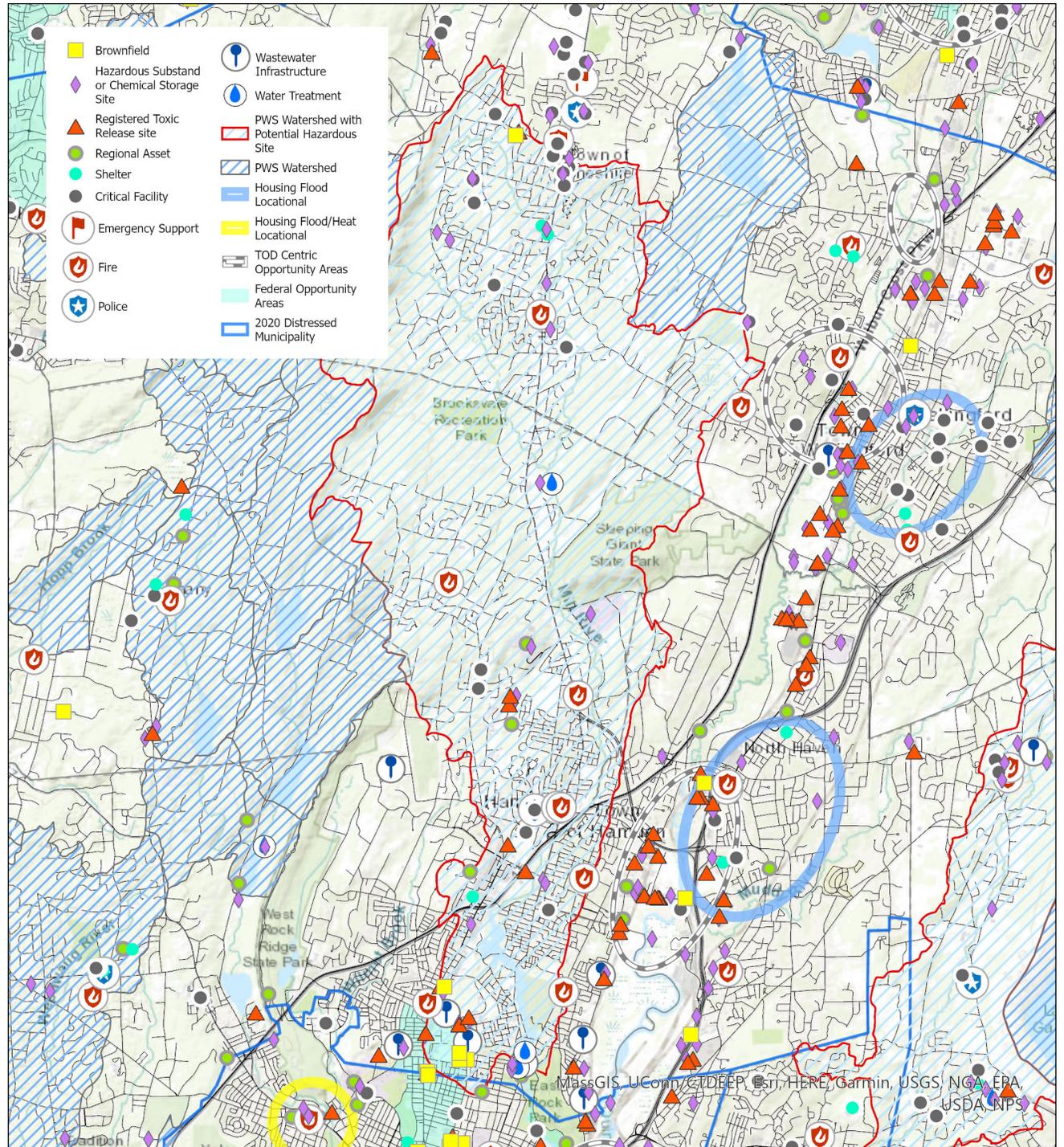
Regional Adaptation/Resilience Opportunity Areas

Name: Lake Whitney Watershed
 Location: Cheshire/Hamden/North Haven

Considerations	Characteristics of Area
Flood Vulnerability	● ● ○ ○ ○
Heat Vulnerability	● ● ○ ○ ○
Social Vulnerability	● ● ○ ○ ○

The Lake Whitney watershed has several sites of potential concern throughout its 23,000 acres. While overall flood vulnerability is low to moderate throughout the watershed, some potential toxic substance sites are situated along the Mill River, Willow Brook, and within direct proximity to Lake Whitney, presenting potential concerns in the event of a flood that causes a release or spill. Notwithstanding the source protection programs in place at the State and local levels, the presence of the potential releases in the watershed suggest an opportunity for advancing resilience to climate impacts such as more intense or frequent floods.

Public water supply watershed with potential risk of toxic releases from land uses that have flood vulnerability.



Resilient Connecticut Phase II

Regional Adaptation/Resilience Opportunity Areas

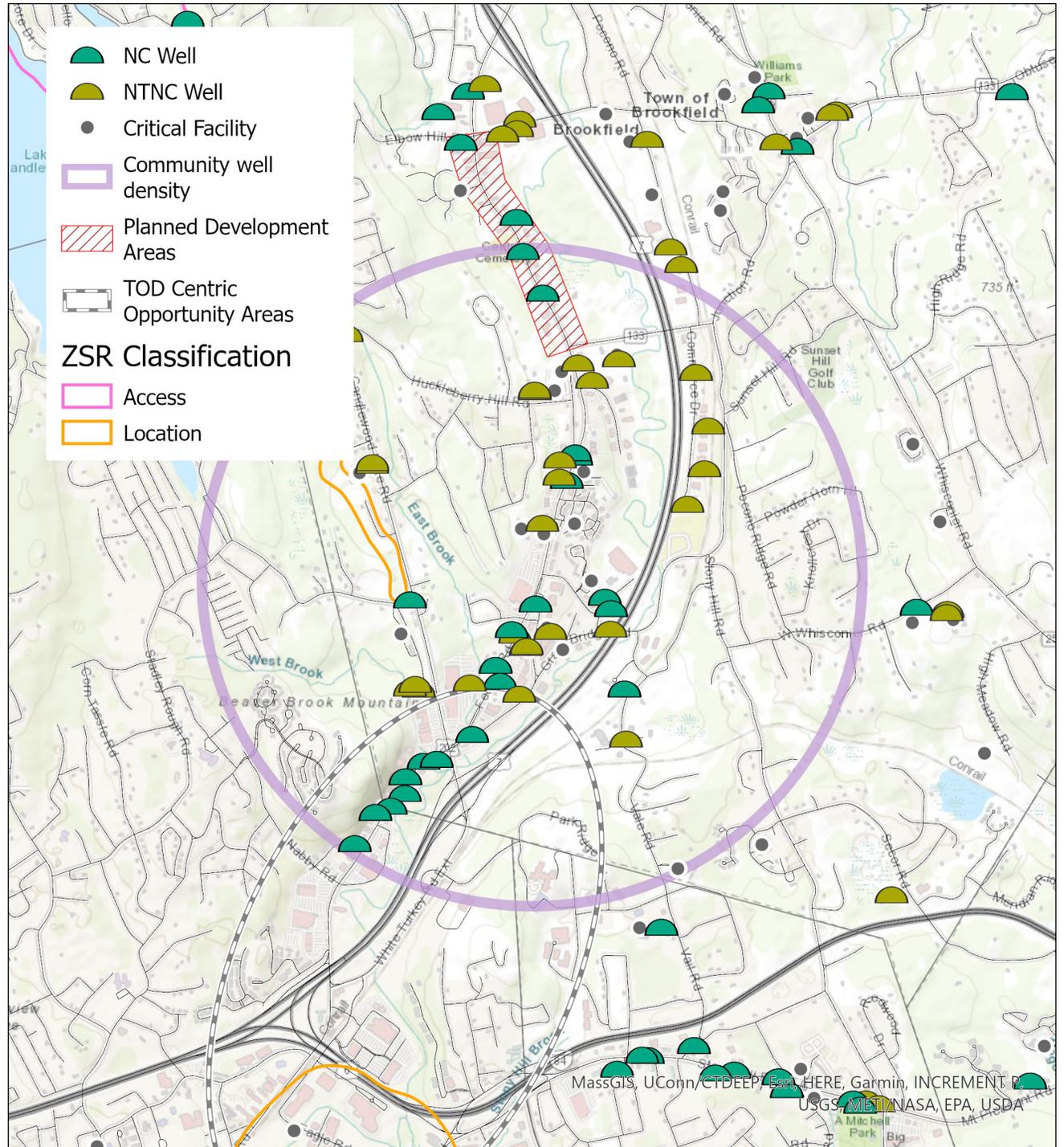
Name: Federal Road

Location: Brookfield

Considerations	Characteristics of Area
Flood Vulnerability	
Heat Vulnerability	
Social Vulnerability	

The Town of Brookfield and Aquarion Water Company have taken steps to expand Aquarion’s water system and connect individual properties with non-transient non-community and transient non-community wells, but numerous wells and small water systems remain present. With increasing flood and heat risks possible due to variable flood and heat vulnerabilities along the heavily developed Route 7 corridor, individual wells and water systems could be adversely impacted over time. The opportunity area includes many of the non-transient non-community and transient non-community wells.

High density of public water supply wells in areas of flood and heat vulnerability.



Resilient Connecticut Phase II

From Regional Vulnerabilities to Resilience Opportunities



Report Issued in October 2021

- A review of social, built, and ecological vulnerabilities
- Assessments evaluate at COG level and on specific assets

Executive Summary

- High level overview of process and tools
- COG “fact sheets” for flood and heat
- Brief intro on asset vulnerabilities and opportunity areas

Opportunity Area Info Sheets and Maps

- 40 TOD and infrastructure/asset based
- 23 additional for affordable housing, WWTPs, and public drinking water systems/sources

**Resilient Connecticut Phase II:
From Regional Vulnerabilities to Resilience Opportunities in
Fairfield County and New Haven County**

Executive Summary

- 1 About Resilient Connecticut
- 2 Technical Tools & Resources
- 3 Vulnerability Mapping
- 4 Resilience Opportunity Areas

Phase II of Resilient Connecticut is a dynamic, multidisciplinary planning process to identify and address climate change vulnerabilities in New Haven County and Fairfield County. This Phase of the Resilient Connecticut planning process included progressive technical analysis and robust stakeholder engagement and collaboration with a goal of identifying opportunities for climate change adaptation through resilience projects throughout the region.

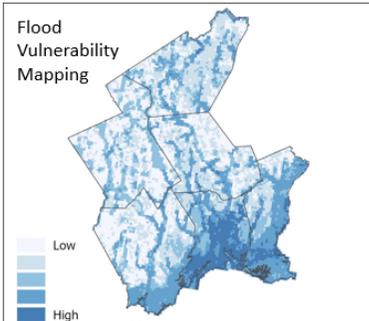
The subsequent summary high-level review of the vulnerability analysis and the preliminary identification of areas where adaptation opportunities to community resilience tools advanced to reduce risks associated with flooding and extreme weather events.

Vulnerability Mapping

- 1
- 2
- 3
- 4

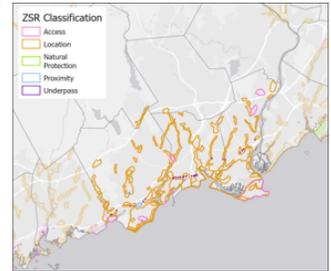
MetroCOG

This region is comprised of three coastal and three inland communities. Flood vulnerability is highest along the shoreline due to storm surge and sea level rise, with additional vulnerabilities along the streams and rivers in the region.



The highest flood vulnerabilities are found along the shoreline and major rivers of the MetroCOG region, although urbanized areas in the three coastal communities exhibit vulnerabilities that are not necessarily located along rivers and streams. These may be due to stormwater drainage concerns reflected in the aspects of the CCVI that capture pooling and ponding. Higher social vulnerabilities in Bridgeport and Stratford also lead to relatively high flood vulnerabilities. Flood vulnerabilities in the three northern communities of Easton, Trumbull, and Monroe are aligned with watercourses. The most vulnerable TOD in the MetroCOG region is the Bridgeport TOD. In addition, there are three shelters located in high flood vulnerable areas: Columbus School, Jettie Tisdale School, and Multicultural Magnet School.

ZSR Classification



ZSR were primarily delineated along the developed portions of the riverine corridors and shorelines. Numerous nested ZSR were delineated in coastal Fairfield and Stratford to represent areas that can be isolated or affected by multiple scales of isolation during an evolving flood event. Areas of potential isolation in northern Stratford were also identified. Downtown Fairfield was identified due to its frequent flooding caused by stormwater.



<https://resilientconnecticut.uconn.edu/>

Next Steps for “Resilient Connecticut 1.0”

- Phase II summary report at end of December 2021
- Phase II will transition to Phase III in January 2022
- Up to five of the opportunity areas will be selected and advanced to public engagement, study, and concept design. This could include:
 - Hydrologic and hydraulic analysis of river and stream systems
 - Coastal flood analysis
 - Transportation and traffic studies; corridor studies
 - Analysis of existing affordable housing
 - Some combination of the above
 - Followed by concept designs

Introducing “Resilient Connecticut 2.0”

- The Phase II planning process will be expanded in 2022
 - SVI mapping and CCVI expanded to the remainder of Connecticut
 - Intensive planning (meetings with municipalities and identification of opportunity areas) expanded to Hartford, Middlesex, and New London Counties
 - The TOD focus will need to shift to a more expansive approach; let us know if you have ideas
 - Target completion is end of 2022
- The Phase III planning process will be expanded in 2023
 - Selection of opportunity areas in Hartford, Middlesex, and New London Counties
 - Engagement, study, and concept designs completed by the end of 2023