



Robust Adaptive Plans: Integrating Sea Level Rise and Tsunami Inundation Models at the Community Level in Washington State

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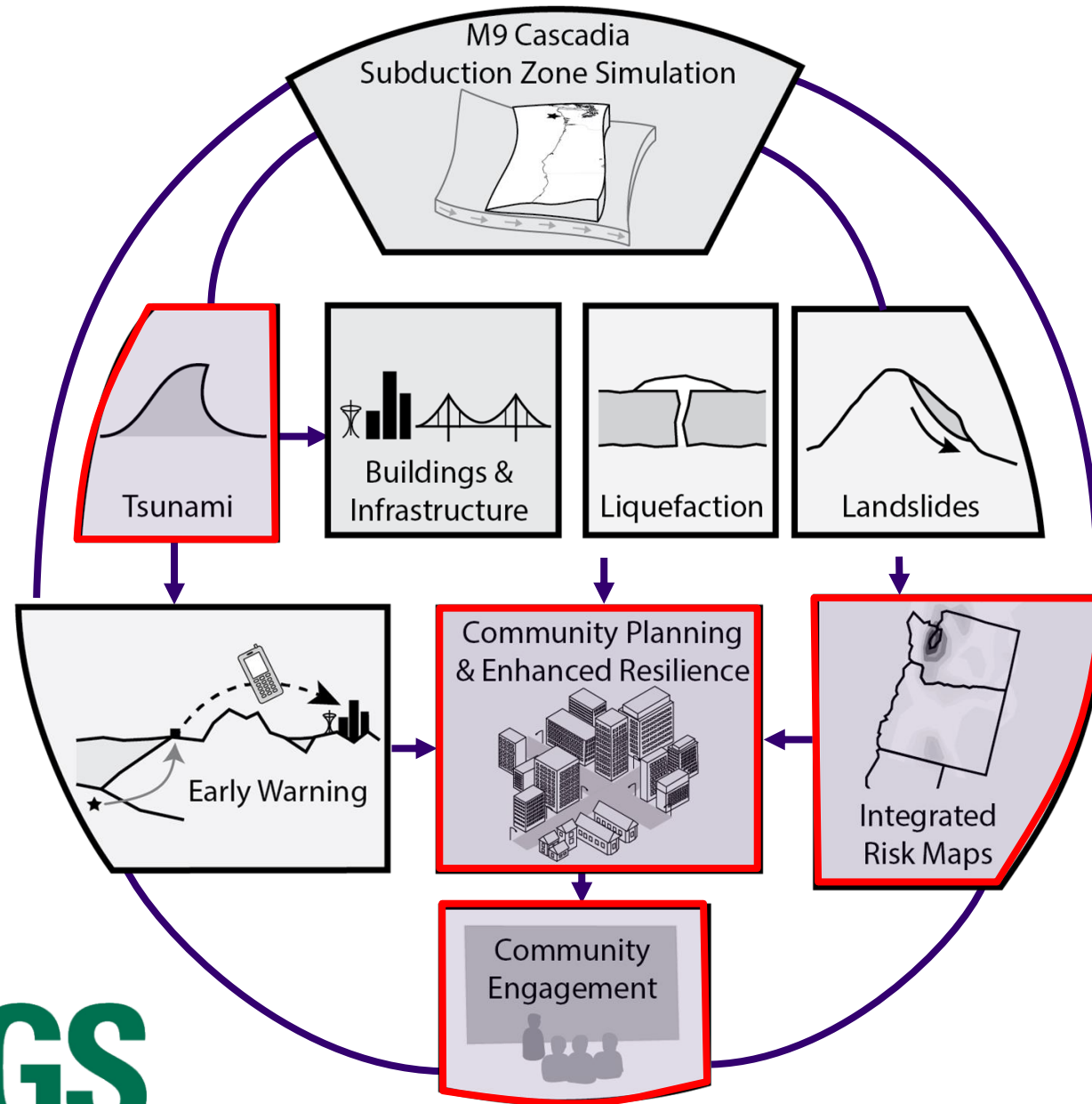
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M9 Project



EAR-1331412
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Localizing hazard mitigation planning and integrating hazards into comprehensive planning

- > Comprehensive plans articulates the long-term vision of a community and is intended to guide day-to-day decisions of elected officials and planners.
- > Hazard mitigation planning is required by FEMA to qualify for non-emergency disaster assistance.
- > Hazards are not incorporated into comprehensive planning



Community Planning Research Questions

- > What kinds of robust adaptive strategies are applicable to multiple hazard scenarios?
- > What kinds of robust adaptive strategies can also promote on-going community development goals?
- > What conflicts exist between mitigation and community development goals?



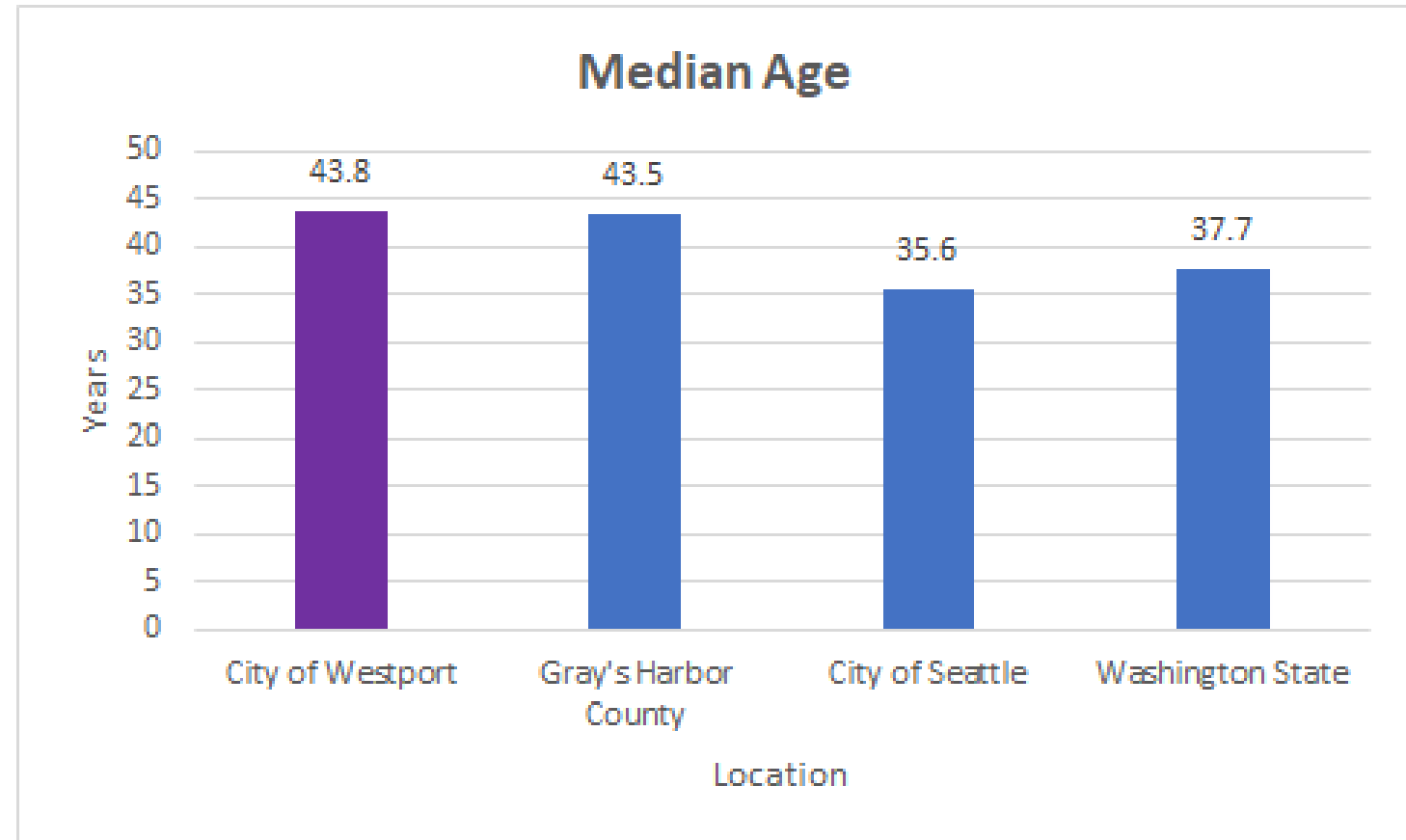
According to different definitions, *robust adaptive strategies* are strategies that are:

- Functional for hazard and non-hazard purposes;
- Functional for multiple hazard scenarios; or
- Redundant for a system.



Demographics

Location	Population*
City of Westport	2,125
Grays Harbor County	74,160
City of Seattle	747,300
Washington State	7,546,400

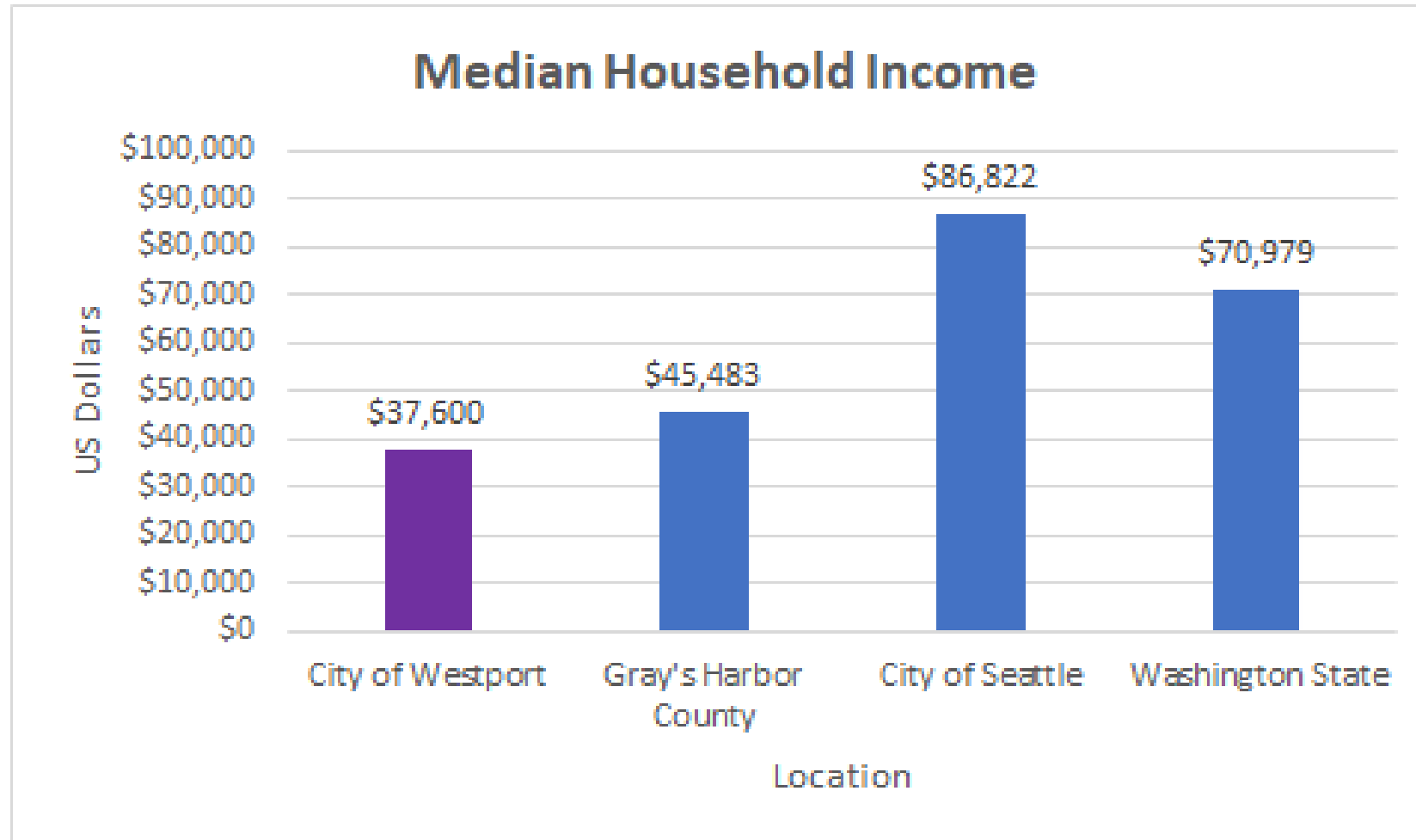


* 2019 estimate

Source: State of Washington Office of Financial Management Forecasting & Research Division, *2019 Population Trends*, August 2019.



Demographics



Source: <https://datausa.io/profile/geo/westport-wa/?compare=washington#housing>



Safe and Affordable Housing Needs

- > **Approximately 27-40% of the population live in either mobile homes or recreational vehicles.**
- > **Units are located in low-lying coastal areas.**
- > **People living in RVs are considered homeless!**
- > **Spatially concentrated socially vulnerable households.**



Westport Marina District

> Commercial fishing

- Largest commercial seafood landing port in the state and 10th largest in the nation.

> Under employment

- Year-round employment is limited.

> Outdoor recreation

- Fishing, surfing, and hiking are popular recreational activities.

> Cultural Identity

- Tied to the coast and marina district.



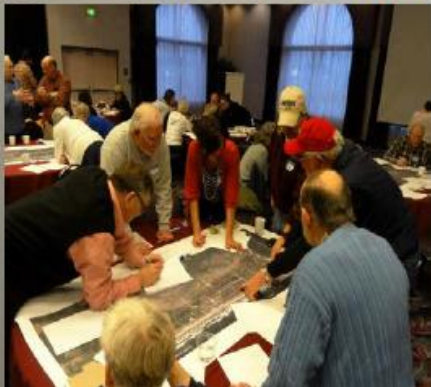
Ocosta Elementary School - Community hub



Ocosta School is only the first of many vertical evacuation structures being planned

Project Safe Haven:

- **Community-based, 'top-down' planning approach** (hint: the community is at the top)
 - All options (buildings, towers, berms, etc.) are on the table for consideration by community participants
 - Community members provide 100% of the input, experts are on hand to answer technical questions and facilitate the planning and design meetings.
- *After all, this is the **community's plan**...*



Common Themes:

- School safety!!!
- Seniors and special needs populations
- More conservative travel times – 15 min. instead of 30 min.
- Requested more conservative estimates of elevations



Community perspective

“This community is worried because we are subject to natural disasters, and due to the remoteness of the community and the distance from urban areas, the community will have to rely on itself. But the community has lots of assets and resourceful people who like to meet together and work on issues like these.” - Workshop participant



Community Workshops Process

ROUND 1



People share stories about community values and assets.

ROUND 2



People map community assets.

ROUND 3



People discuss hazards and potential impacts then develop mitigation strategies that align with community values for long-term planning.



City of Westport hazards

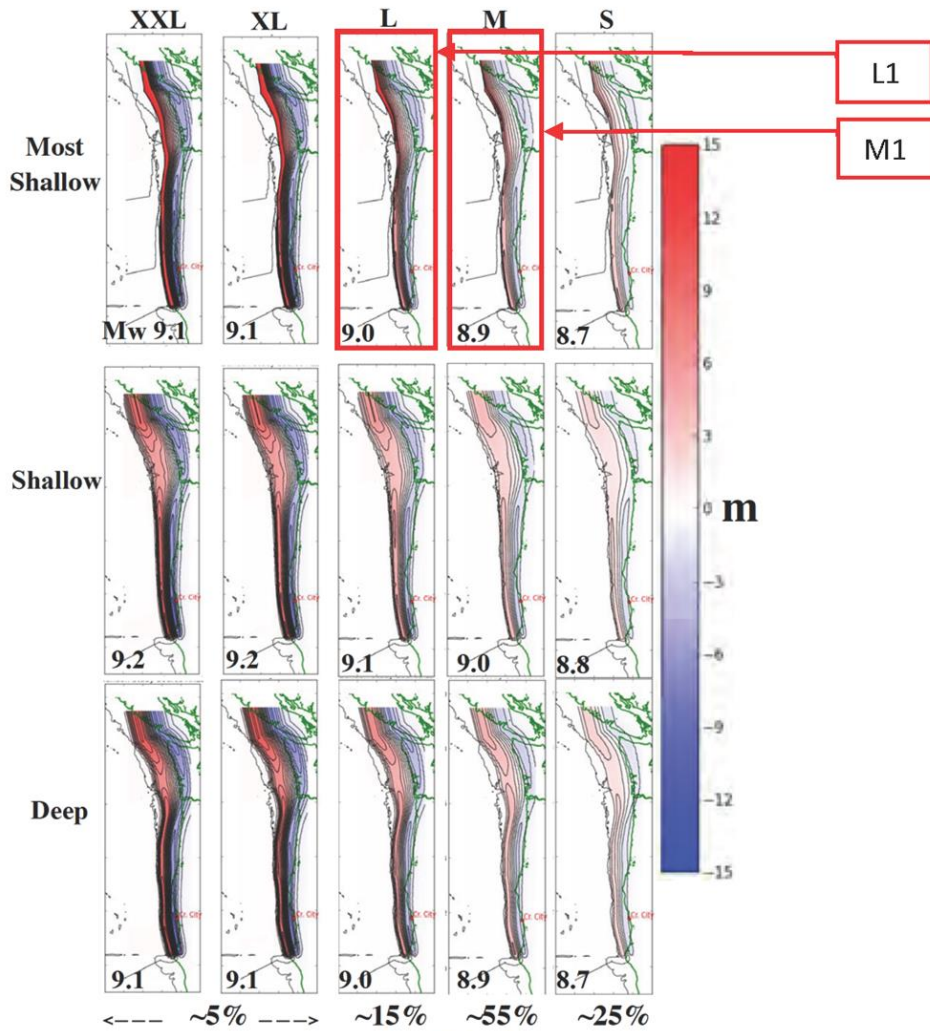
Hazard Rank	Hazard Type	CPRI Score	Vulnerability Rank
1	Earthquake	3.85	High
2	Tsunami	3.50	High
3	Erosion	3.30	High
4	Flood	3.25	High
5	Severe Weather	2.85	Medium
6	Climate Change	1.95	Low
7	Drought	1.55	Low
8	Volcano	1.55	Low
9	Wildfire	1.50	Low
10	Landslides	1.10	Low

Source: Grays Harbor County Multi-Jurisdiction Hazard Mitigation Plan 2018 Update, Westport Annex.



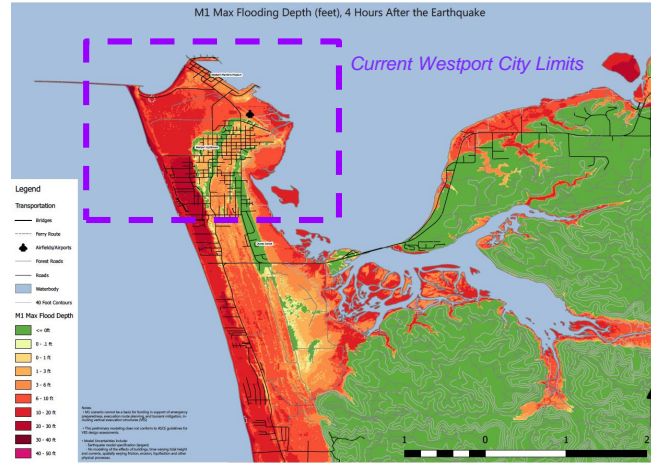
CSZ Earthquake Tsunami and Subsidence

“T-shirt” Size Classes of Bandon Sources (Each with 3 members of varying depth)

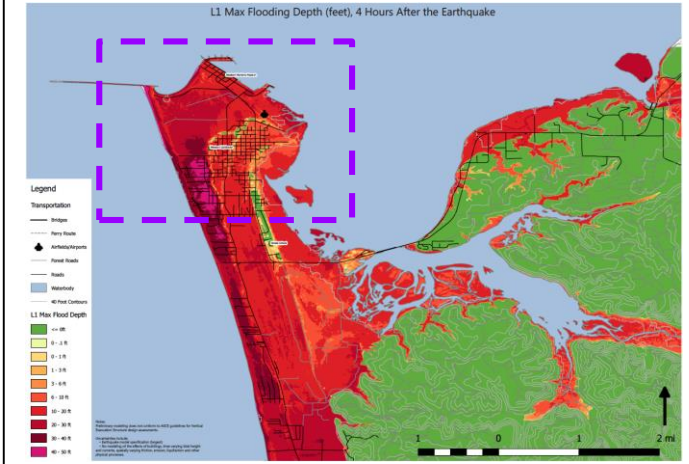


More likely “Like the last time” 1700 (M1)

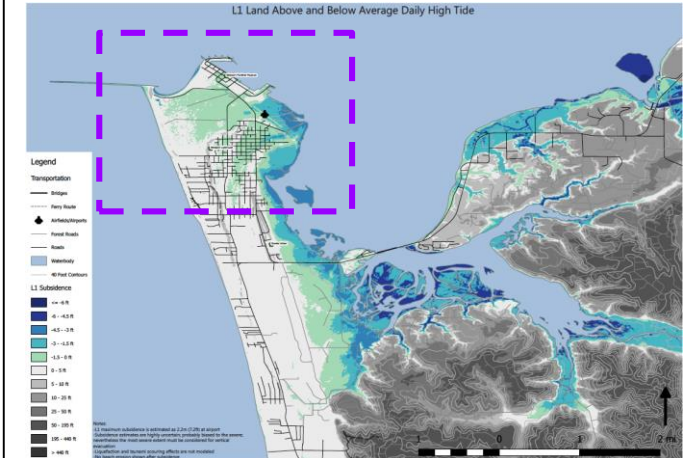
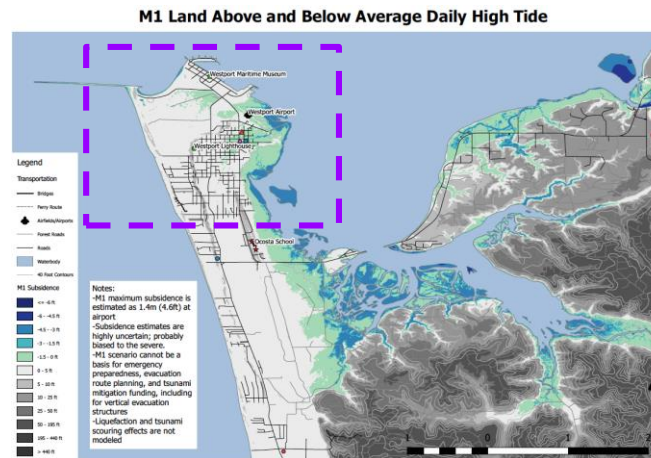
Immediate Response: Tsunami inundation area



More severe “Maximum Considered” (L1)



“New Normal”: post-earthquake-and-subsidence coastline



Sea Level Rise

2060, 2080 and 2100

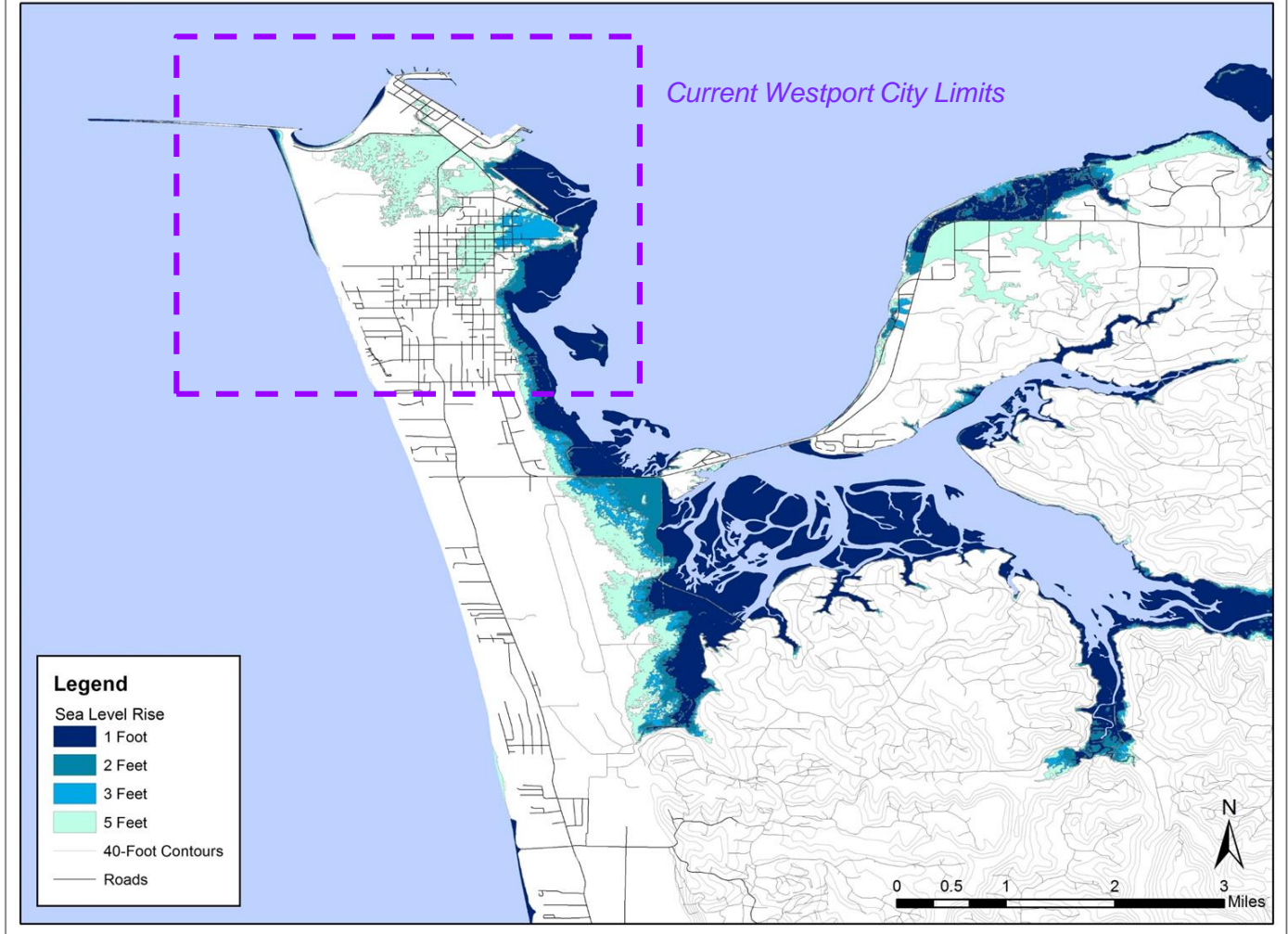
Sea Level Rise Projections

	1 Foot	2 Feet	3 Feet	5 Feet
2060	11% Probability	0% Probability	0% Probability	0% Probability
2080	51% Probability	5% Probability	1% Probability	0% Probability
2100	77% Probability	27% Probability	5% Probability	1% Probability

Assumptions:

- Global carbon emissions continue to rise
- Annual extreme storm flooded areas would be more extensive
- Assumes no earthquake (with co-seismic subsidence) takes place
- Assumes tidelands do not build up with sediment

Average Daily High Tide Inundation Due to Sea Level Rise in South Beach, WA



Source: Map generated from NOAA Sea Level Rise Viewer, <https://coast.noaa.gov/slrdata/>; table generated on 07/18/18 for the Washington Coastal Resilience Project, www.wacoastalnetwork.com/wcrp-documents.html



Robust Adaptive Strategies

Near Term (< 5 years): Multi-use Vertical Evacuation and Economic Development

“We value access to the outdoors, nature, and ocean. We have a state park, lighthouse walking trail, and beaches.”

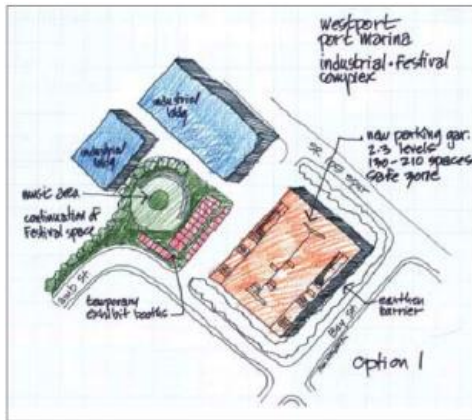
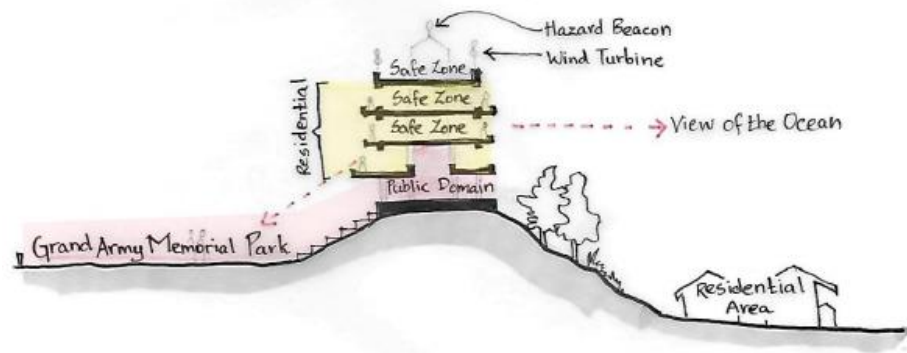
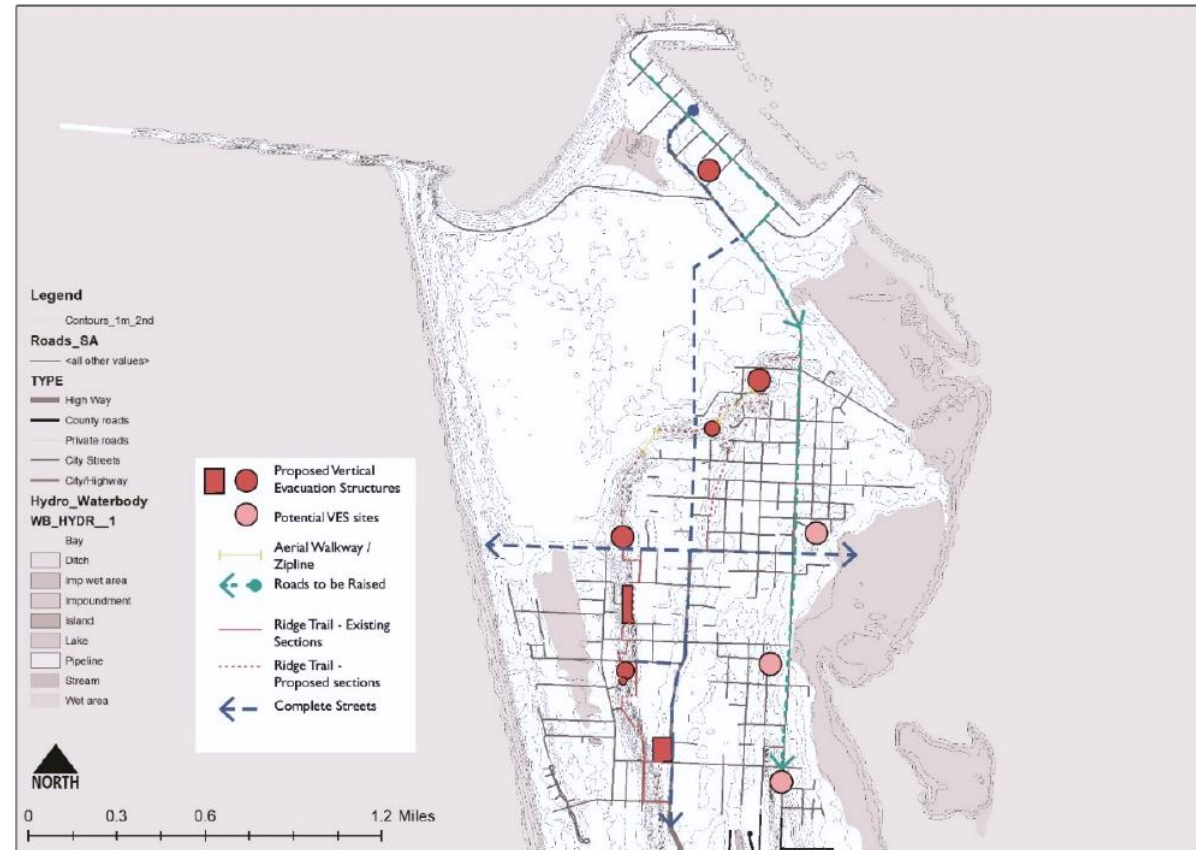


Photo credit: Steve Giordano, highonadventure.com, August 1, 2009.



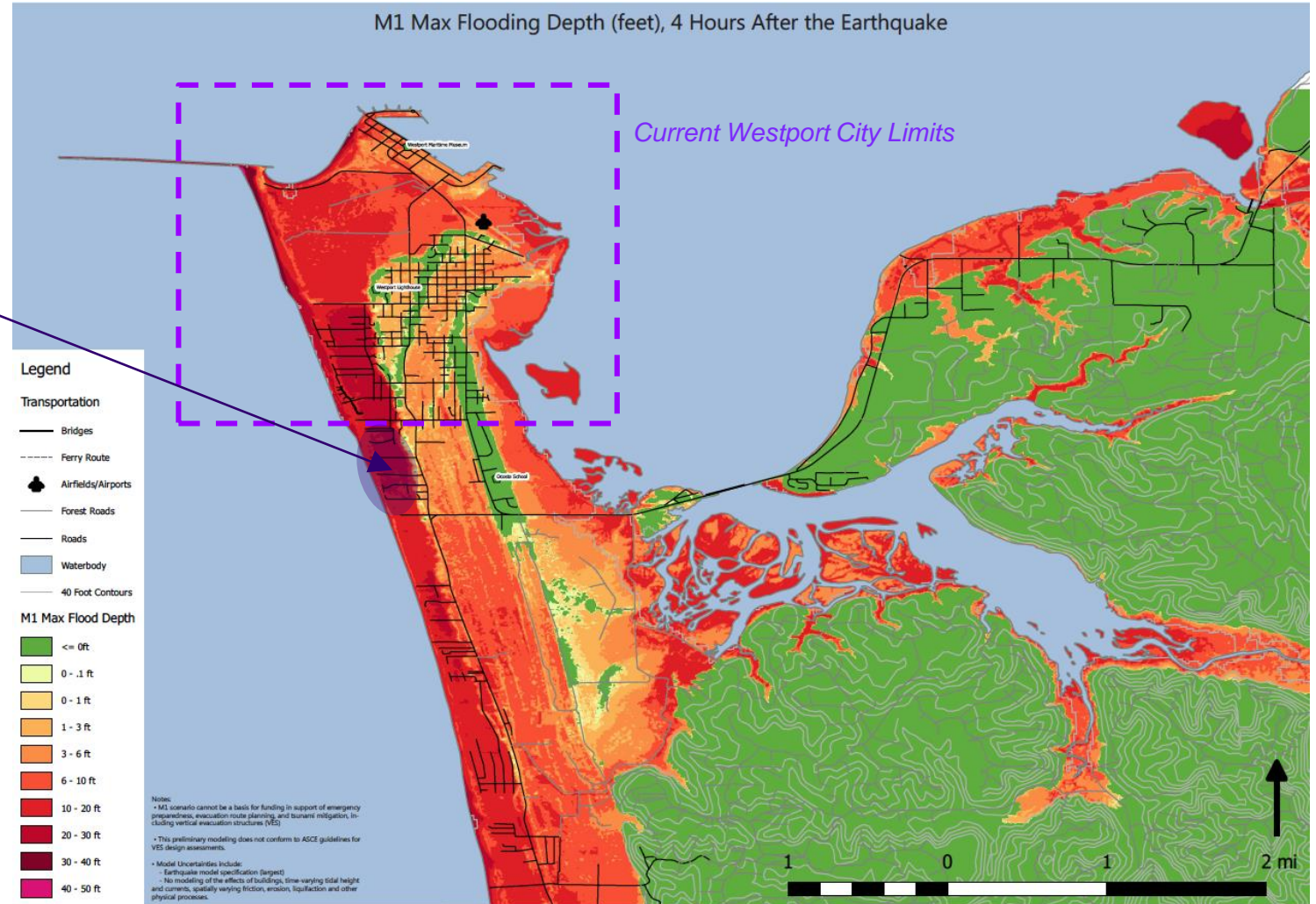
Design concepts by Project Safe Haven Grays Harbor County Westport charrette, 2011; and Sreya Sreenivasan, *Urban Design for Resilience to Multiple Uncertain Hazard Scenarios: Robust Strategies for Coastal Resilience in Westport, Washington*, University of Washington Masters of Urban Planning Thesis, June 2019.

Robust Adaptive Strategies

Near Term (< 5 years): Securing Access to More Higher Ground

- 1) City annexation
... of beachfront properties

“We have a strong sense of community that extends beyond Westport. We also identify as being from South Beach.”



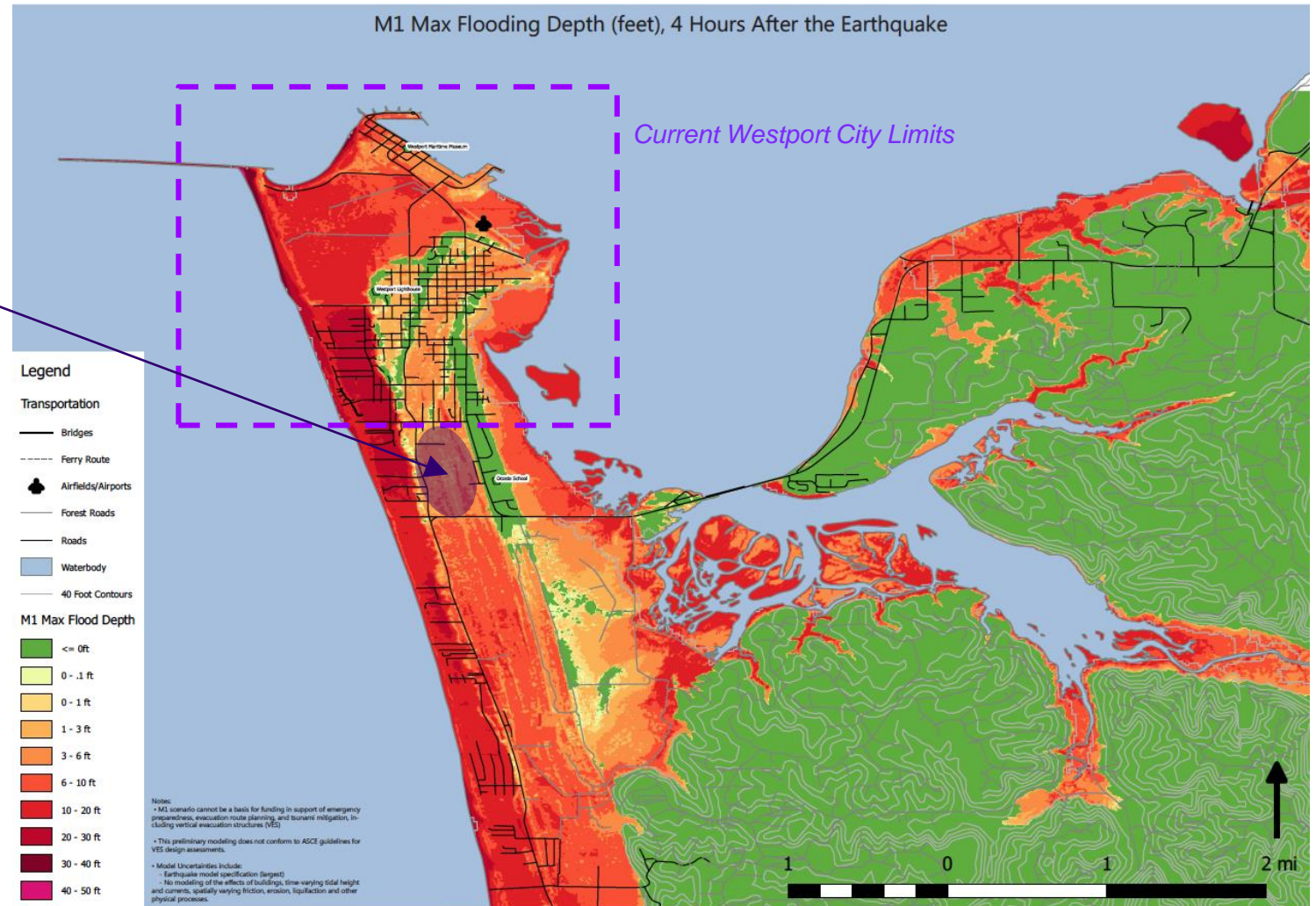
Robust Adaptive Strategies

Near Term (< 5 years): Securing Access to More Higher Ground

1) City annexation

... of exposed mobile homes

“We value that we are a small town that has a can-do attitude and working class mentality. Westport has banded together not only for recreation services, but also health services, food services, and an operational marina.”

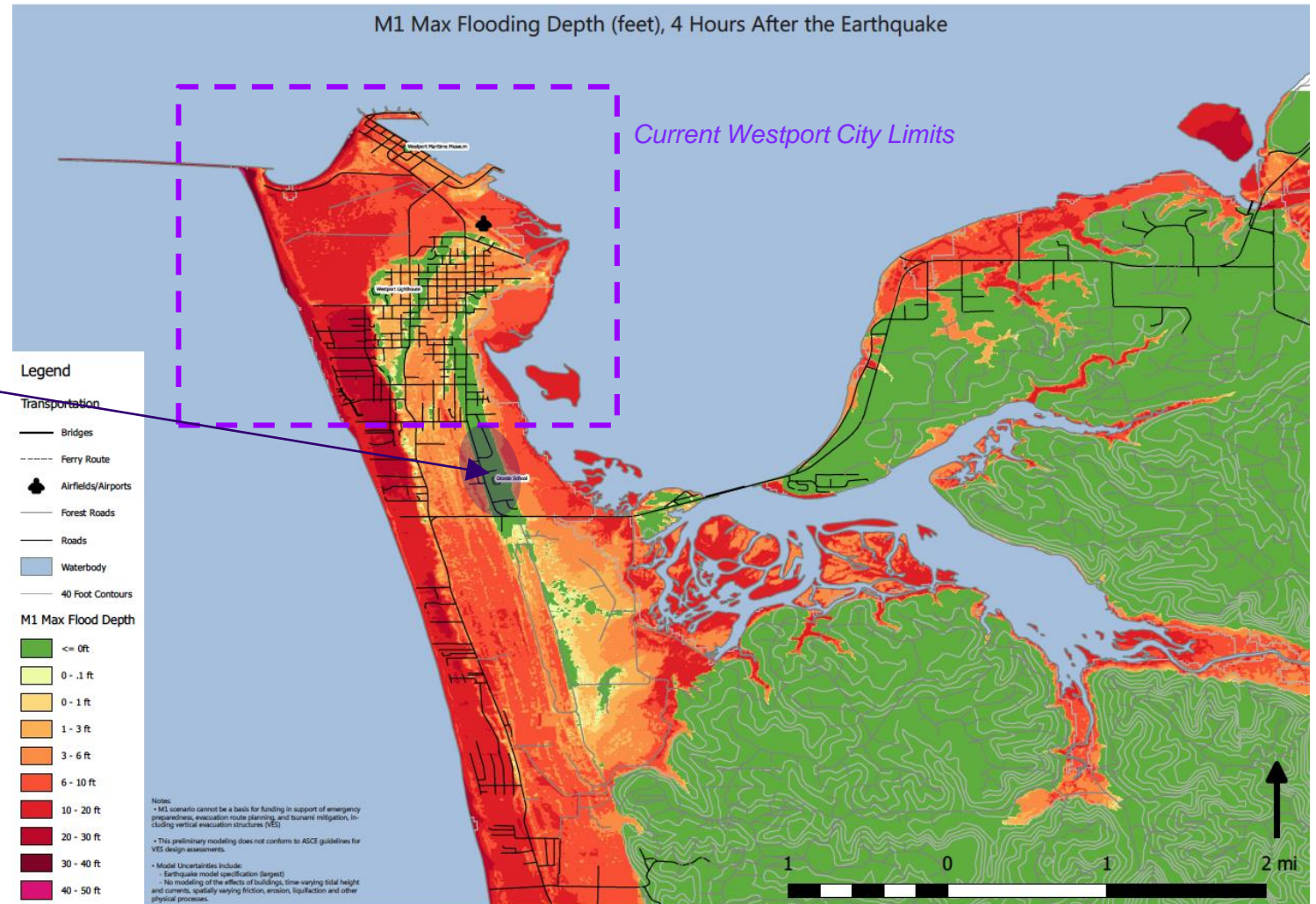


Robust Adaptive Strategies

Near Term (< 5 years): Securing Access to More Higher Ground

1) City annexation

... of more high ground for vertical evacuation, critical facilities and affordable housing



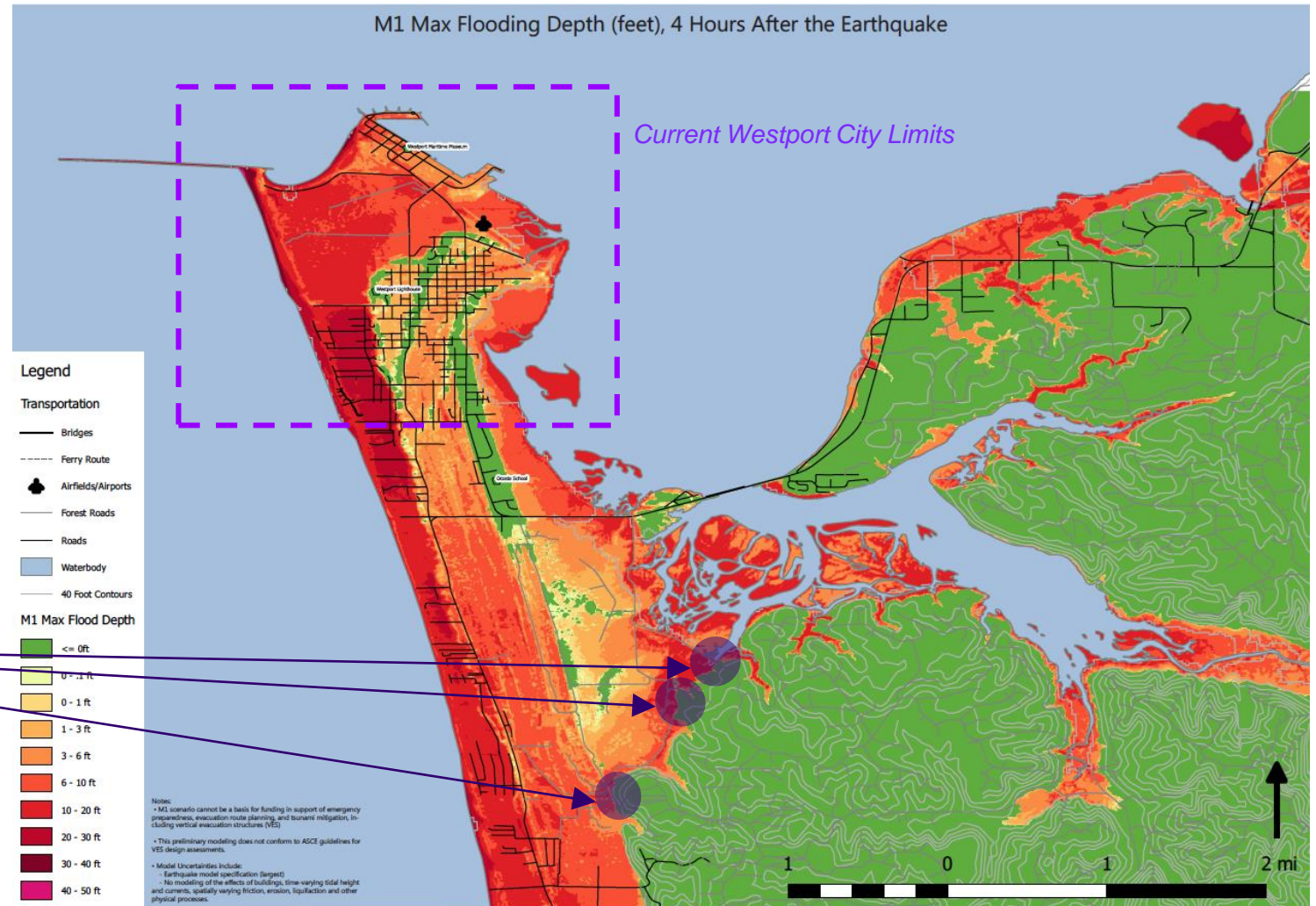
Robust Adaptive Strategies

Near Term (< 5 years): Securing Access to More Higher Ground

1) City annexation

- ... of beachfront properties
- ... of exposed mobile homes
- ... of more high ground for vertical evacuation and critical facilities and affordable housing

2) Map private logging roads and obtain access for evacuation to highest ground



Robust Adaptive Strategies

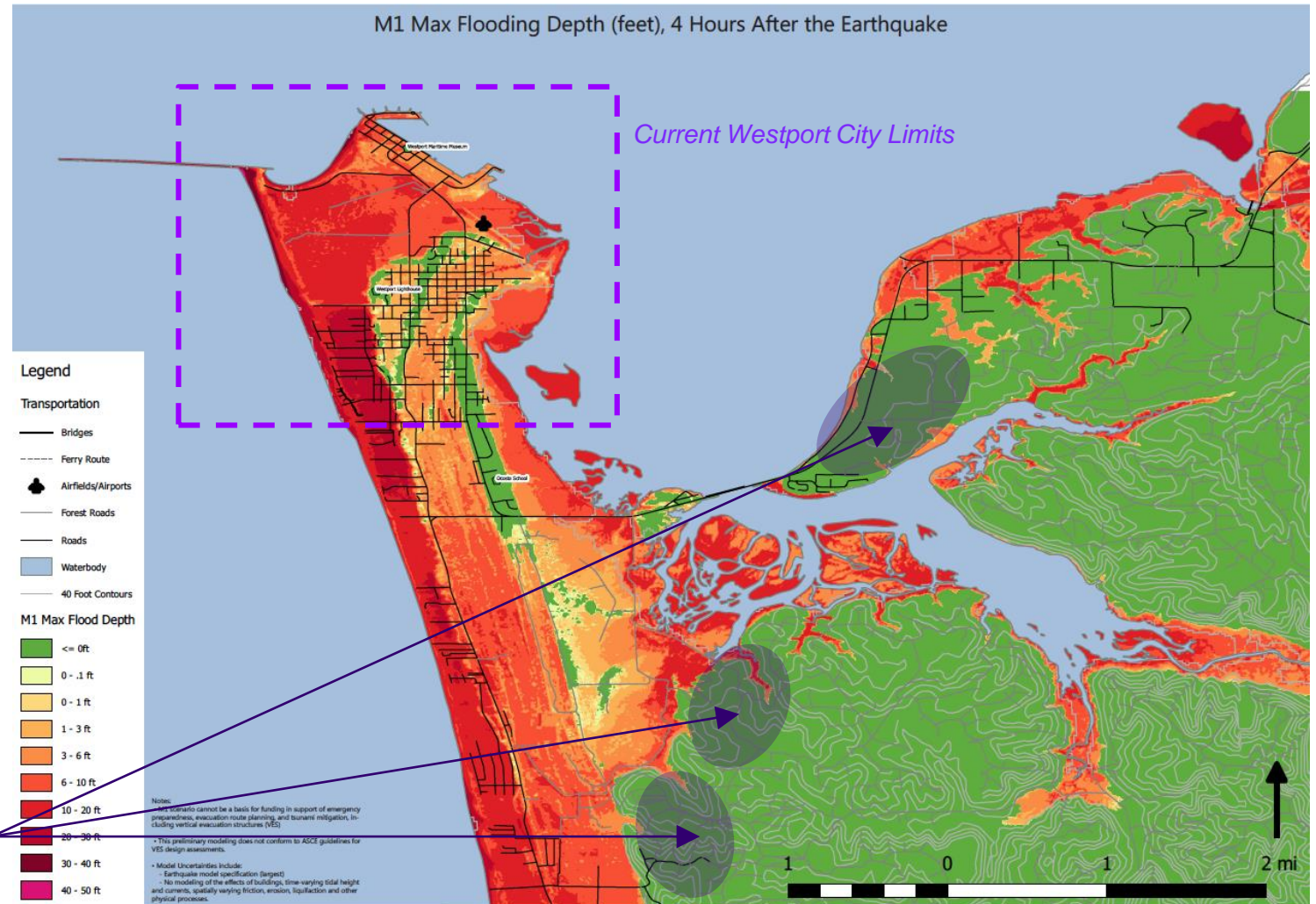
Near Term (< 5 years): Securing Access to More Higher Ground

1) City annexation

- ... of expensive but exposed beachfront properties for tax revenue
- ... of exposed mobile homes of low-income residents in need of subsidy
- ... of more high ground for vertical evacuation and critical facilities and affordable housing

2) Map private logging roads and obtain access for evacuation to highest ground

3) Secure rights for emergency refuge and assess feasibility of acquisition

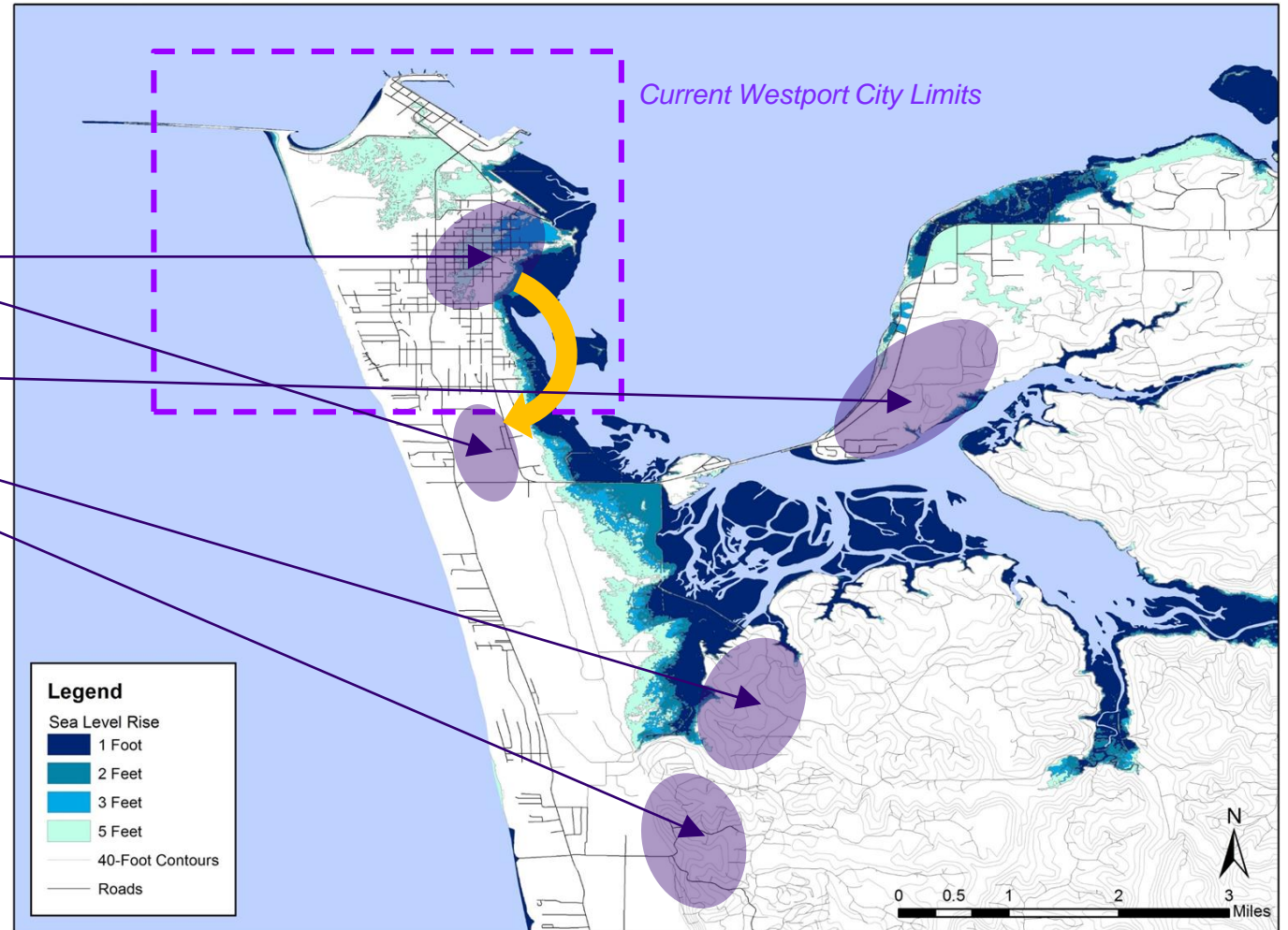


Robust Adaptive Strategies

Medium Term (5-10 years): Preparing for Sea Level Rise

- 1) Transfer Development Rights to relocate sea-level-rise-exposed housing and critical facilities
- 2) Low-cost, low-impact camp and recreation sites

“The ocean and forests surrounding Westport provide an abundant amount of fresh seafood, elk, deer, berries, and mushrooms for the community to fish, hunt, and collect freely with the right permits and equipment.”



“New Normal”: loss of coastal land due to sea level rise

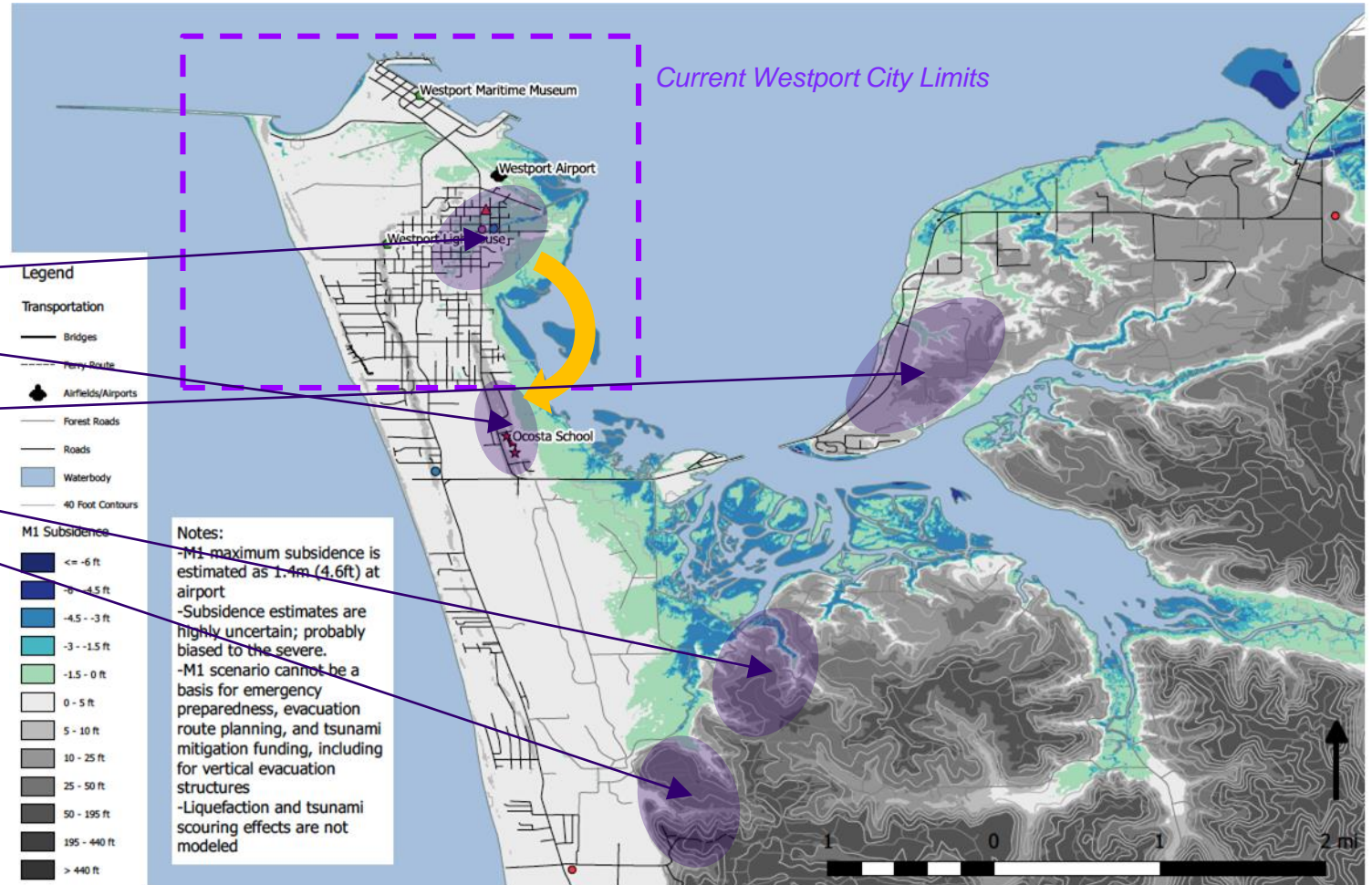


Robust Adaptive Strategies

Long Term (10-20+ years):

Preparing for Resettlement Post-Earthquake (with Subsidence)

- 1) Additional relocation from flood-prone areas
- 2) Revenue-generating resort development



“People love coming here to visit... State and local parks and beaches provide excellent recreational space for hiking, running, walking, and site seeing.”

“New Normal”: loss of coastal land due to earthquake subsidence (M1 scenario)



Conclusions

- > Values-driven, asset-based participatory planning with gradual *and* sudden hazards
 - ▶ long-term, localized resiliency plans
- > Multiple, low-to high-severity hazard scenarios
 - ▶ robust land use strategies for inclusion in comprehensive plans
- > Focusing only on very severe (but low-probability) existential threats
 - ▶ limited set of strategies and conflicts with community identity

