Flood Mapping and Sea Level Rise

City of Petaluma

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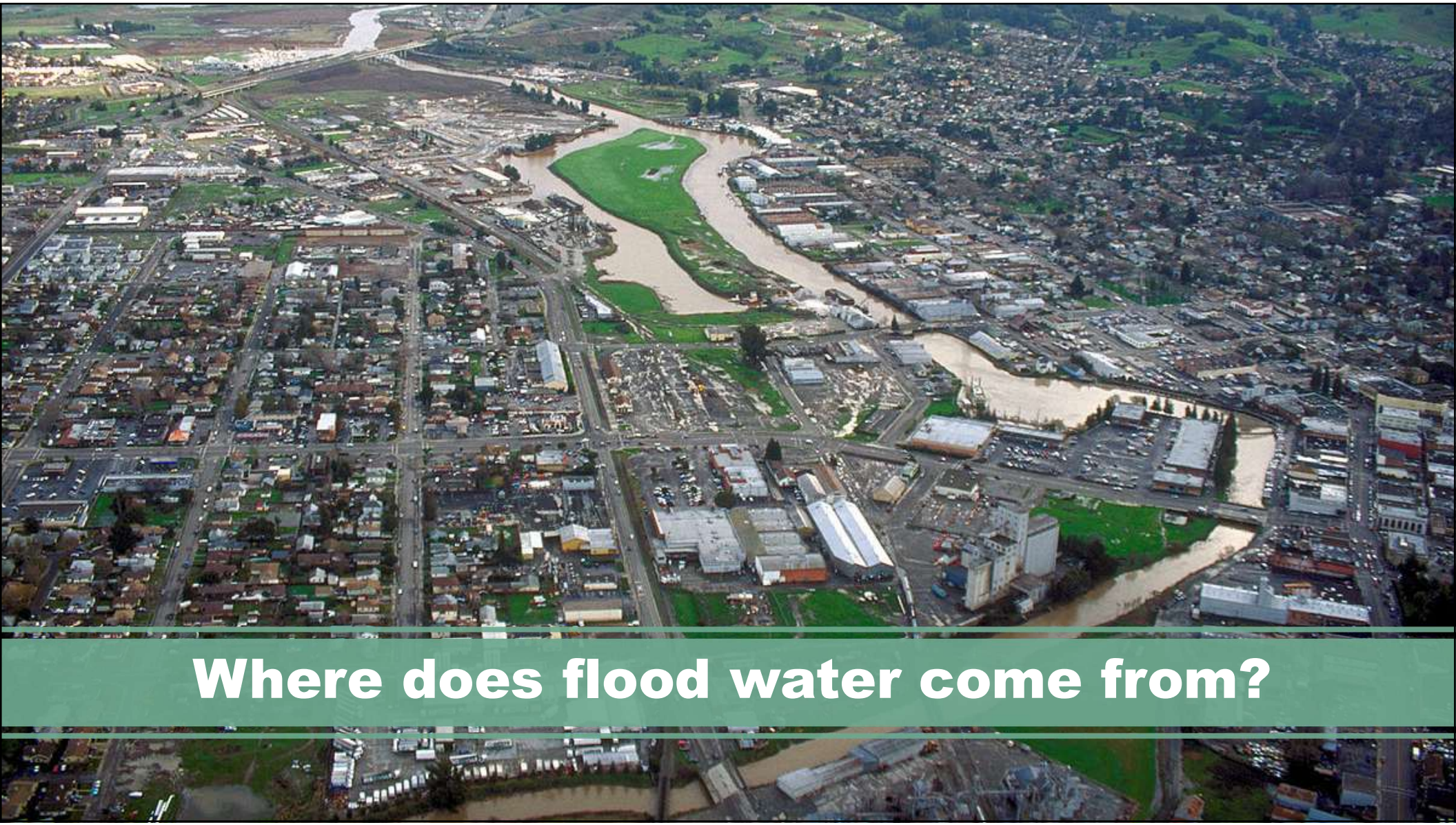
Public Works & Utilities

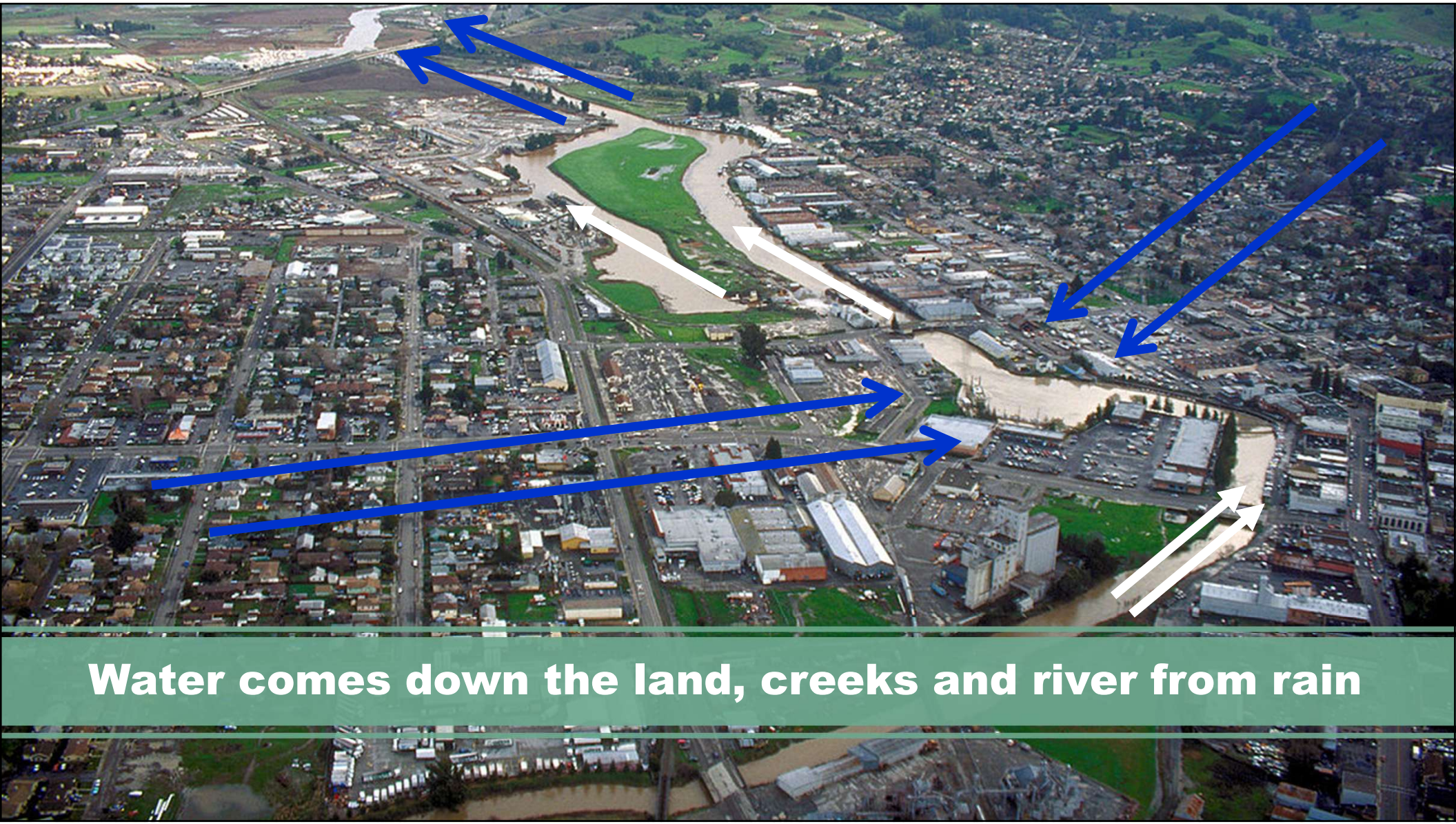
Zone 2A Briefing
August 14, 2025

Discussion Topics

- New Flood Modeling
  - Rain/Storm
  - Sea Level Rise
- FEMA Mapping updates
- Combined Storm and SLR Maps
- General Plan Framework for Flood Resiliency
- Upcoming Floodplain Management Initiatives



Where does flood water come from?



Water comes down the land, creeks and river from rain

Water also comes up the River from the Bay

3 Flood Types to Consider

King Tide

The highest tides of the year

Happen every year

Tide gauges

Rainfall

Rain falling on the city and watershed, trying to move down river

1% chance of happening every year

Flood models

Storm Surge

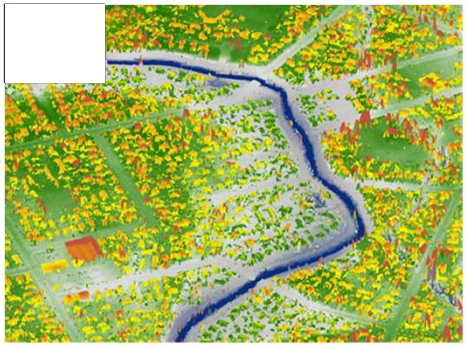
Extreme high water in the river due to atmospheric events, separate from rain

1% chance of happening every year

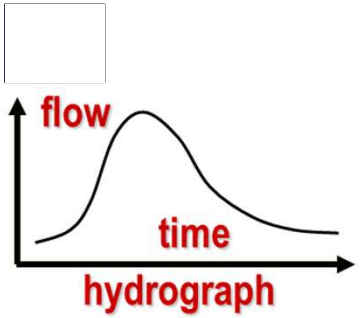
Tide gauges

Petaluma Flood Modeling

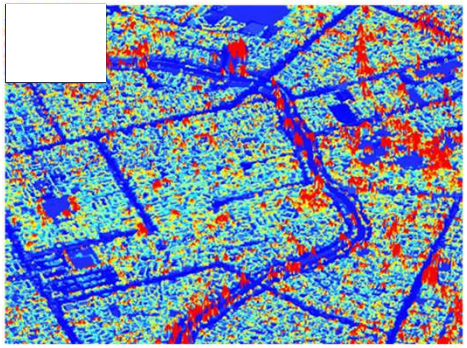
- Petaluma's HEC-RAS 2D model considers 4 main factors
  - 1: The shape of the land and creeks
  - 2: Rainfall amount and location
  - 3: Amount and speed of run off
  - 4: Height of the River/Bay
- 1% Annual Flood Risk = 1% chance every year = 100 year flood
  - Common standard for Flood Planning



elevation model



hydrograph



surface roughness model

flood depths & extent

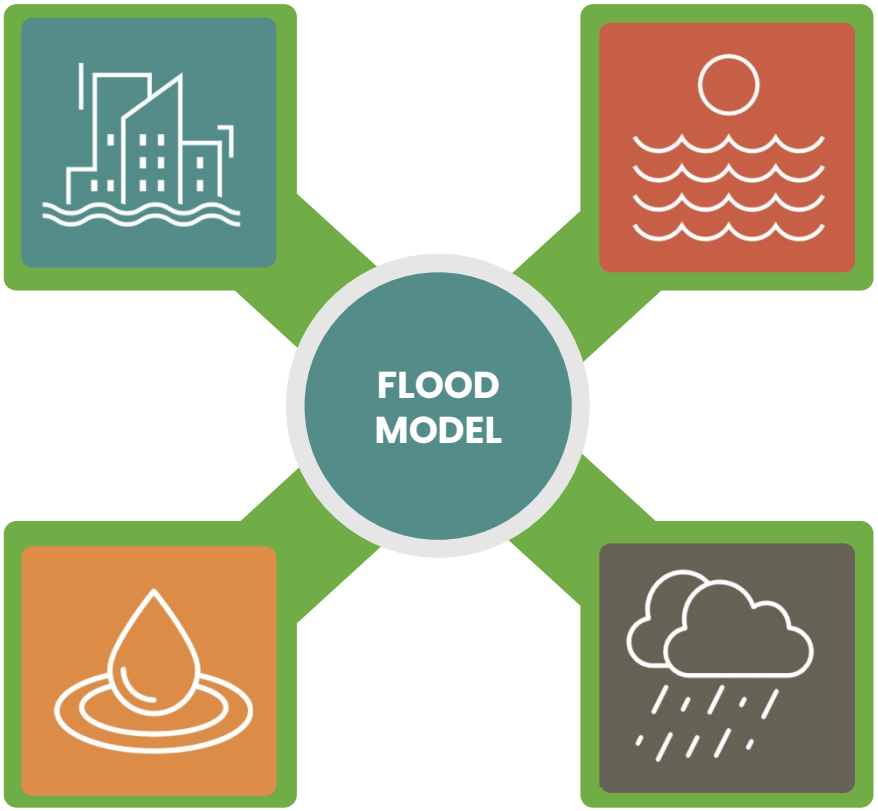
Niwa.co.nz

PETALUMA FLOOD MODELING

Includes Climate Change Impacts, Uses Petaluma Specific Data

SEA LEVEL RISE

Based on current science



MEAN HIGHER HIGH TIDE

The average of the highest tides each year as provided by NOAA.

HYDROLOGY and HYDRAULICS

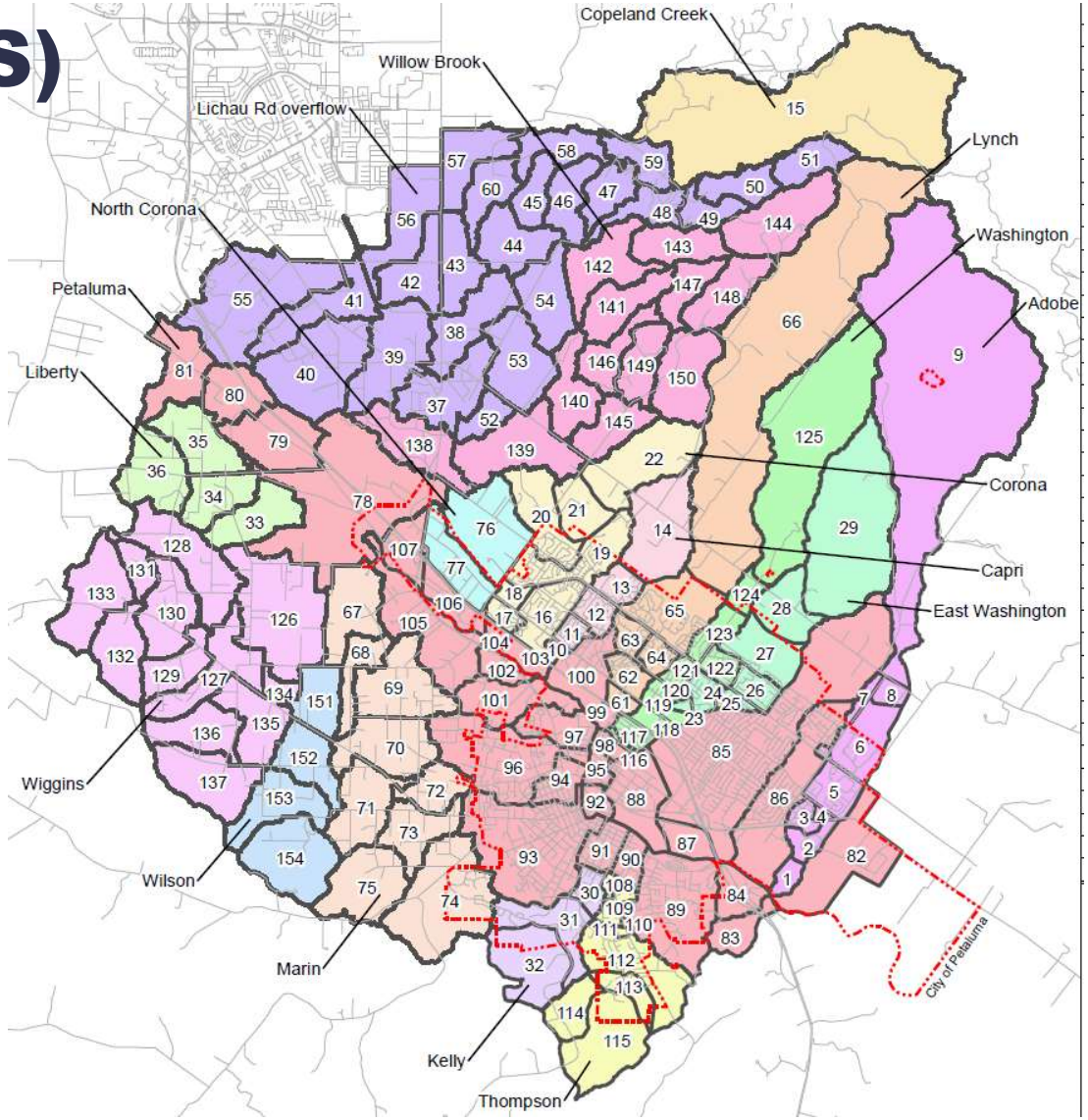
Ground Surface Terrain, Field Surveys, Land Uses, Vegetation levels

RAIN

Custom rain study specific to Petaluma in 2023. Considered how much rain is reasonable, where it falls in the watershed heaviest, and how quickly it falls.

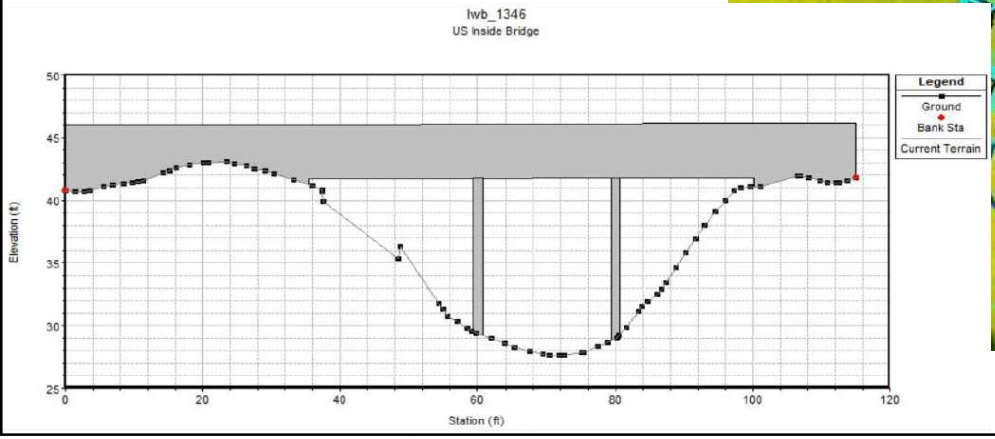
Hydrology (HEC-HMS)

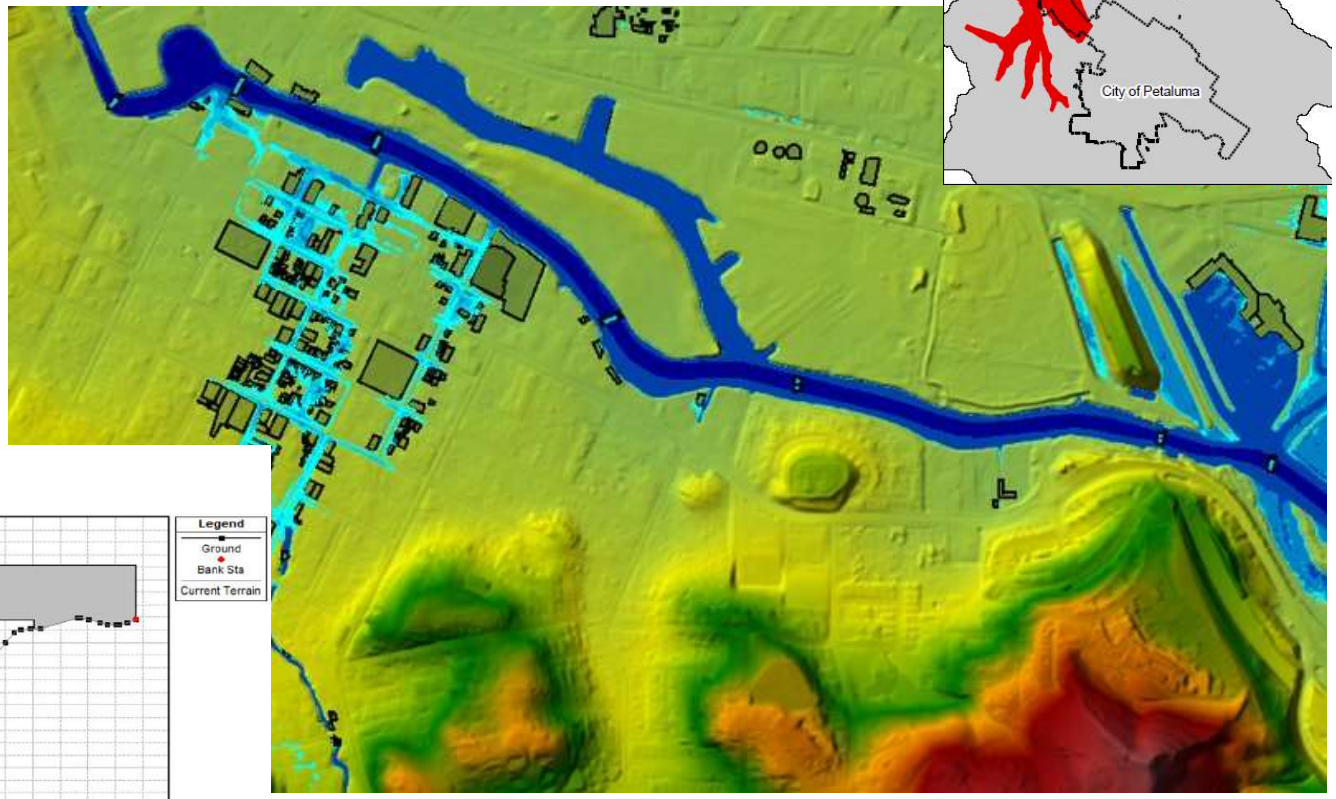
- This is the Petaluma River watershed
- Flow estimated in each drainage area
- 154 subbasins

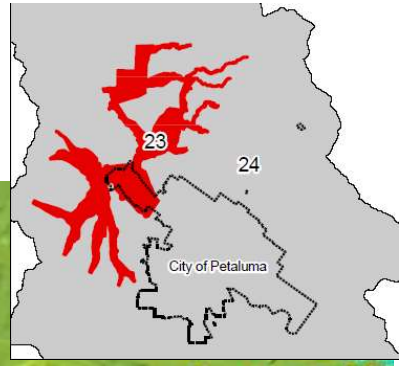


Hydraulics (HEC-RAS 2D)

- Ground elevation data
- Structures
- Roughness (streets vs. vegetation)

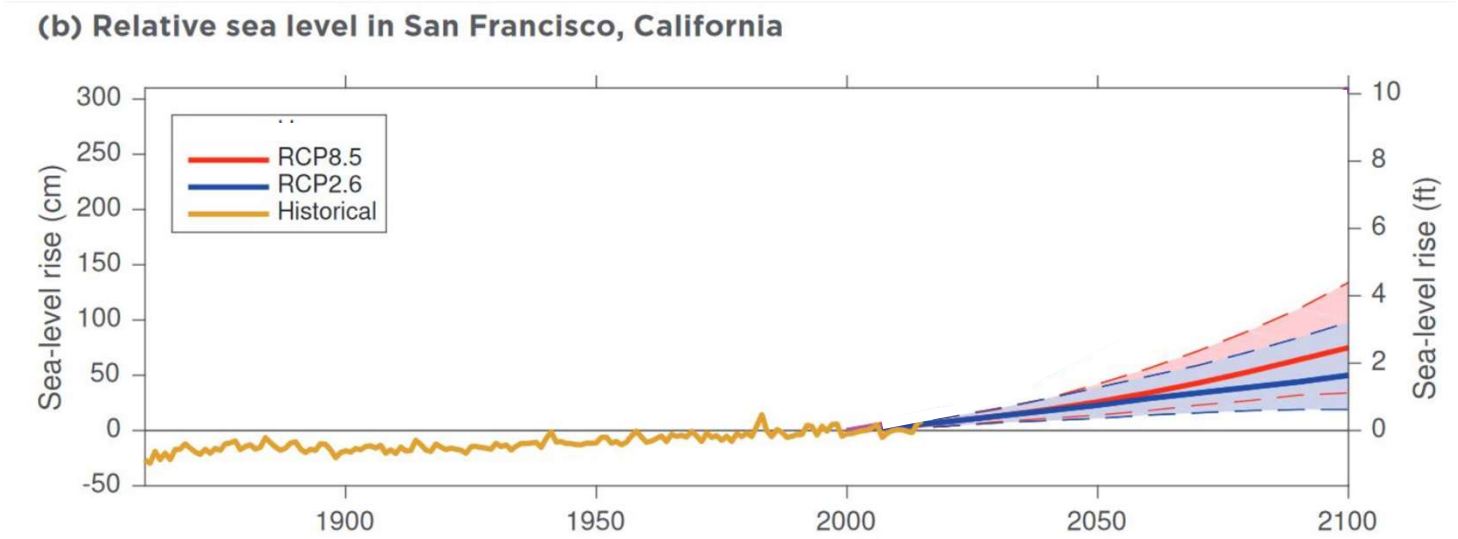






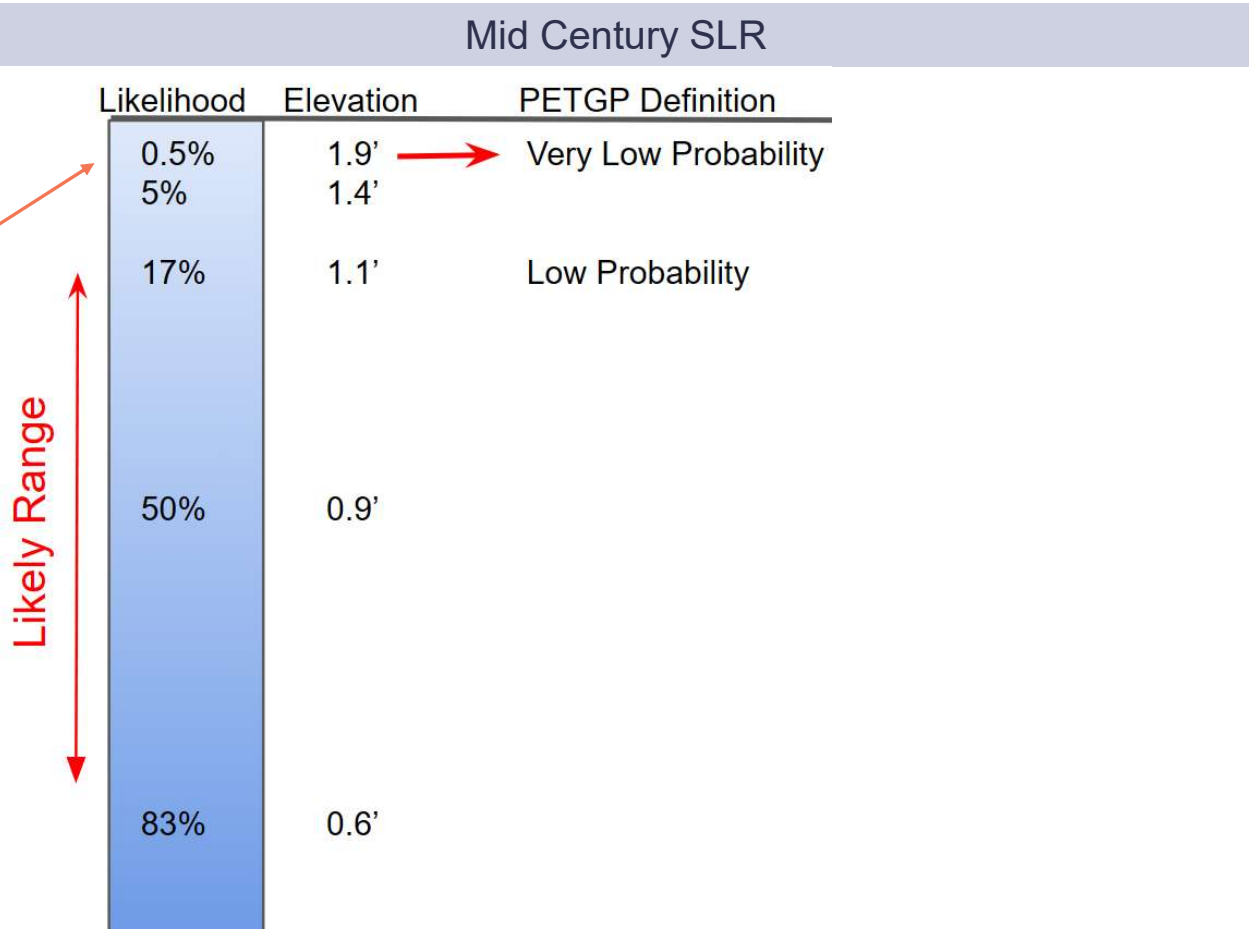
Source for SLR Predictions

- California Ocean Protection Council Guidance (OPC2018)
  - Used by numerous state and local agencies and counties/cities
  - Provides ranges of SLR, and how likely they are to happen in future decades
  - Recommends which predictions are appropriate for different planning efforts
  - Recommends assuming continued High Emissions (RCP)



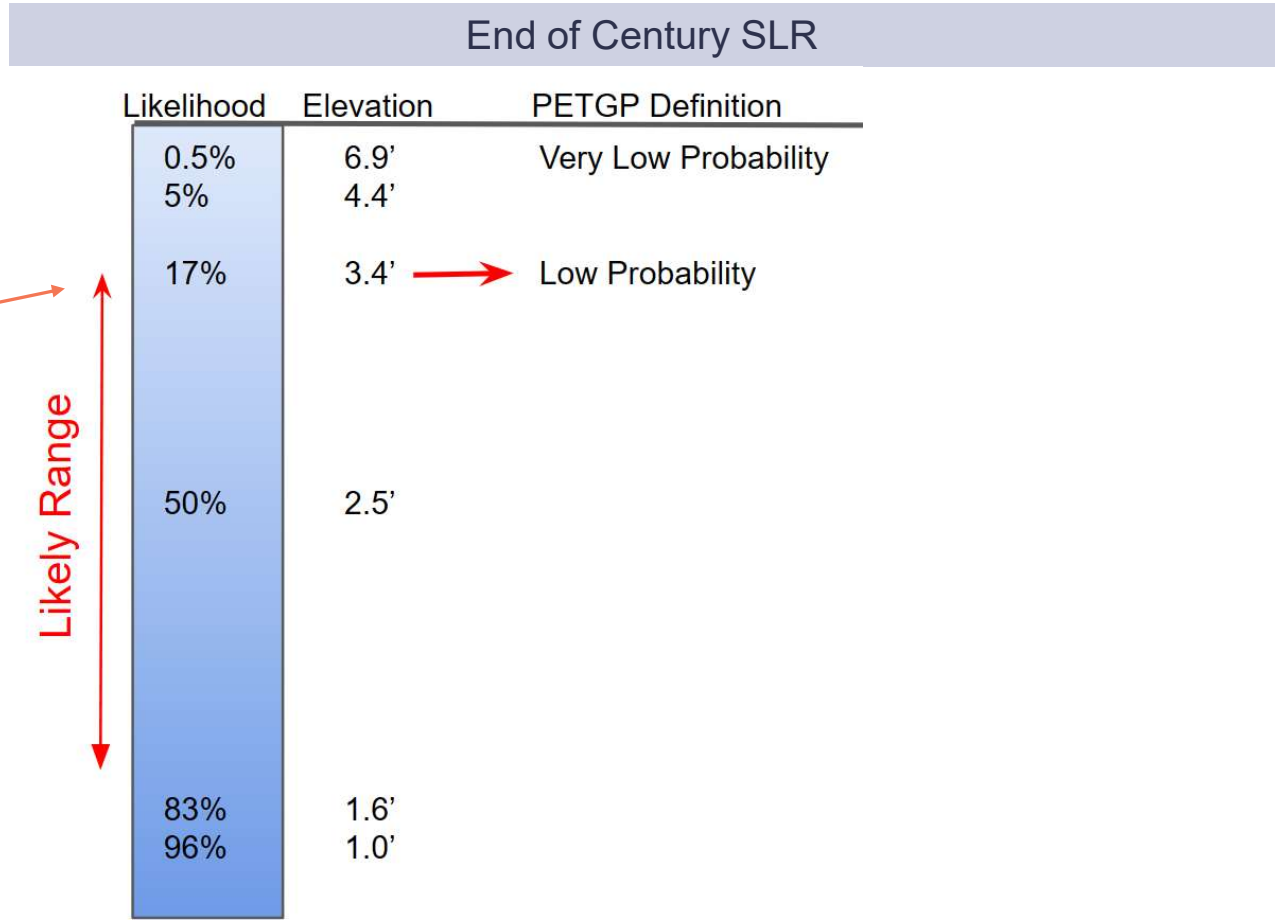
Sea Level Rise (SLR) Selections

- Mid-Century
  - Roughly 2050
  - Very low probability SLR
  - 0.5% chance
  - **1.9 feet**
  - Short planning horizon, so the worst case was selected



Sea Level Rise (SLR) Selections

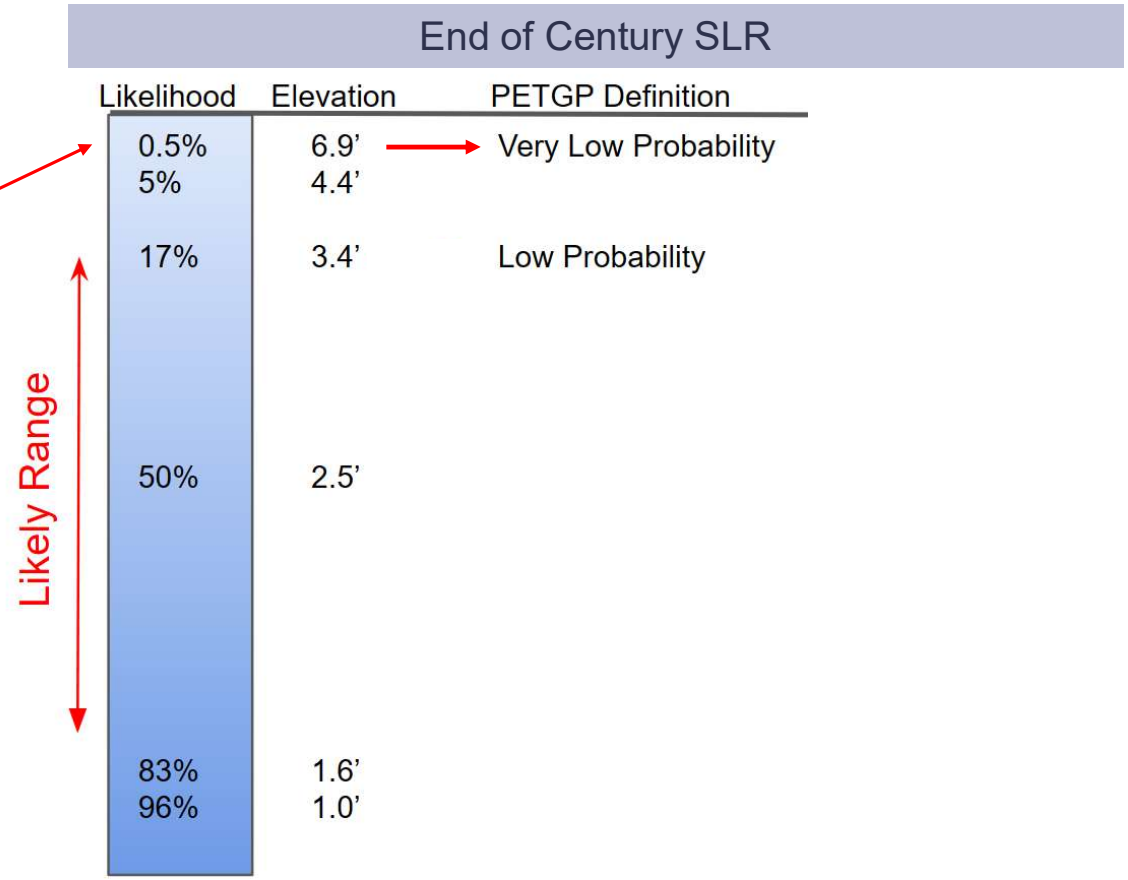
- End-of-Century
  - Roughly 2100
  - Low probability SLR
  - 17% chance
  - **3.4 feet**
  - Longer planning horizon gives us more time to prepare
  - Appropriate for most planning efforts



Sea Level Rise (SLR) Selections

- End-of-Century
  - Roughly 2100
  - Very Low probability SLR
  - 0.5% chance
  - **6.9 feet**

- Longer planning horizon gives us more time to prepare
- Appropriate for isolated critical or high risk infrastructure and uses

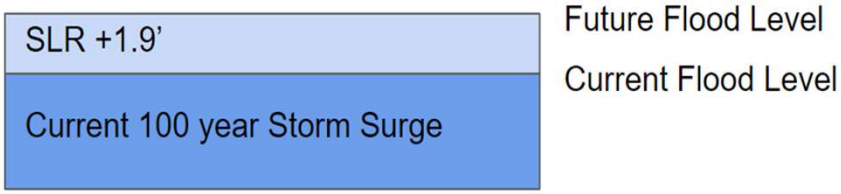


Using SLR in flood analysis

- The maps most relevant for long term planning are 1.9 ft. of SLR in Mid-Century and 3.4 ft. in the End-of-Century.
  - It is straightforward to explore how SLR affects King Tide and Storm Surge flooding
  - Considering how SLR affects Rainfall flooding requires our new model
  - 6.9’ ft. scenario is relevant only to a few critical uses

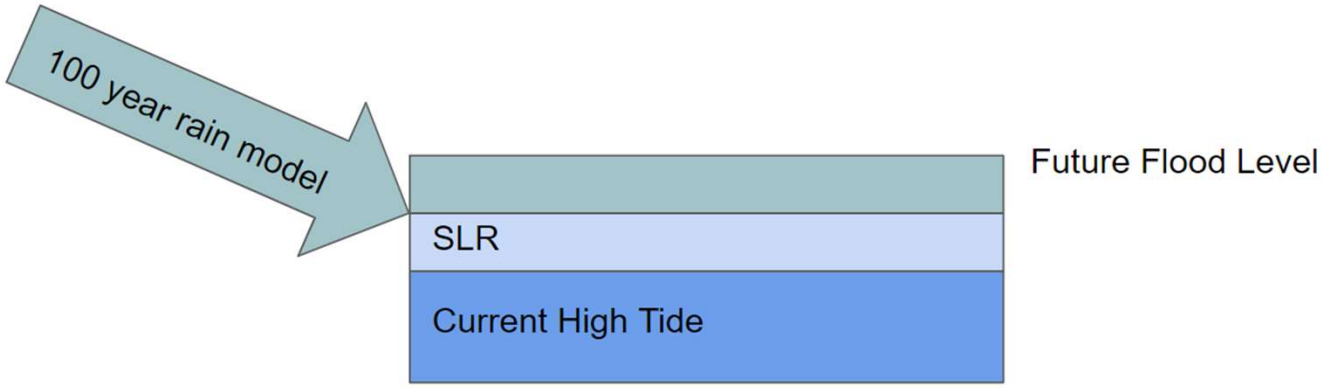
King Tide and Storm Surge

- Current King Tide and Storm Surge patterns are layered on top of Sea Level Rise to predict what will flood in the future



SLR effects on Rainfall flooding

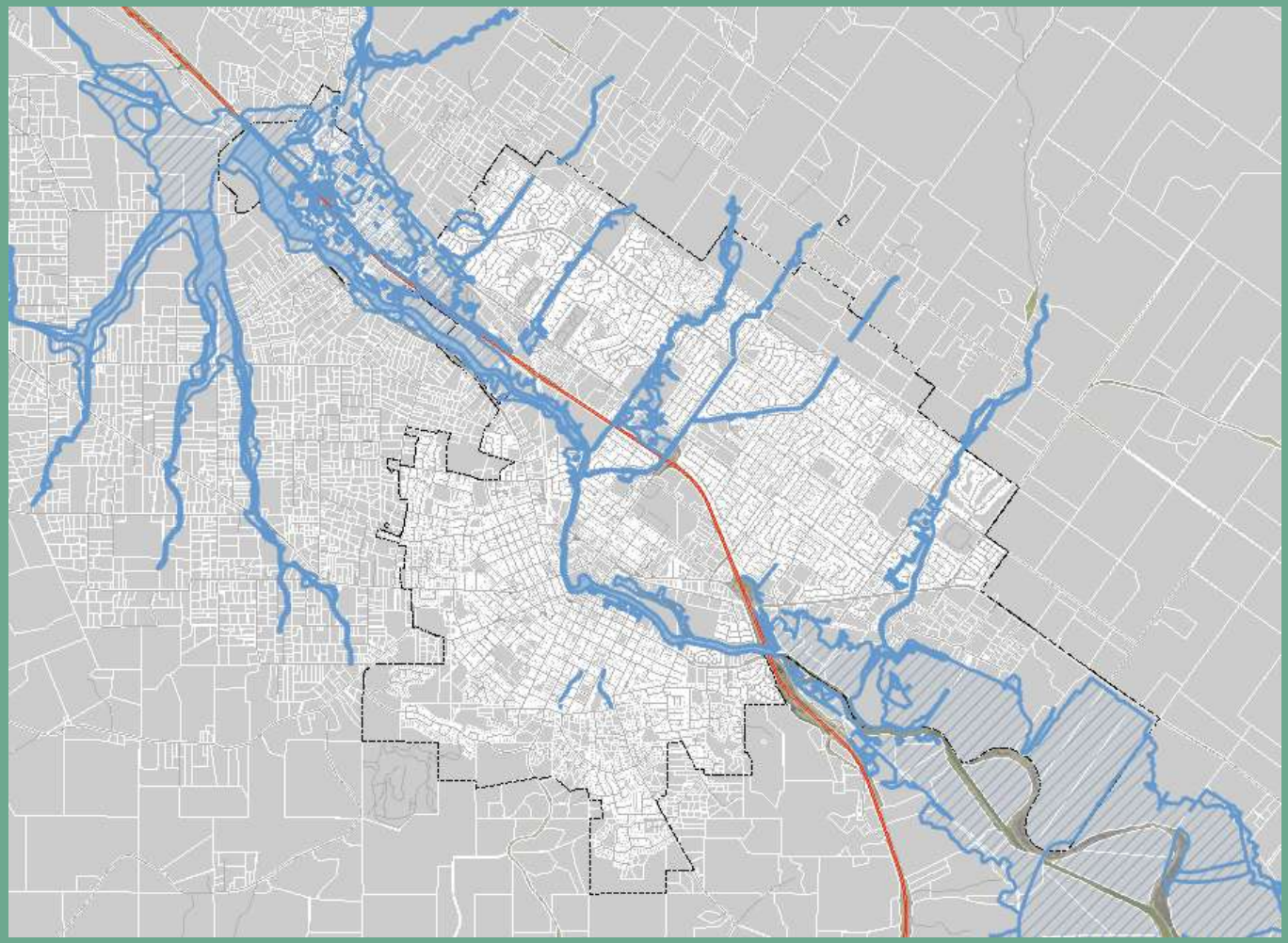
- Considering how SLR impacts rainfall flooding requires updated rain model
  - Model Method
    - 1: Add SLR amount to current MHHW tide level
    - 2: Run the rain flood model, now with rainfall needing to "fight" the higher river elevation
    - 3: Model results may show extra flooded areas



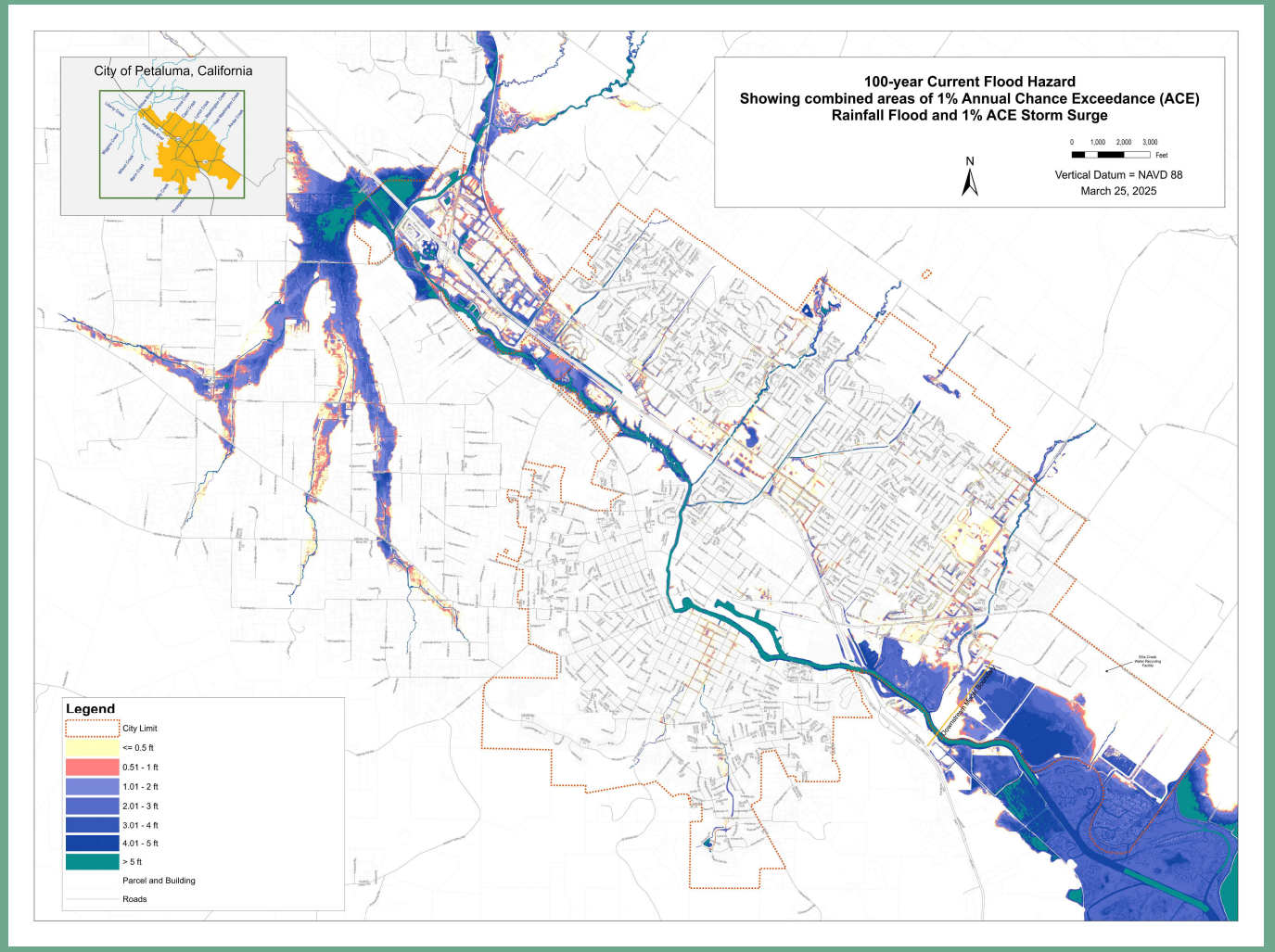
What did we model?

- What are flood risks at mid-century (around 2050), if we look at
  - Rain and storm surge (Map 1)
  - King tides (Map 2)
- What are flood risks at the end of the century (around 2100), if we look at
  - Rain and storm surge (Map 3)
  - King tides (Map 4)
- What could the *very low probability* flood risks at the end of the century
  - Rain and storm surge (Map 5)
  - King tides (Map 6)

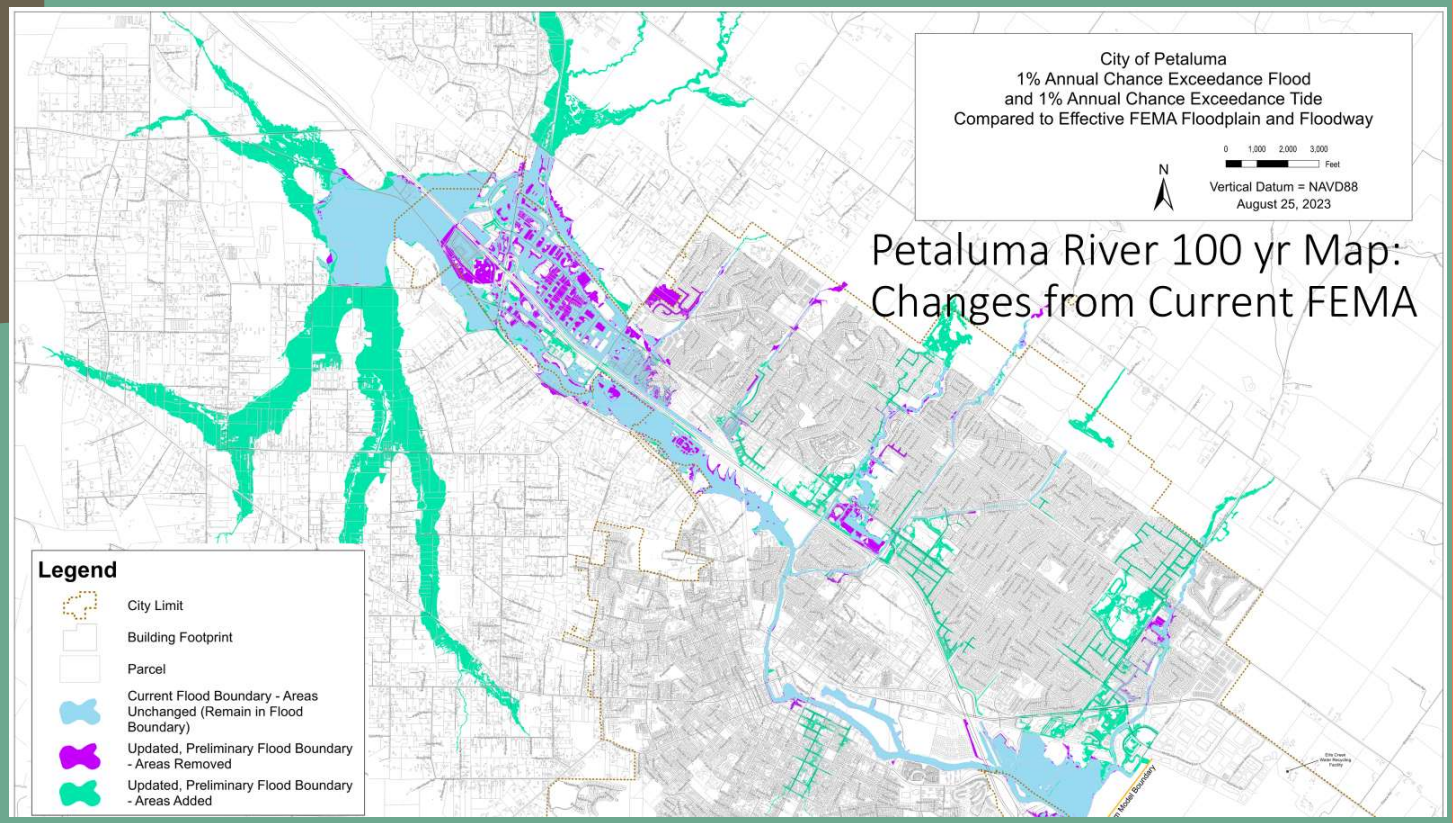
Current FEMA 100 Yr (1% Chance) Floodplain



Proposed FEMA 100 Yr (1% Chance) Floodplain

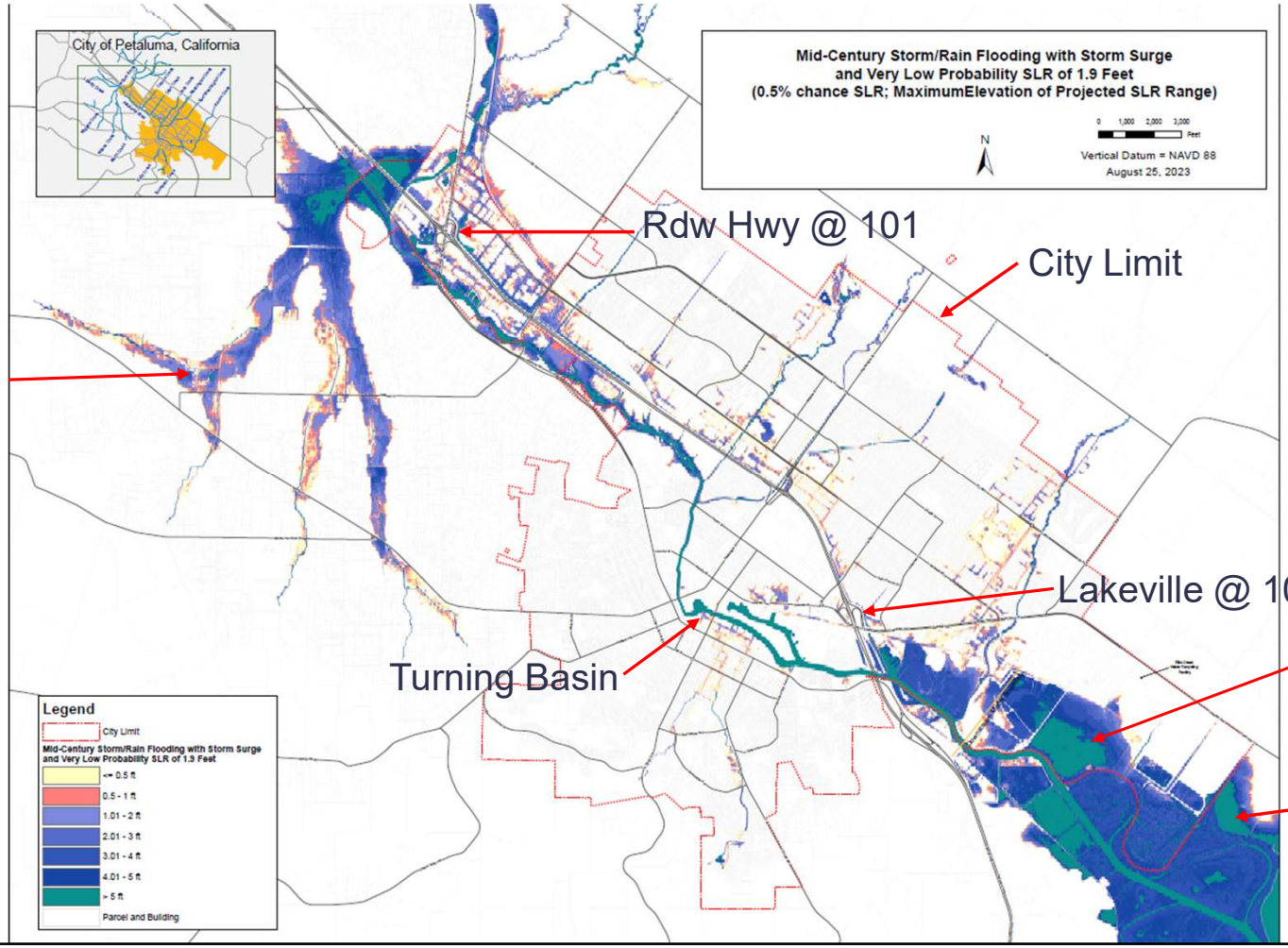


CHANGES in Proposed FEMA 100 Yr (1% Chance) Floodplain



- The City has begun the process to update our flood maps with FEMA
- FEMA model and maps (100 yr, 500 yr and Floodway) are currently in FEMA review
- Community Engagement program will kick off in 2026
  - Smaller neighborhood/community meetings organized by tributary creeks
  - Extensive Educational Outreach campaign for both updated FEMA flood mapping and Sea Level Rise maps
- 1-2 year timeline to completion

Mid-Century SLR (1.9 feet), Rain and Storm Surge



Rdw Hwy @ 101

City Limit

Flooded Areas

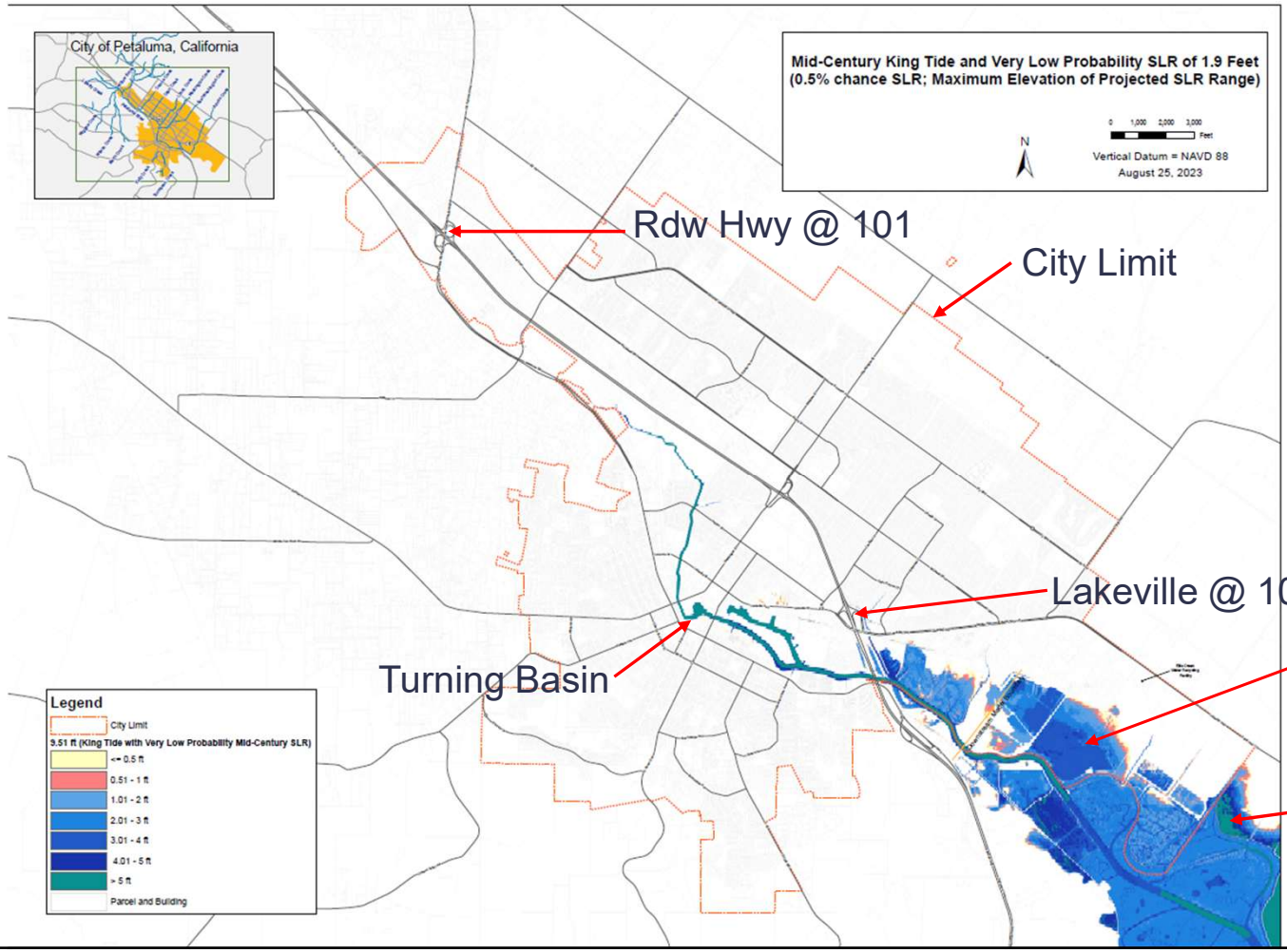
Lakeville @ 101

Turning Basin

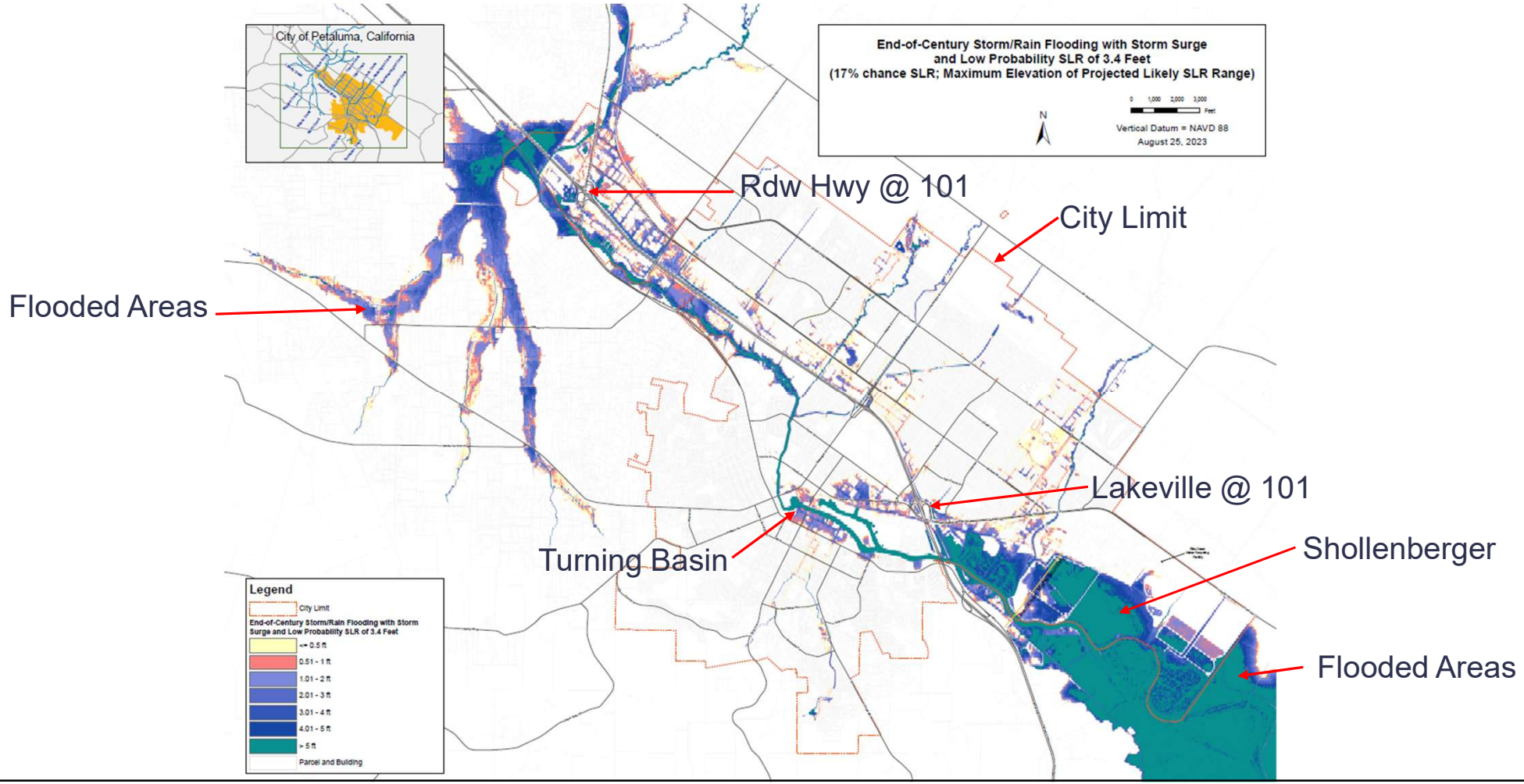
Shollenberger

Flooded Areas

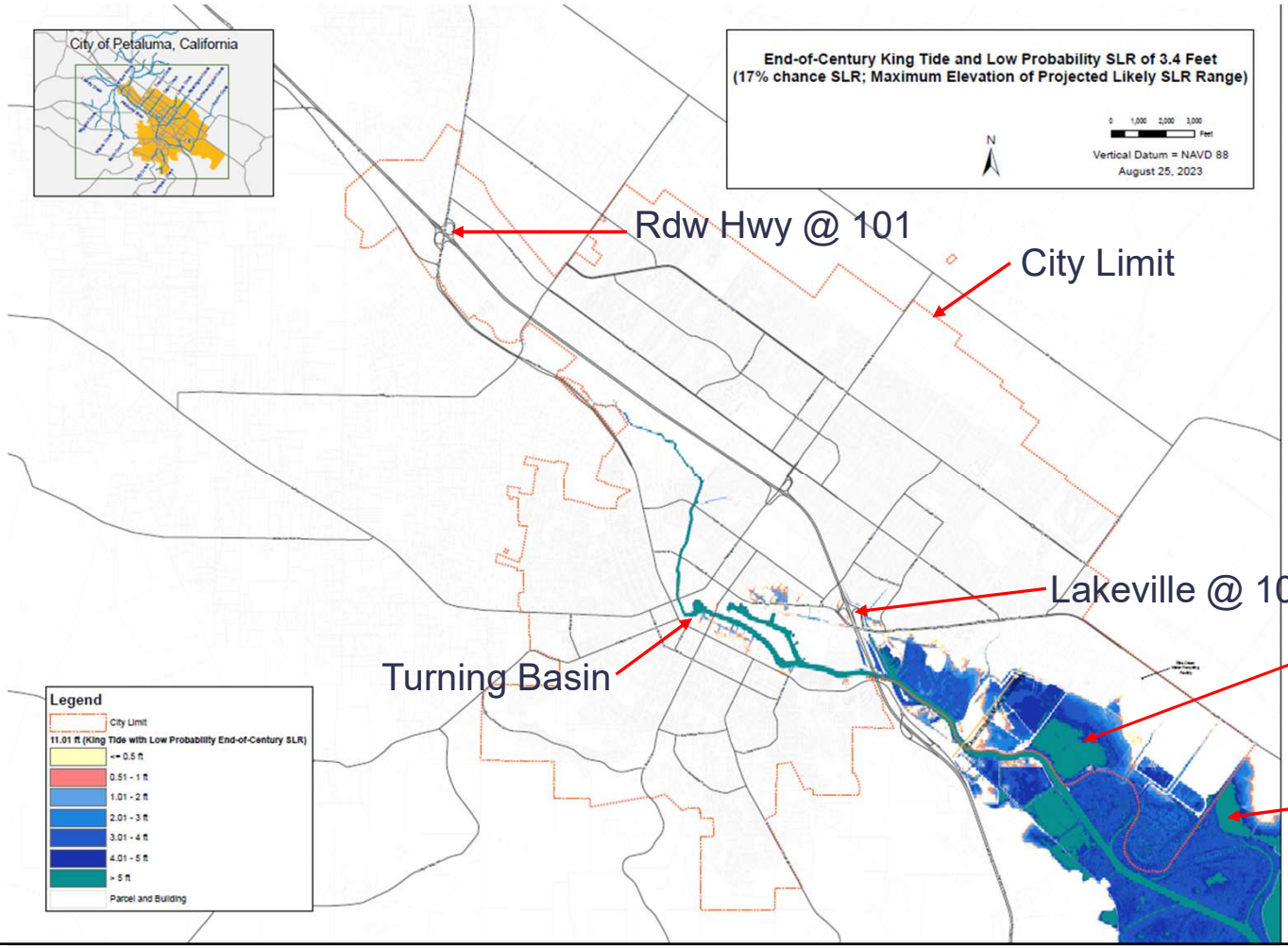
Mid-Century SLR (1.9 feet), King Tide



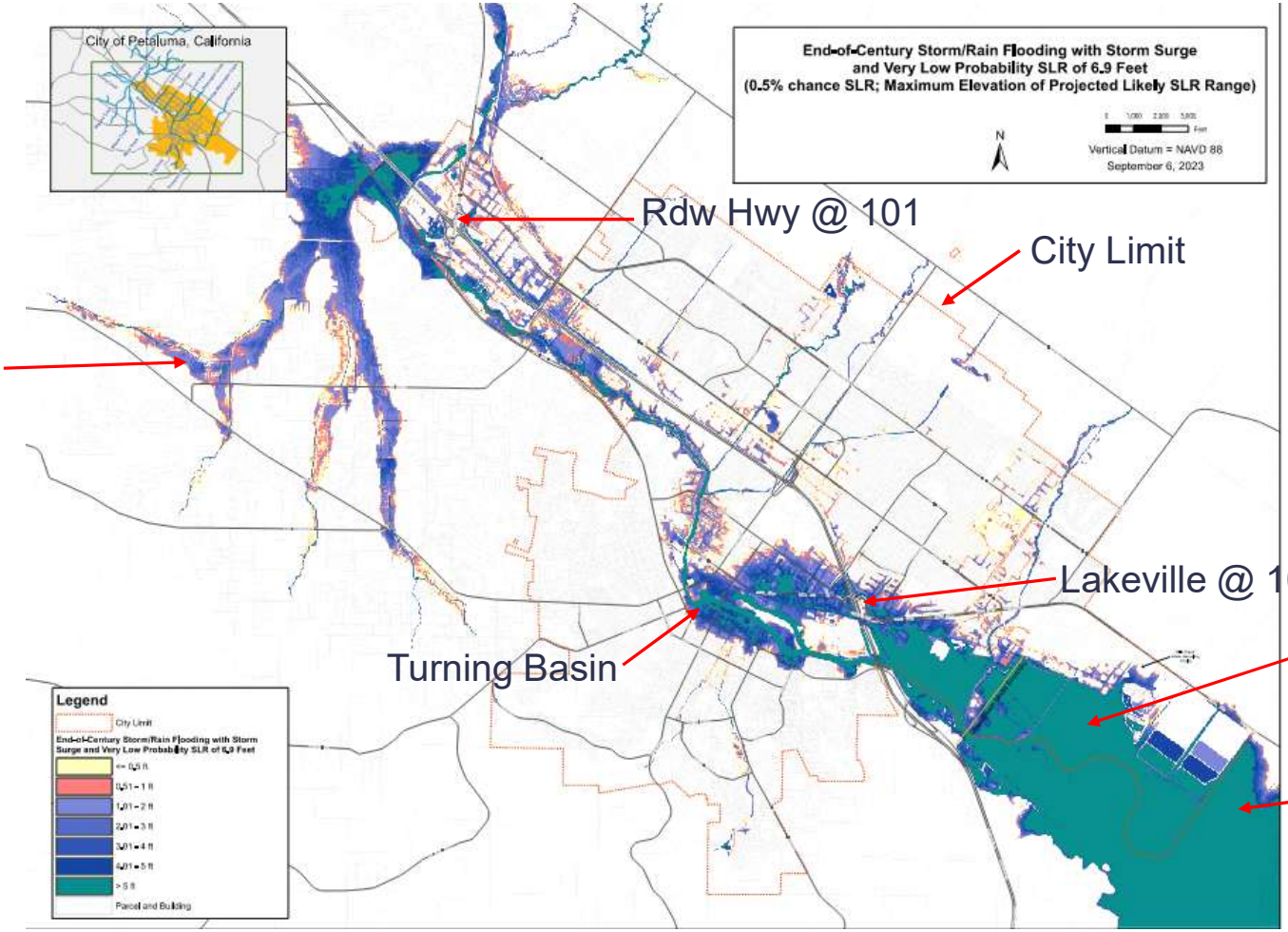
End-of-Century SLR (3.4 feet), Rain and Storm Surge



End-of-Century SLR (3.4 feet), King Tide



End-of-Century SLR (6.9 feet), Rain and Storm Surge



Rdw Hwy @ 101

City Limit

Flooded Areas

Lakeville @ 101

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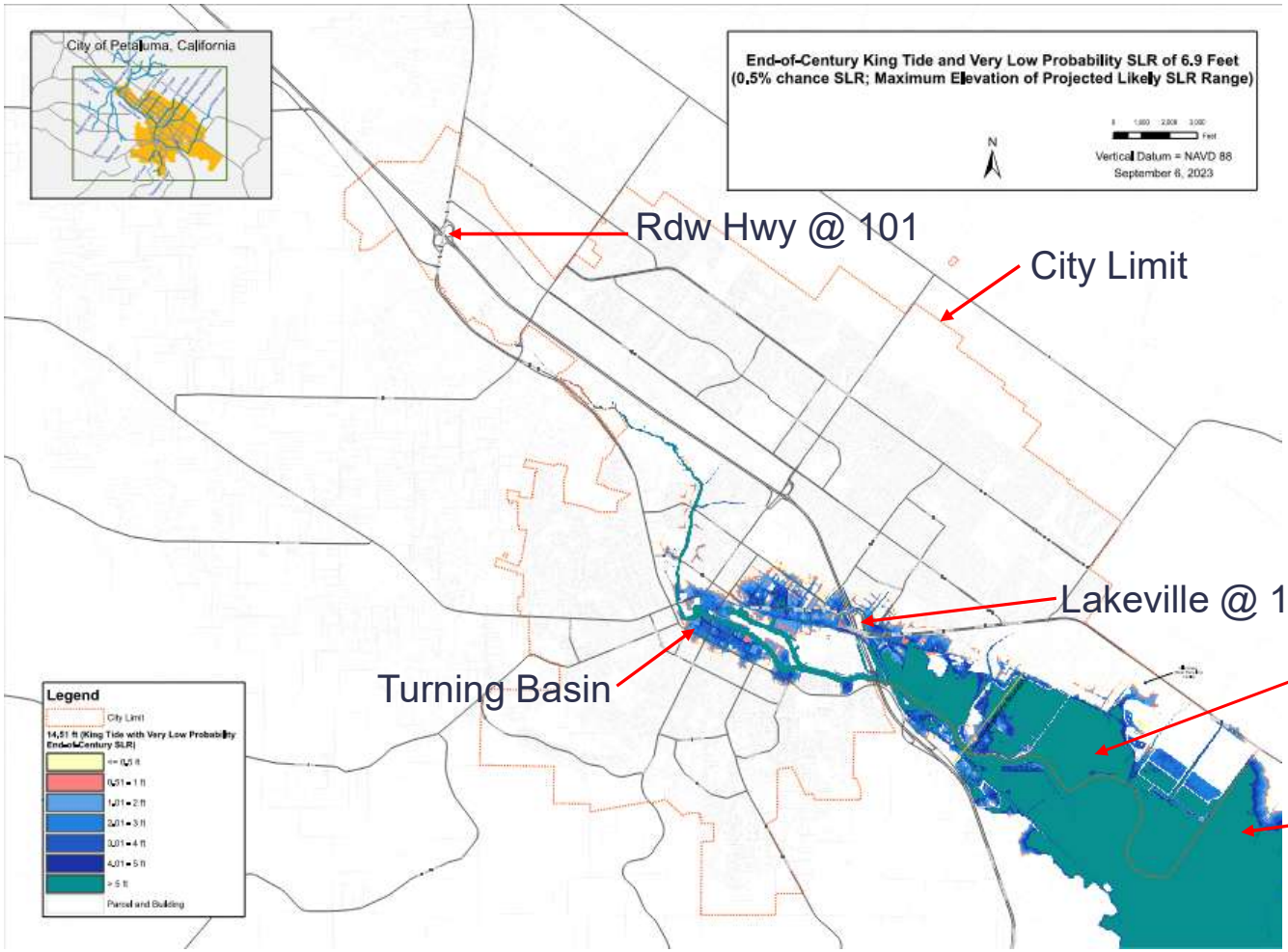
Flooded Areas

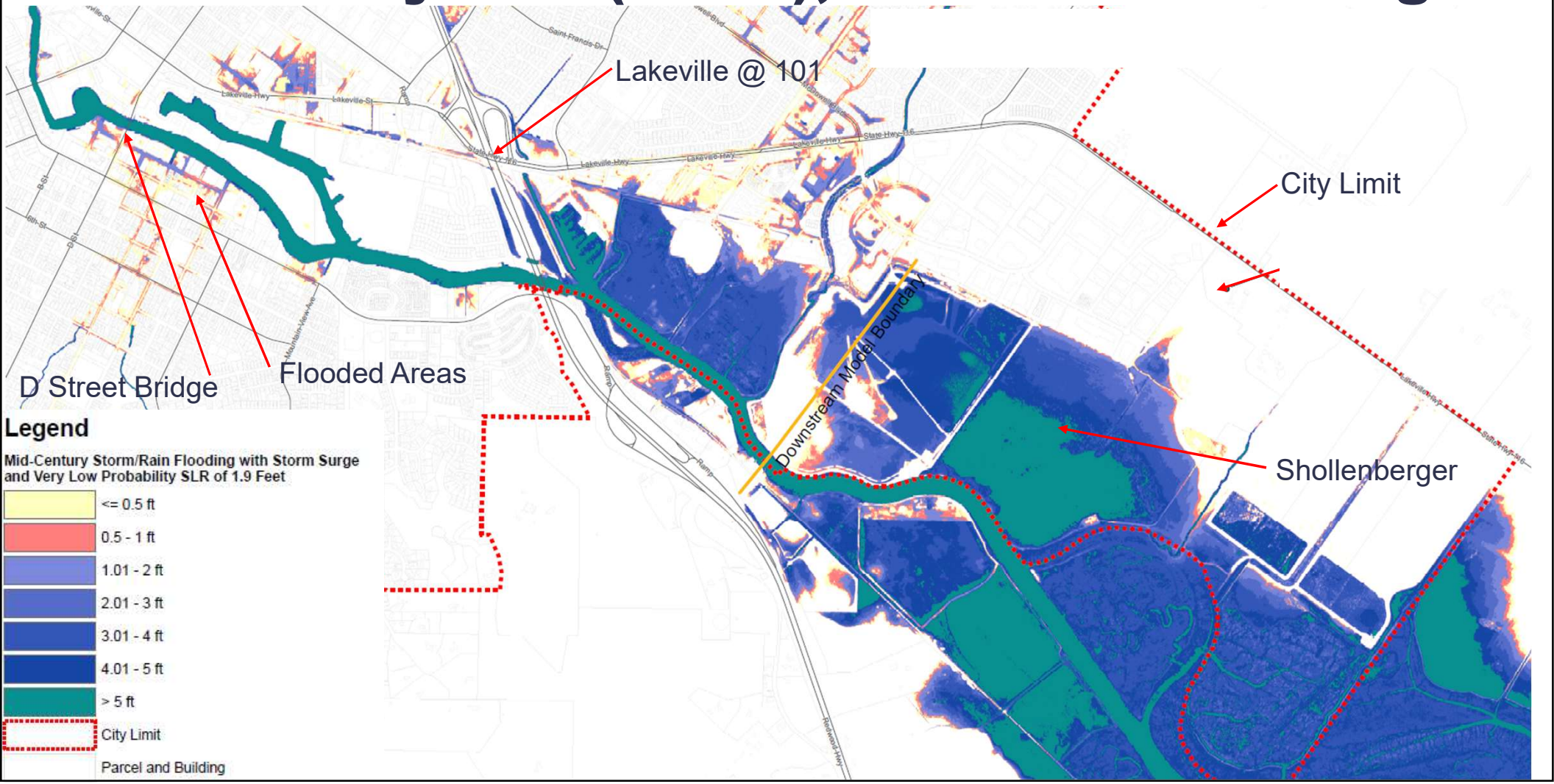
End-of-Century SLR (6.9 feet), King Tide



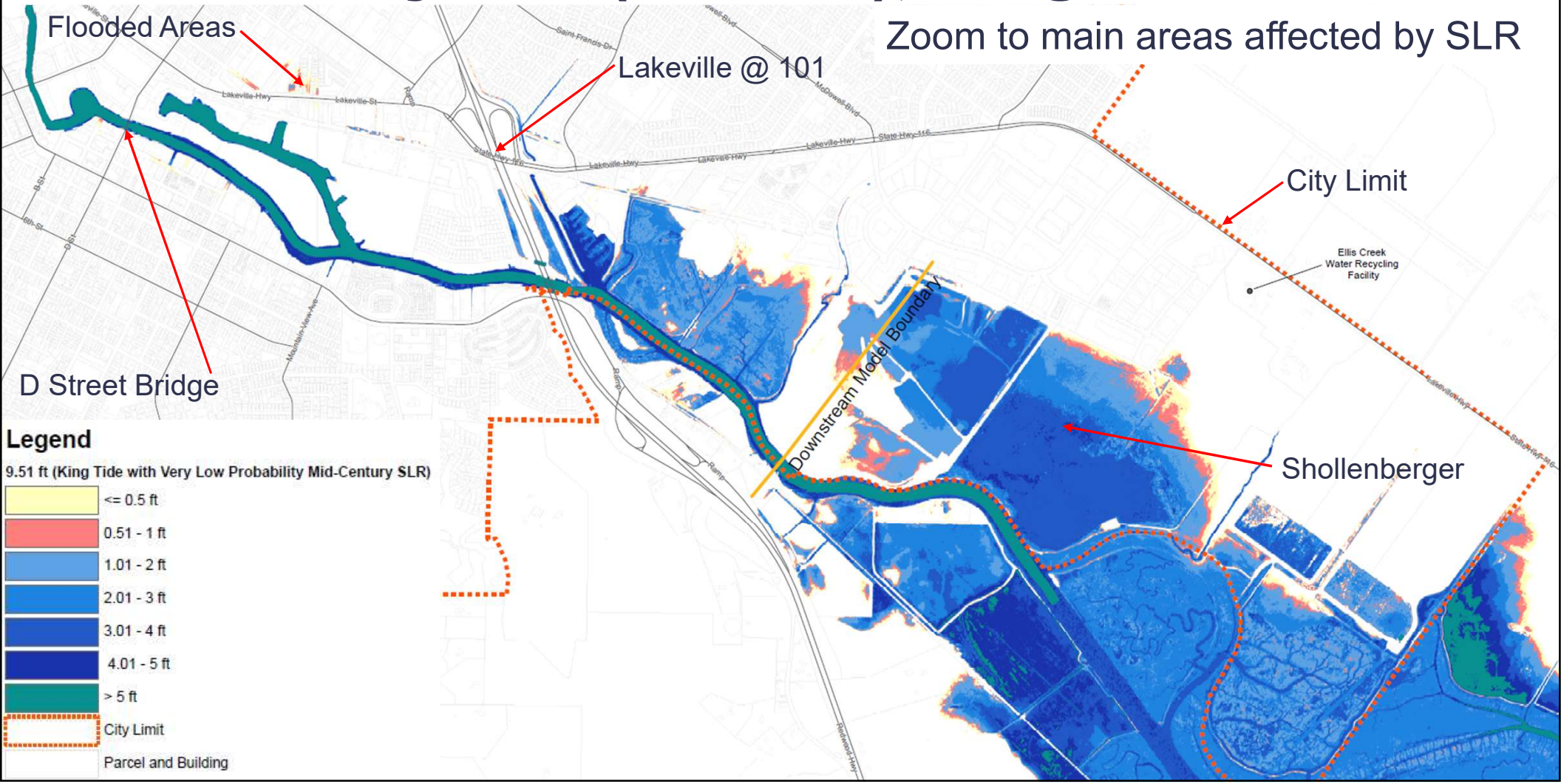
Where can SLR affect the City in the Future

Let’s zoom in to the same maps

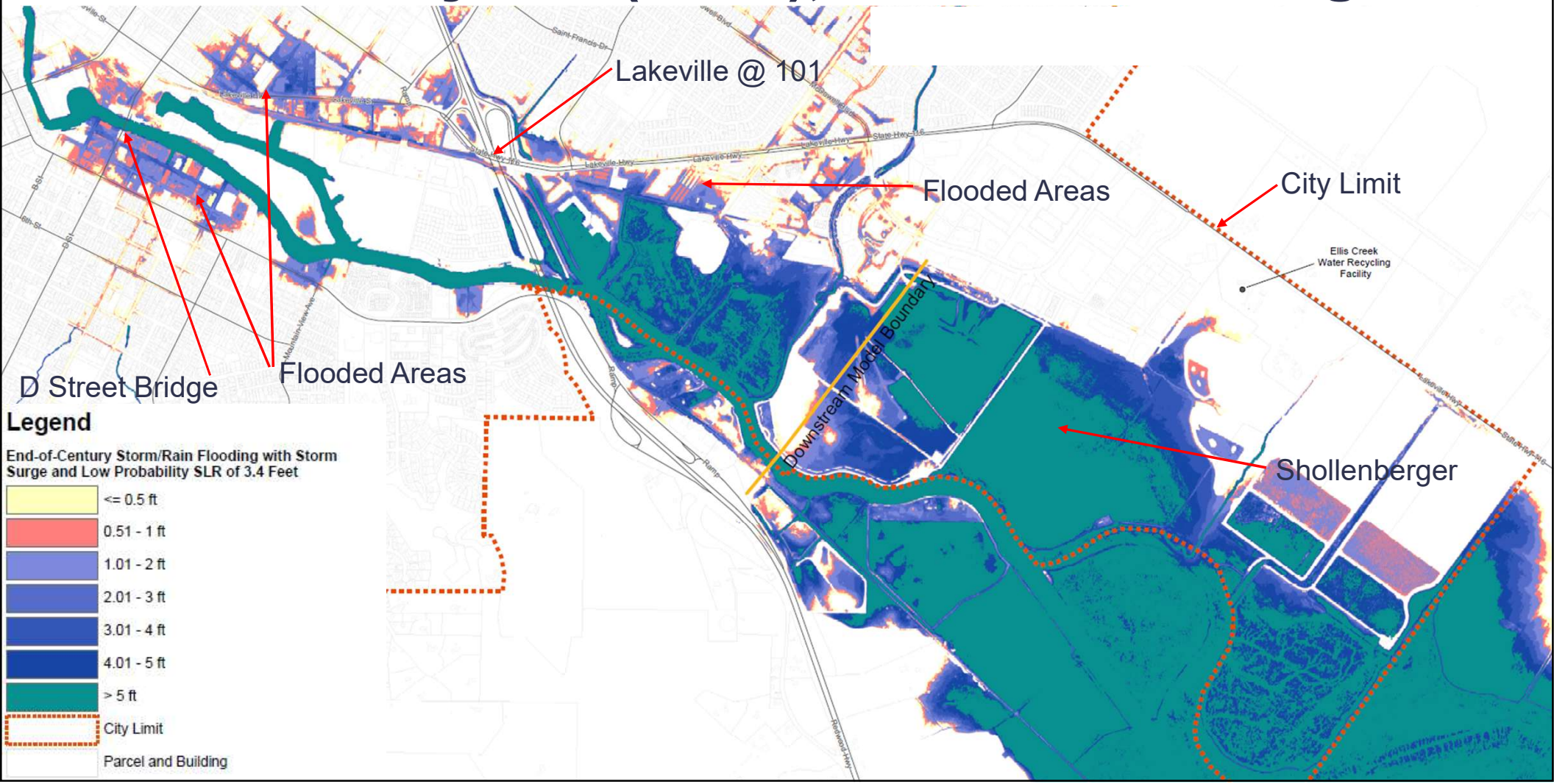
Mid-Century SLR (1.9 ft), Rain + Storm Surge



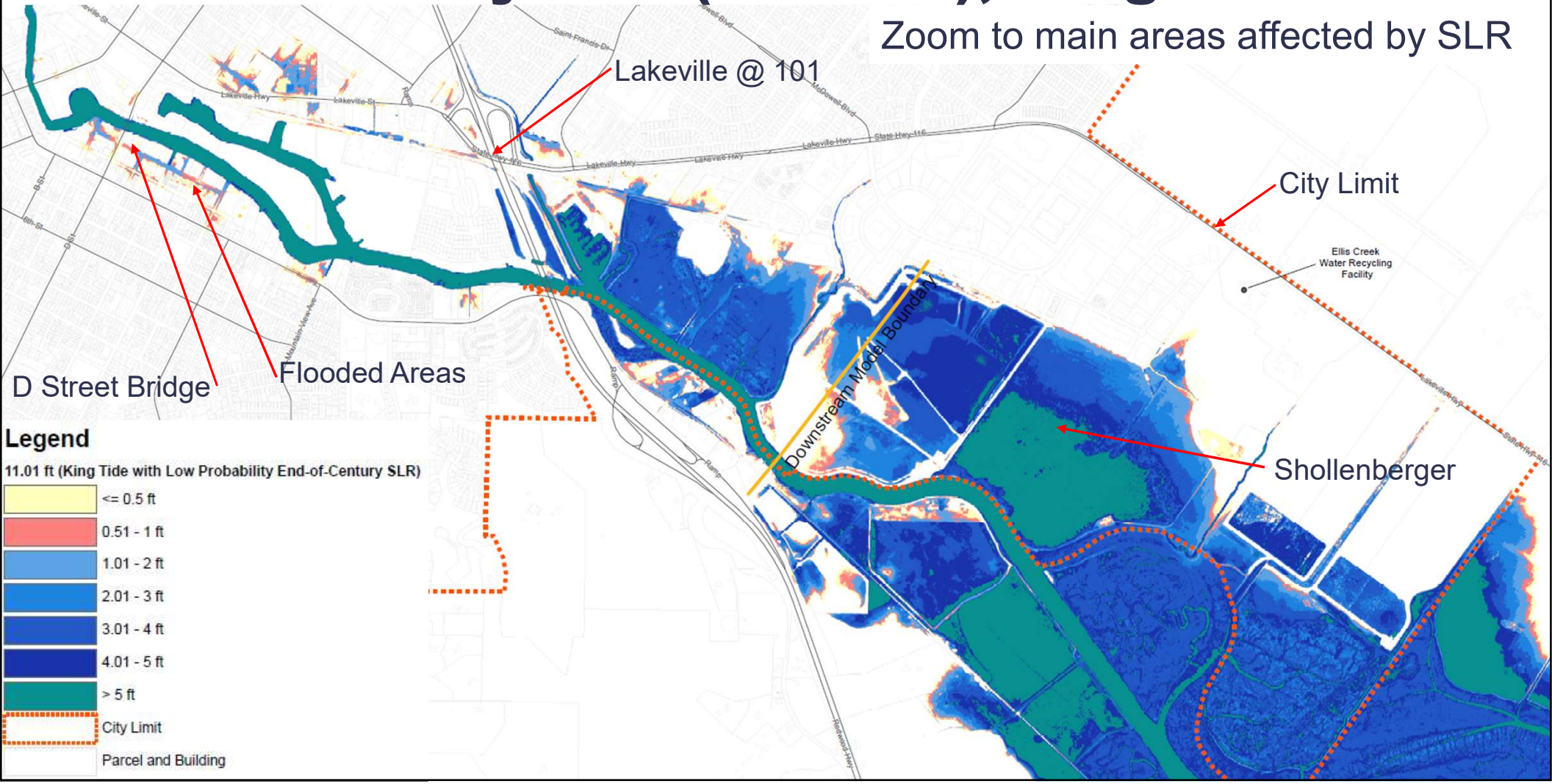
Mid-Century SLR (1.9 feet), King Tide



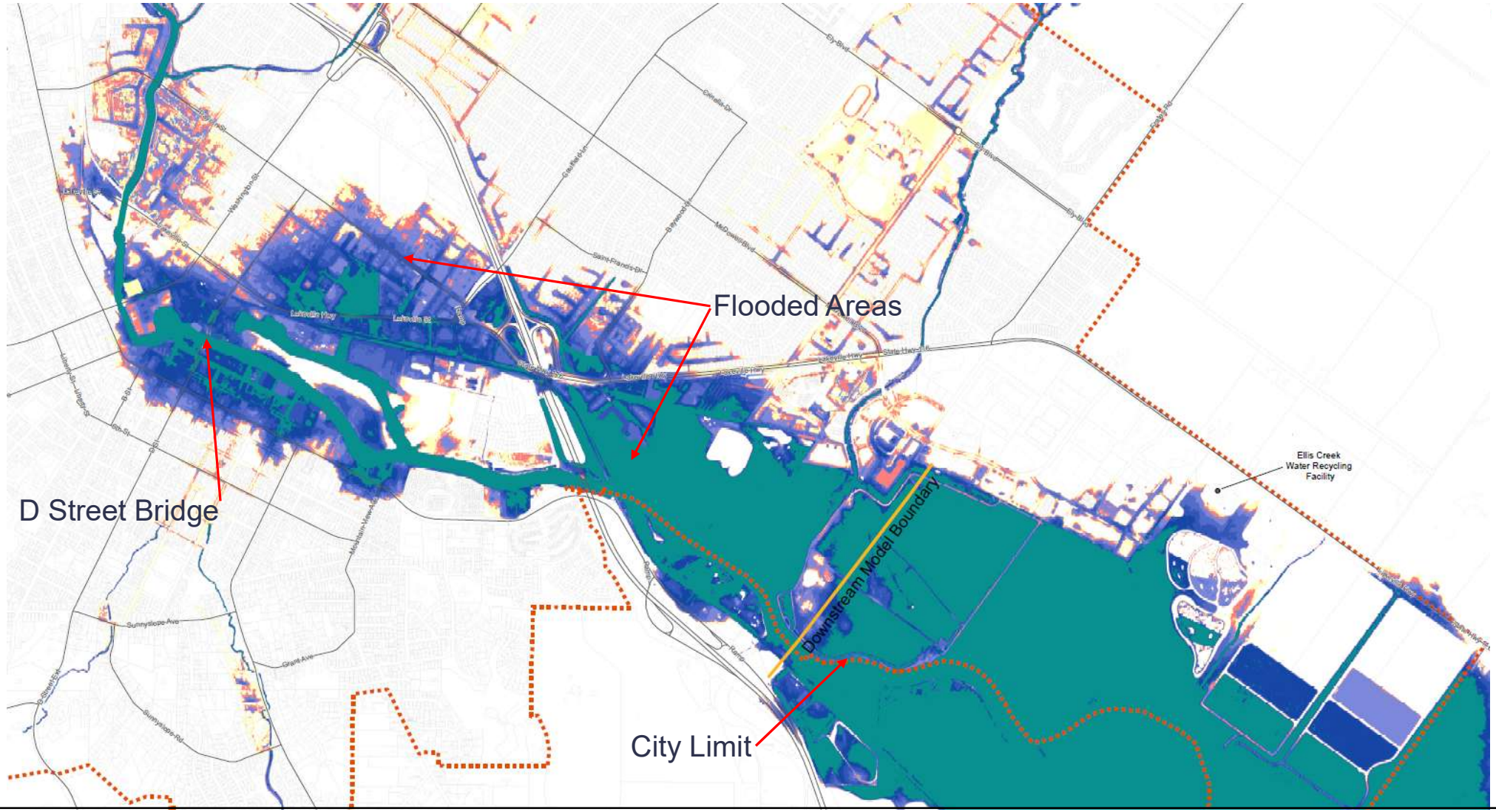
End-of-Century SLR (3.4 ft), Rain + Storm Surge



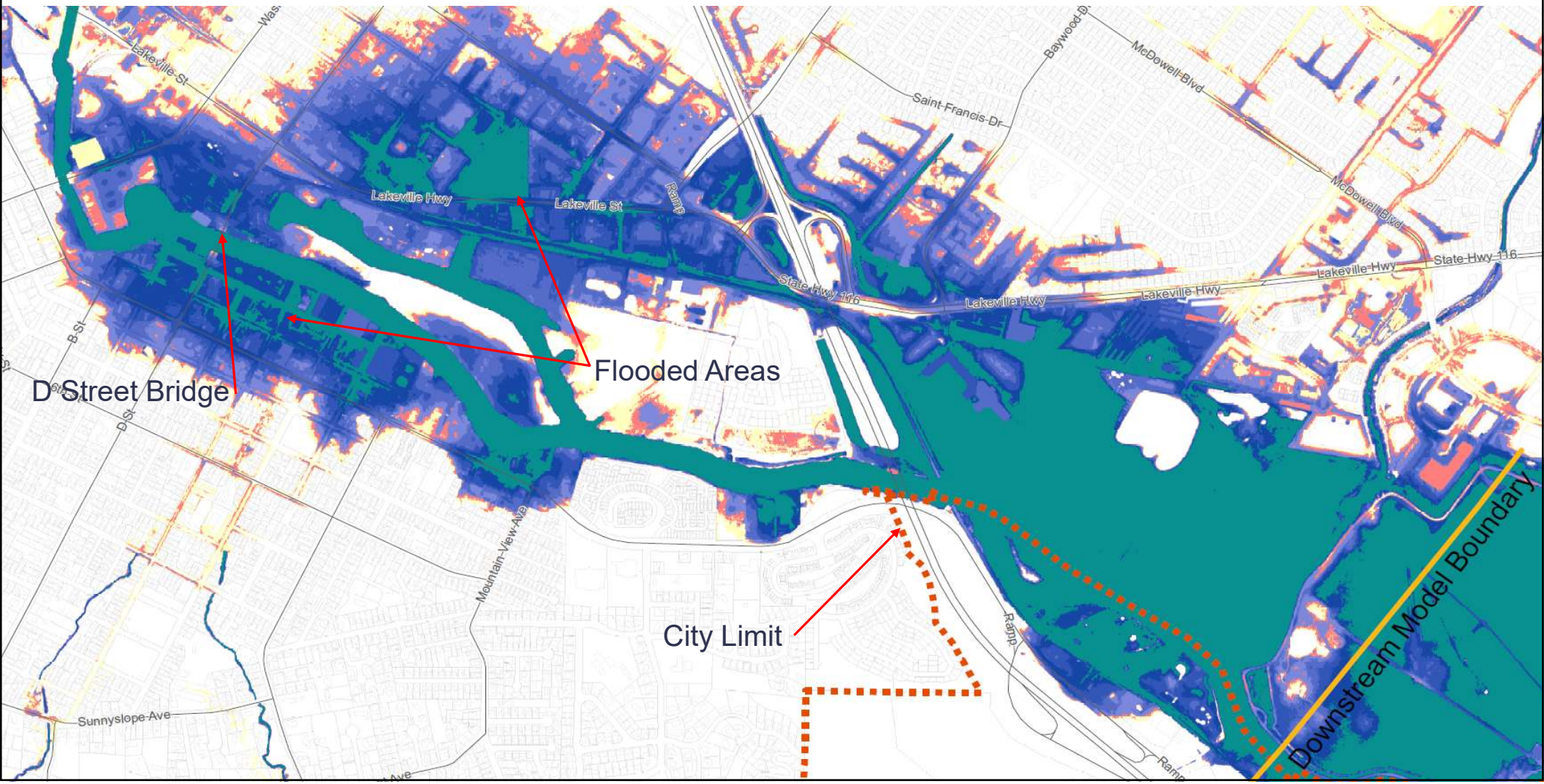
End-of-Century SLR (3.4 feet), King Tide



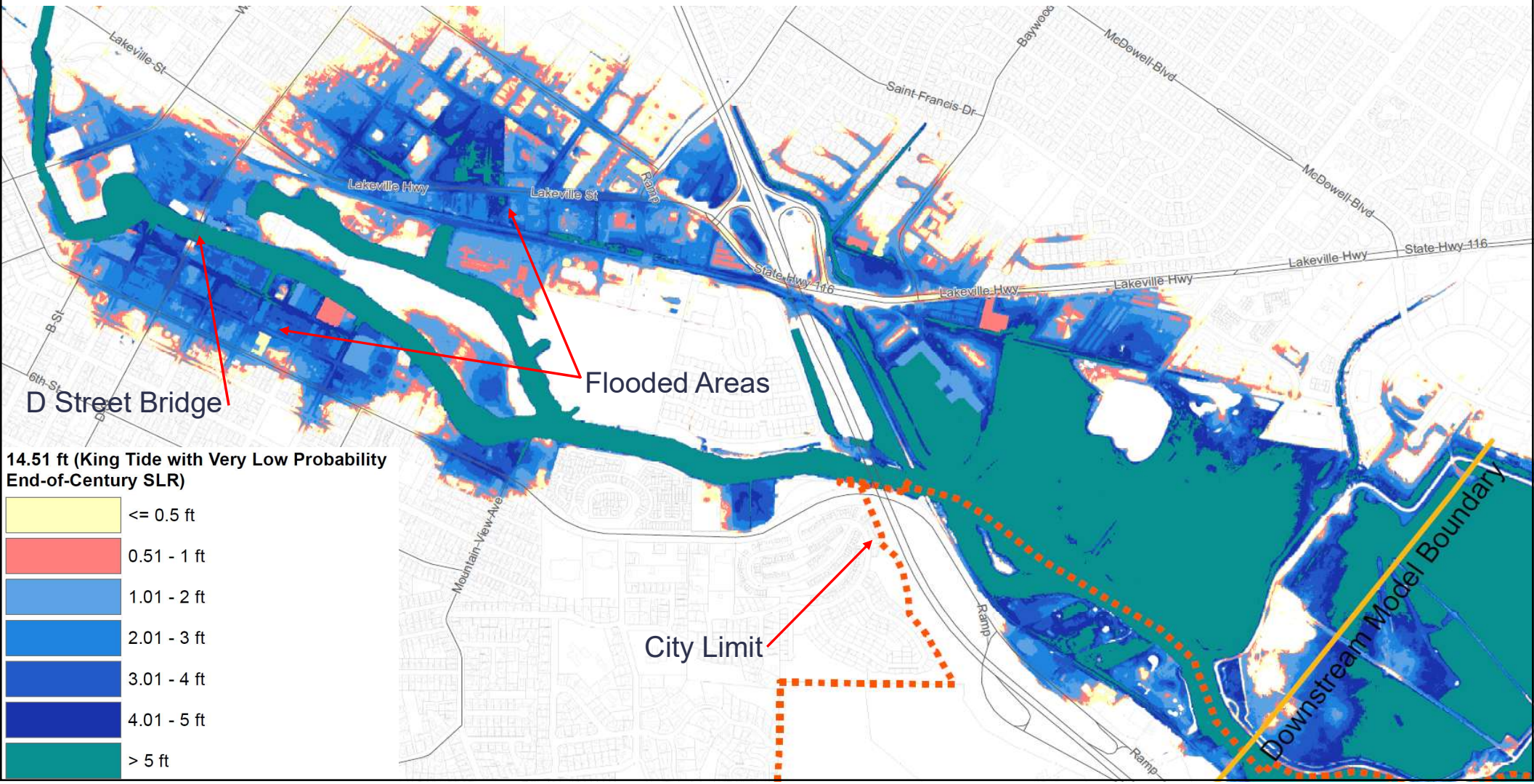
Very Low Probability, End of Century SLR (6.9’), Storm Surge



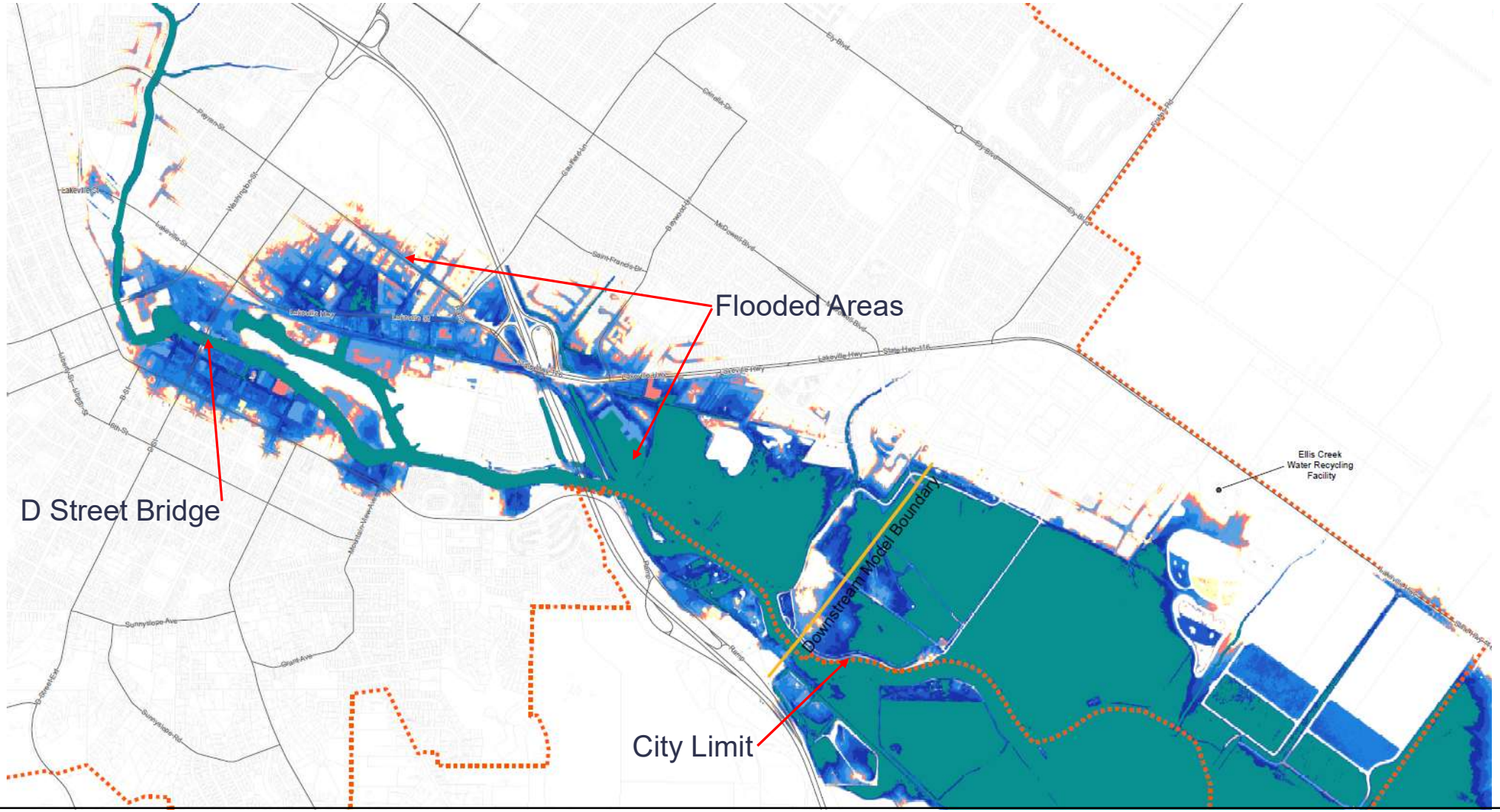
Very Low Probability, End of Century SLR (6.9’), Storm Surge



Very Low Probability, End-of-Century SLR (6.9'), King Tide



Very Low Probability, End of Century SLR (6.9’), King Tide



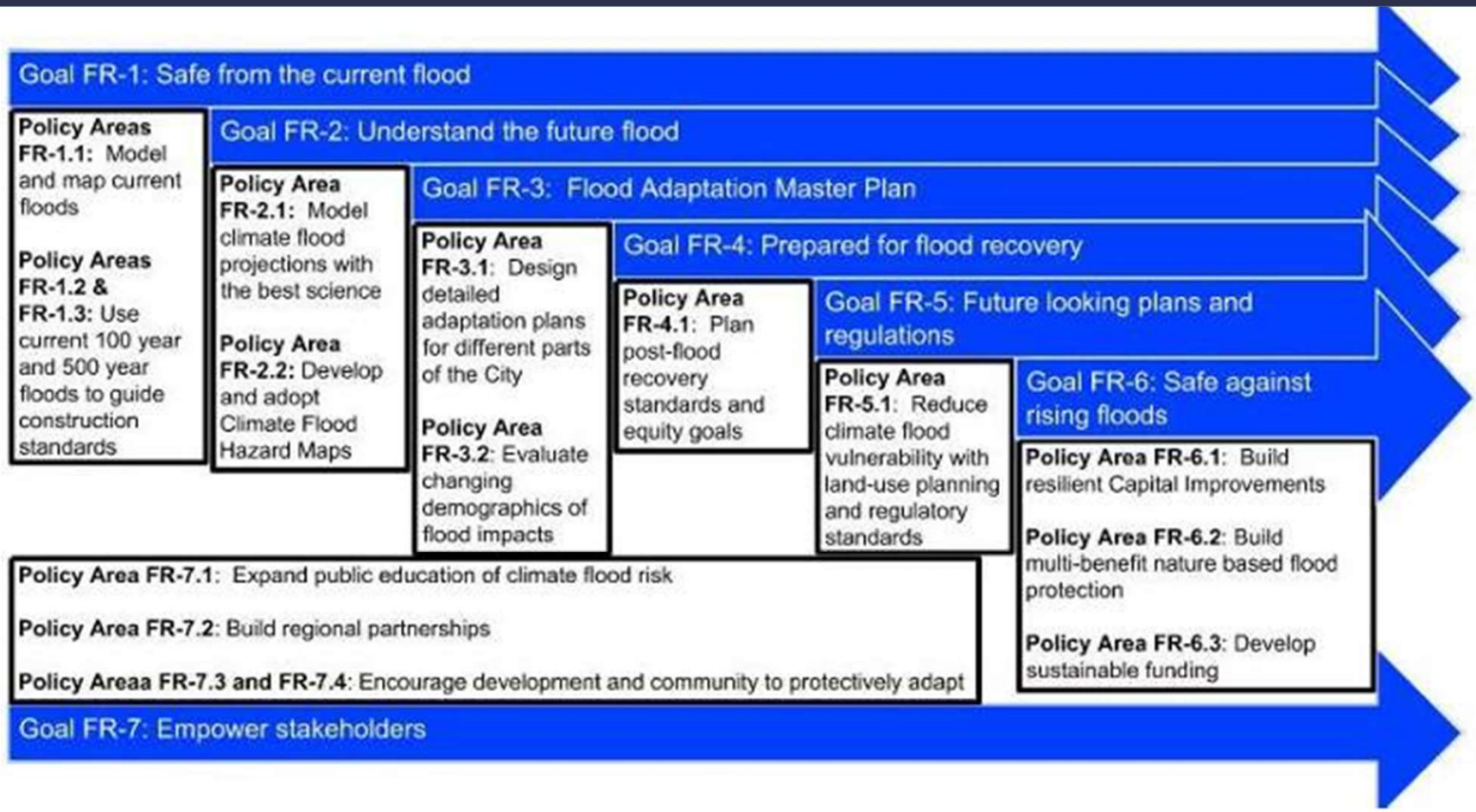
Draft Flood Resiliency Framework

General Plan Frameworks set

Planning for the Future

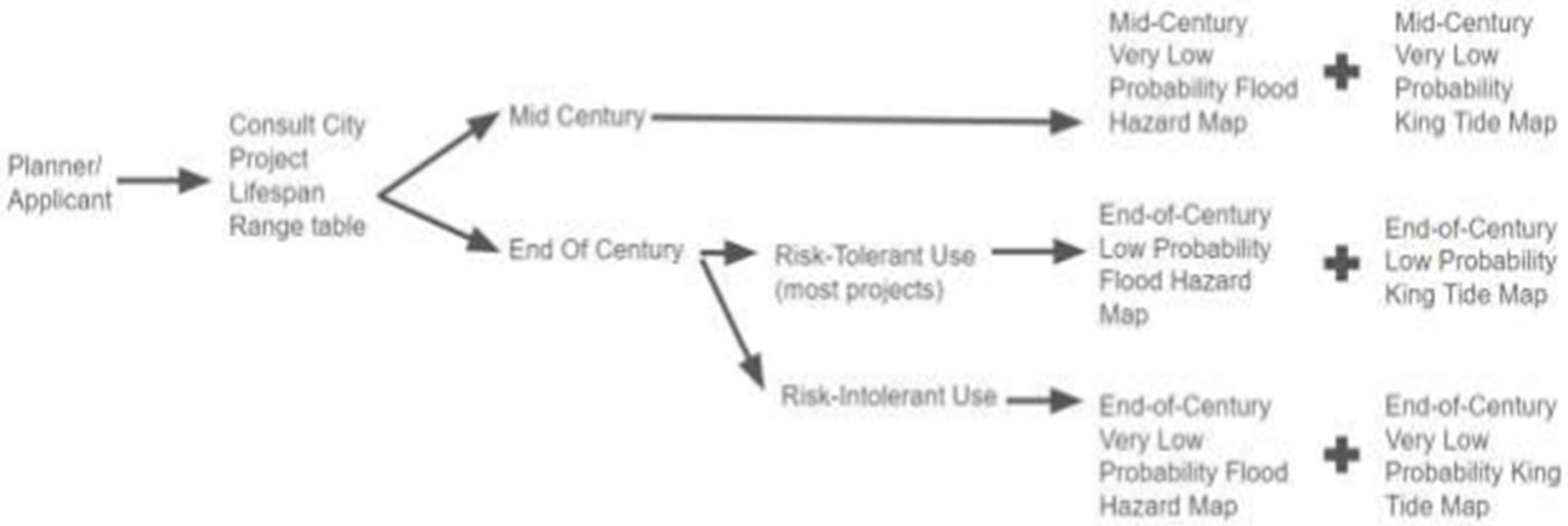
New flood data and maps guide the **General Plan Update** with predictions of potential future floods

General Plan Update
Proposed Flood Resiliency Framework



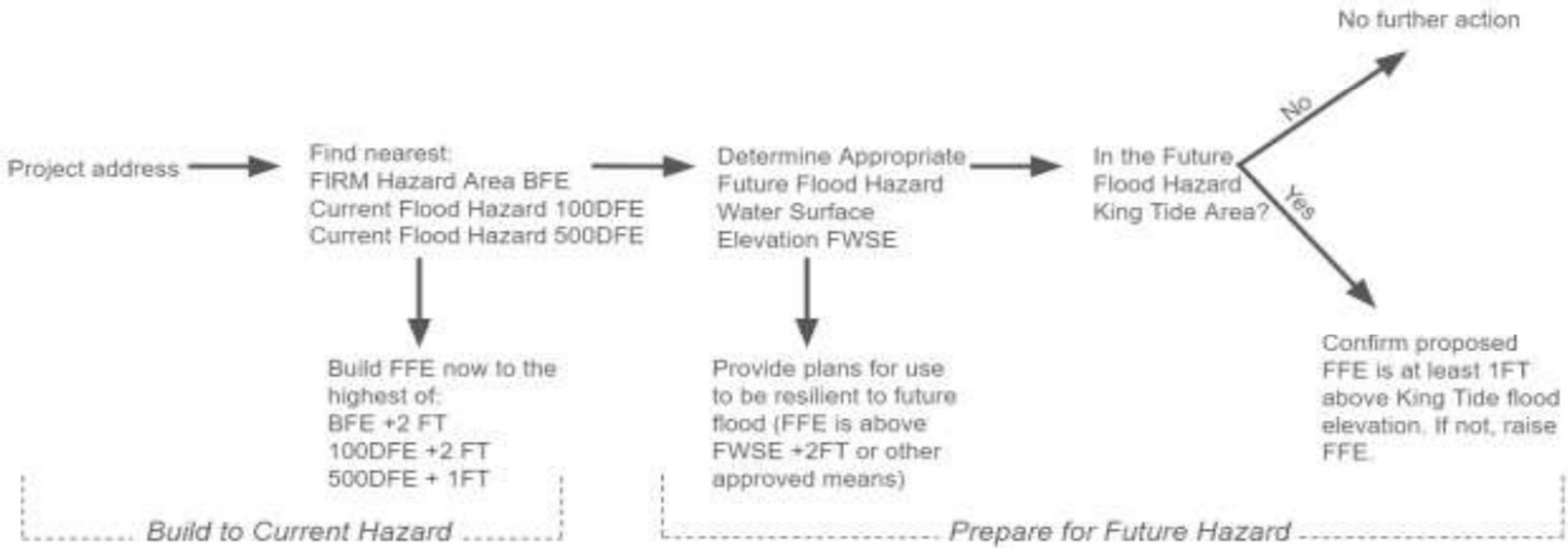
General Plan Update
Proposed Flood Resiliency Framework

Figure 2: Selection Process of Appropriate Future Flood Hazard Maps



General Plan Update
Proposed Flood Resiliency Framework

Figure 11: A summary of the steps a project applicant or planner would use to determine the flood resilience building standards applicable to their project

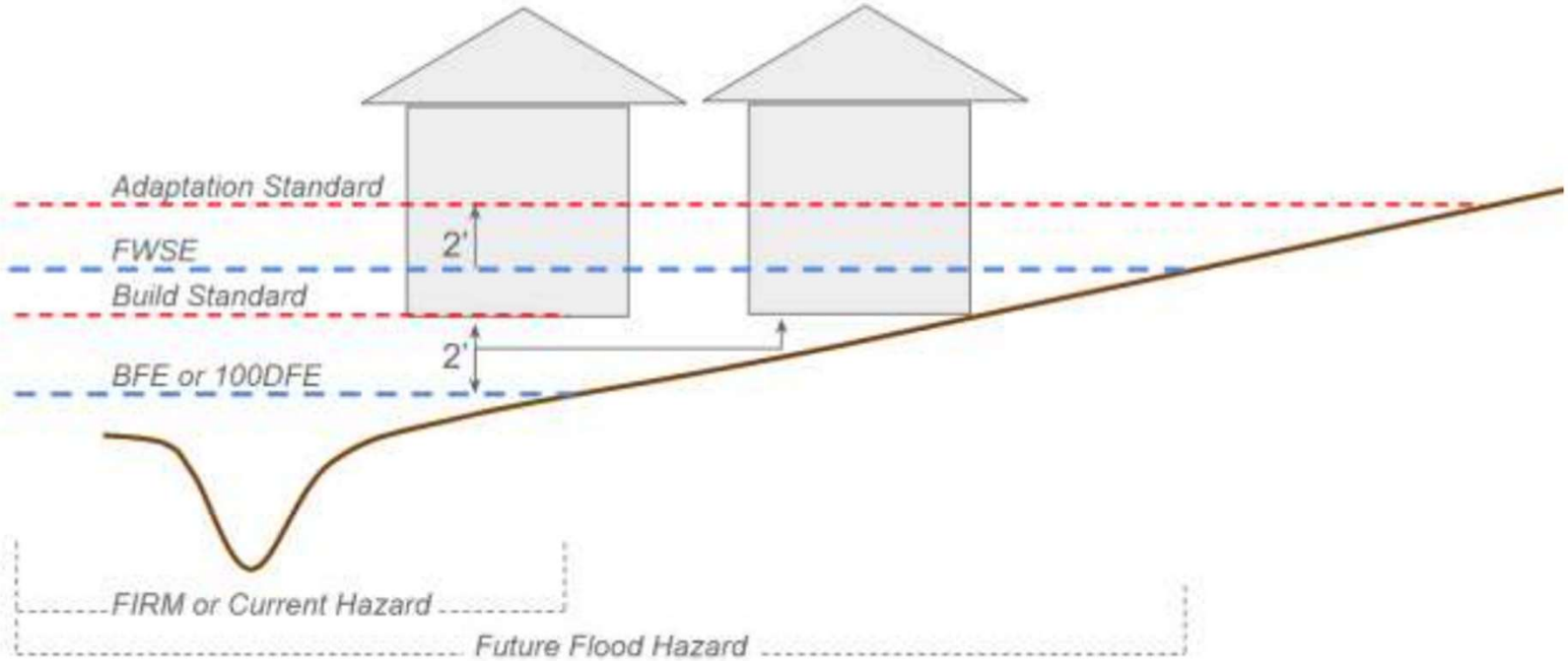


General Plan Update
Proposed Flood Resiliency Framework

Proposed Flood Resilience Standards Summary			
Map	**Requirement**	**Impacted by King Tides**	**Not Impacted by King Tides**
Mid-Century Very Low Probability Flood Hazard Map (Applicable to any short-lived uses)	**Required Finished Floor Elevation**	2' above FIRM BFE and 100DFE, and 1' above 500DFE	
	Adaptability Standard	FFE 2' above Hazard Map FWSE, or other means	
End-of-Century Low Probability Flood Hazard Map Applicable to any Risk-Tolerant uses (retail, residential, etc.)	**Required Finished Floor Elevation**	2' above FIRM BFE and 100DFE, and 1' above 500DFE and King Tide KWSE	2' above FIRM BFE and 100DFE, and 1' above 500DFE
	Adaptability Standard	FFE 2' above Hazard Map FWSE, or other means	
End-of-Century Very Low Probability Flood Hazard Map Applicable to any Risk-Intolerant uses (hospital, emergency shelter, etc.)	**Required Finished Floor Elevation**	2' above FIRM BFE and 100DFE, and 1' above 500DFE and King Tide KWSE	2' above FIRM BFE and 100DFE, and 1' above 500DFE
	Adaptability Standard	FFE 2' above Hazard Map FWSE, or other means	

General Plan Update
Proposed Flood Resiliency Framework

Figure 12: Demonstrating how projects that are within a future flood hazard map but are outside the FIRM or Current 100-Year Flood Hazard Map will reference the nearest BFE or 100DFE to set their FFE standard, see FR-5, General Plan Standards

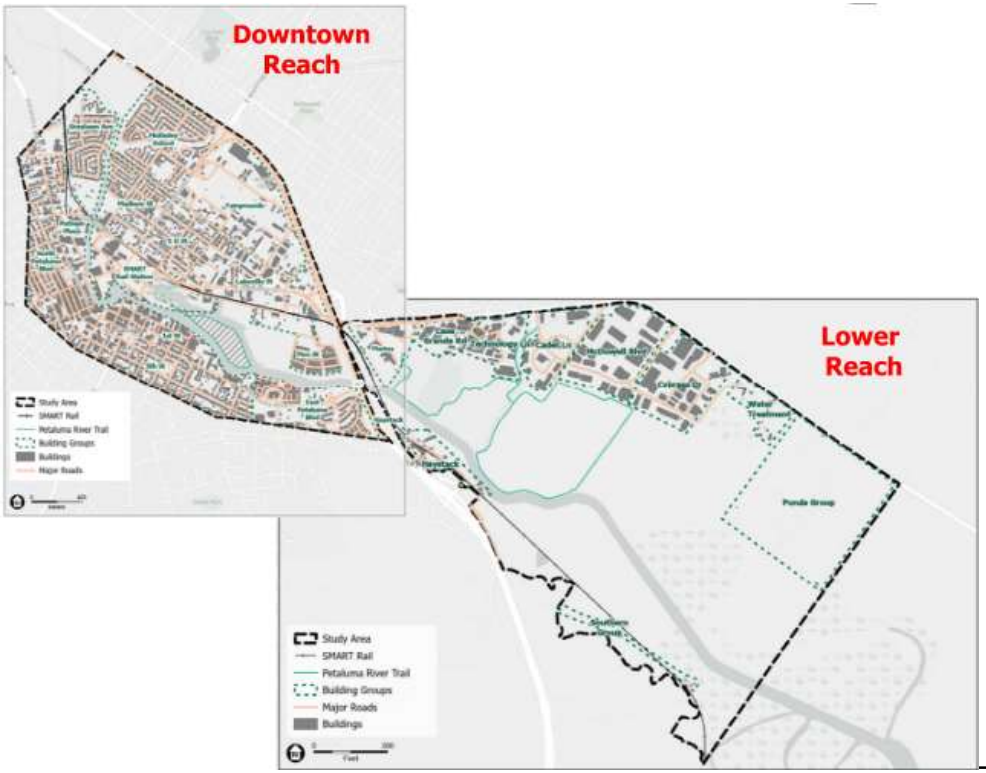


Floodplain Management in Petaluma

- Updated models will inform General Plan policies and zoning ordinance.
- Critical information for flood management projects.
- Improve current Class 6 standing in the FEMA NFIP Community Rating System (CRS)
    - Utilize higher regulatory standards
    - Enhance natural flood management & maintenance solutions
    - Identify priority parcels for mitigation

Next Steps in Petaluma Floodplain Management

Active Partnerships for SLR Planning



North Bay Water Reuse Authority (NBWRA): Draft Petaluma SLR Adaptation Vision and Strategies

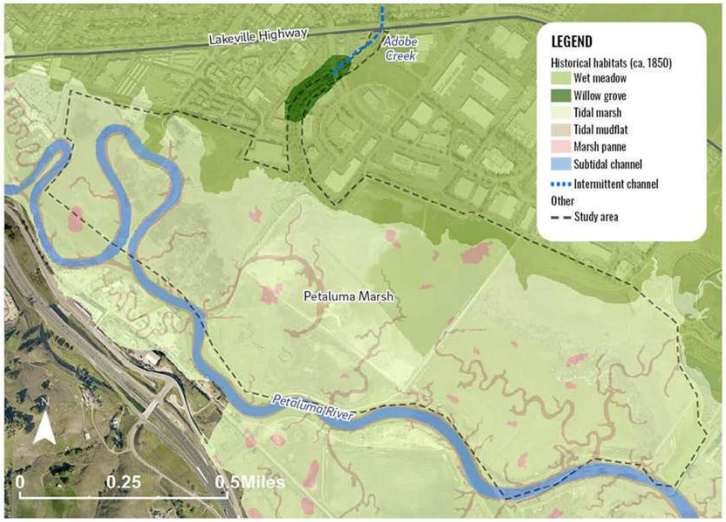
Sonoma County – Joint/Regional OPC Grant Application for Flood Adaptation & Data Gap Analysis

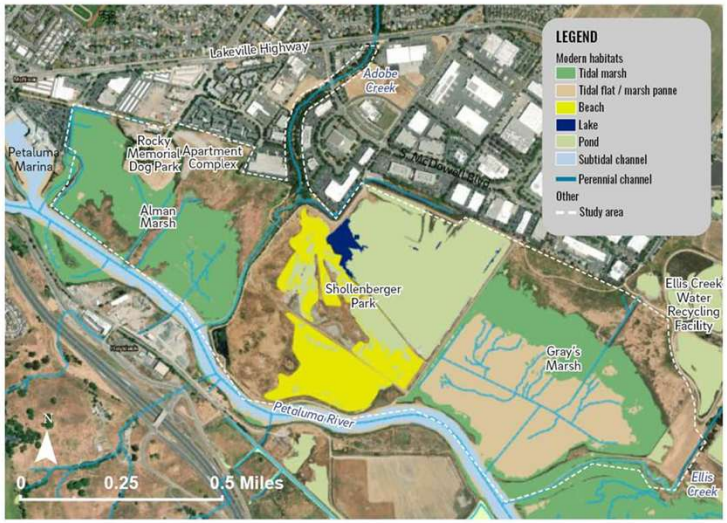
Next Steps in Petaluma Floodplain Management

Active Partnerships for SLR Planning

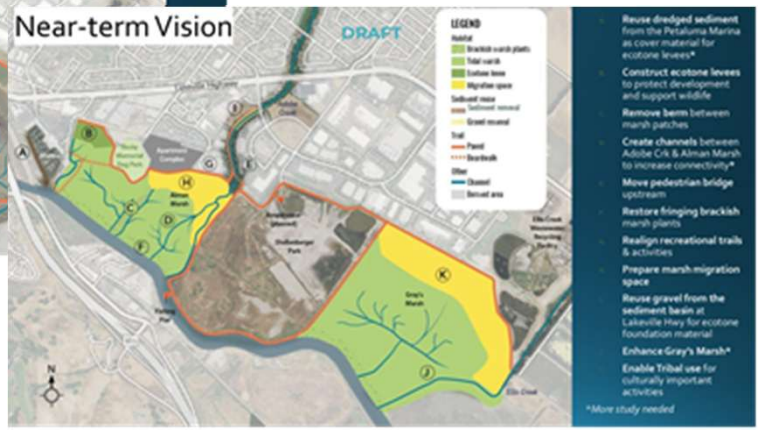
SFEI San Francisco Estuary Institute - Sediment Solutions

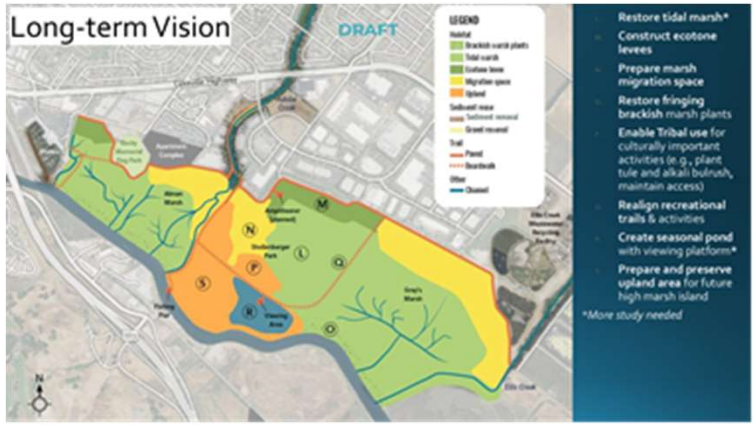
Adobe Creek Baylands – Restoring Sediment Pathways





Partnering with USACE WRDA Restoration Study @ Shollenberger, Alman, and Gray's Marsh





- Environmental restoration feasibility study of the Petaluma marsh area,
- Continuing off SFEI's Lower Adobe Creek Visioning work.
- Study options for beneficial reuse + multi-benefit project to reconnect Alman Marsh, Shollenberger, and Grays Marsh
- Restore tidal marshlands and offer SLR protection in this area.

Next Steps in Petaluma Floodplain Management

Update SLR Maps OPC 2024 & FEMA FIRM Approvals

Currently reviewing and developing SLR map updates for consistency with newly released OPC Guidance ; complete FEMA process for new FIRMS

Flood Adaptation Master Plan

Funding through OPC, will integrate findings from both grants into a comprehensive, long-term strategy for flood mitigation.

CRS Rating improvement

Implementing higher standards to improve CRS to Class 5

Further reduce flood insurance costs to residents in floodplain

Questions

August 14, 2025