FRESNO Council of Governments

ARUP

Technical Working Group Meeting #2

Fresno County Climate Resiliency Plan for Transportation

November 19th 2-4 pm

Agenda

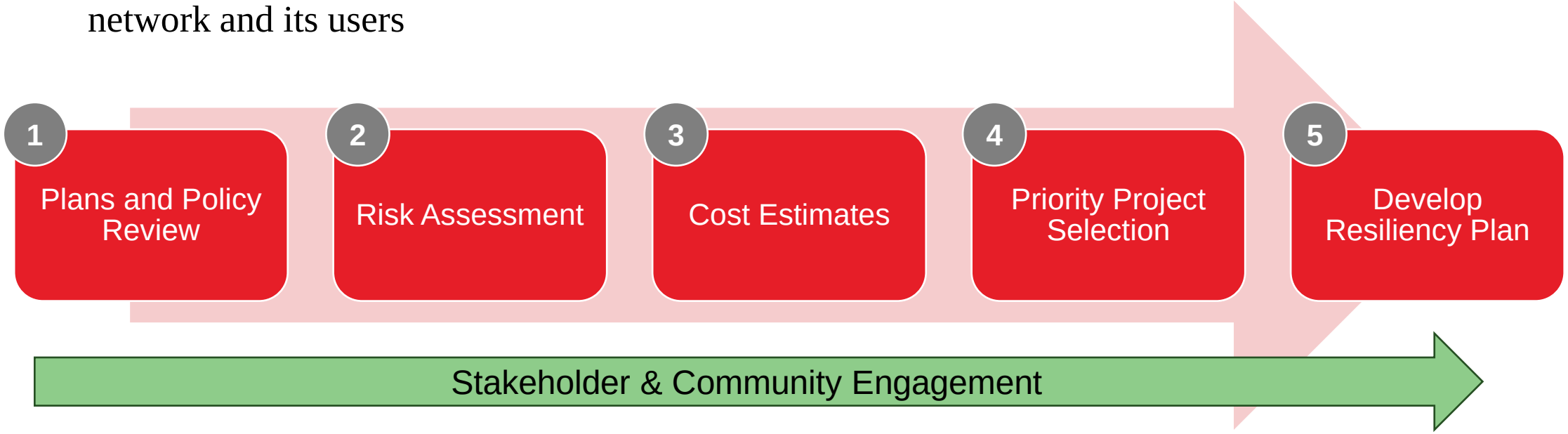
1. Introductions (5 min)
2. Project re-cap (5 min)
3. Climate risk results (45 min)
4. Project prioritization (30 min)
5. Next steps (5 min)

Project Overview

Project Work Plan

Objectives:

- Develop the Fresno Countywide Climate Resiliency Plan that reflects local & regional needs
- Identify a list of projects that will become candidate projects for the 2026 Regional Transportation Plan/Sustainable Community Strategy
- Advance a set of implementable projects that demonstrably reduce risk to the transportation network and its users



Schedule

TASK	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
Task 1. Plan & Policy review													
Task 2. Update Weather & Climate Projections													
Task 3. Risk Analysis & Project Identification													
Task 5. Draft Project List													
Task 6. Cost Estimates													
Task 7. Priority Projects for Risk Assessments													
Task 8. Draft Plan													
Task 9. Final Plan & Board Adoption													

Task 4. Collaboration & Outreach

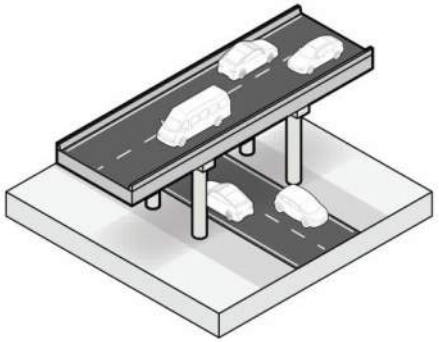
4.1 Outreach Plan													
4.2 Technical & Community WG Meetings				M1		M2		M3		M4			
4.3 Community Outreach													

We are here

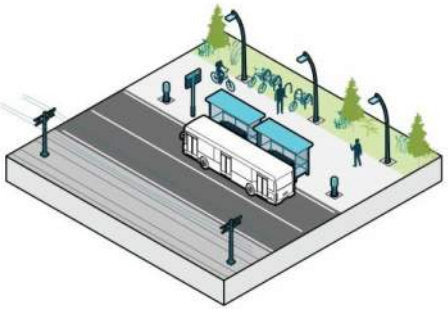
Climate Risk Assessment

Scope

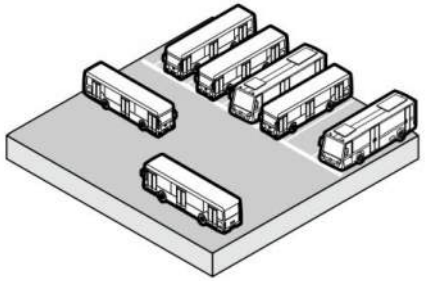
Transportation assets



ROADS & BRIDGES



TRANSIT NETWORK



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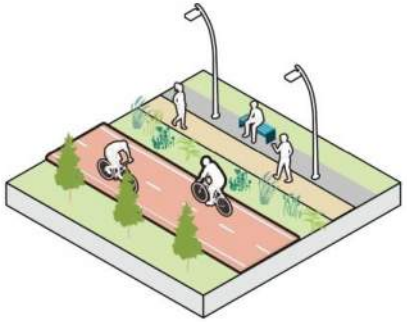
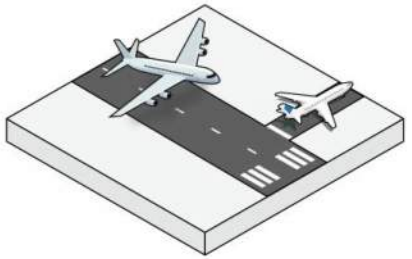


BIKE NETWORK



AIRPORTS

Climate hazards

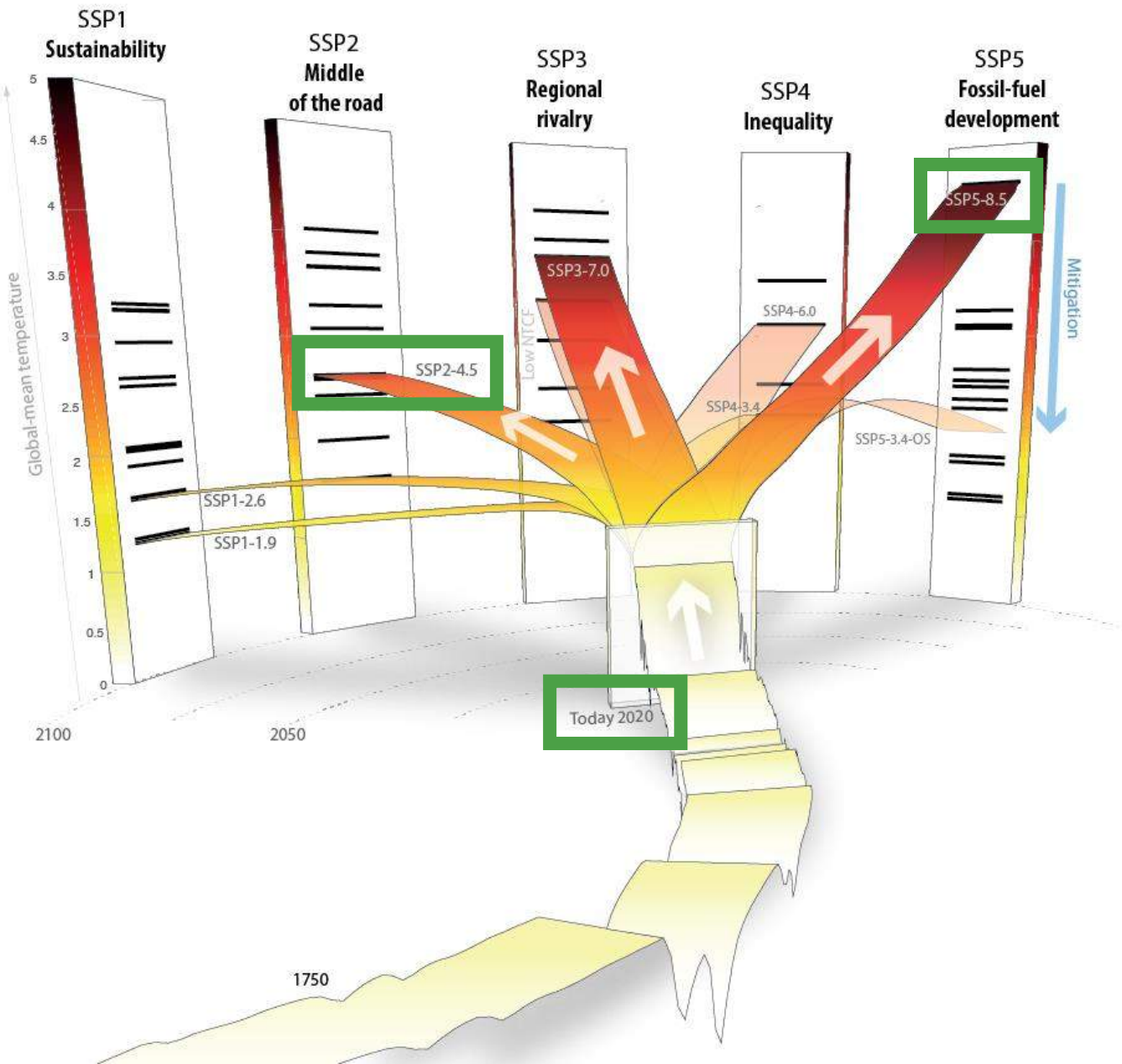
FLOOD

WILDFIRE

EXTREME HEAT

LANDSLIDE

Climate Scenarios & Time Horizons



Time horizons

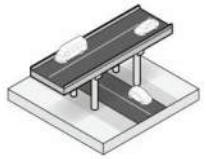
- Present day
- Mid century
- Late century

Two climate scenarios

- Middle of the road
- High emissions

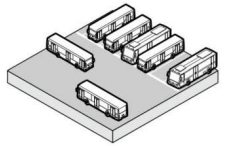
SSP: Shared socio-economic pathway

Today’s Focus



ROADS & BRIDGES

TRANSIT NETWORK



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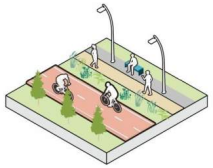


BIKE NETWORK

AIRPORTS

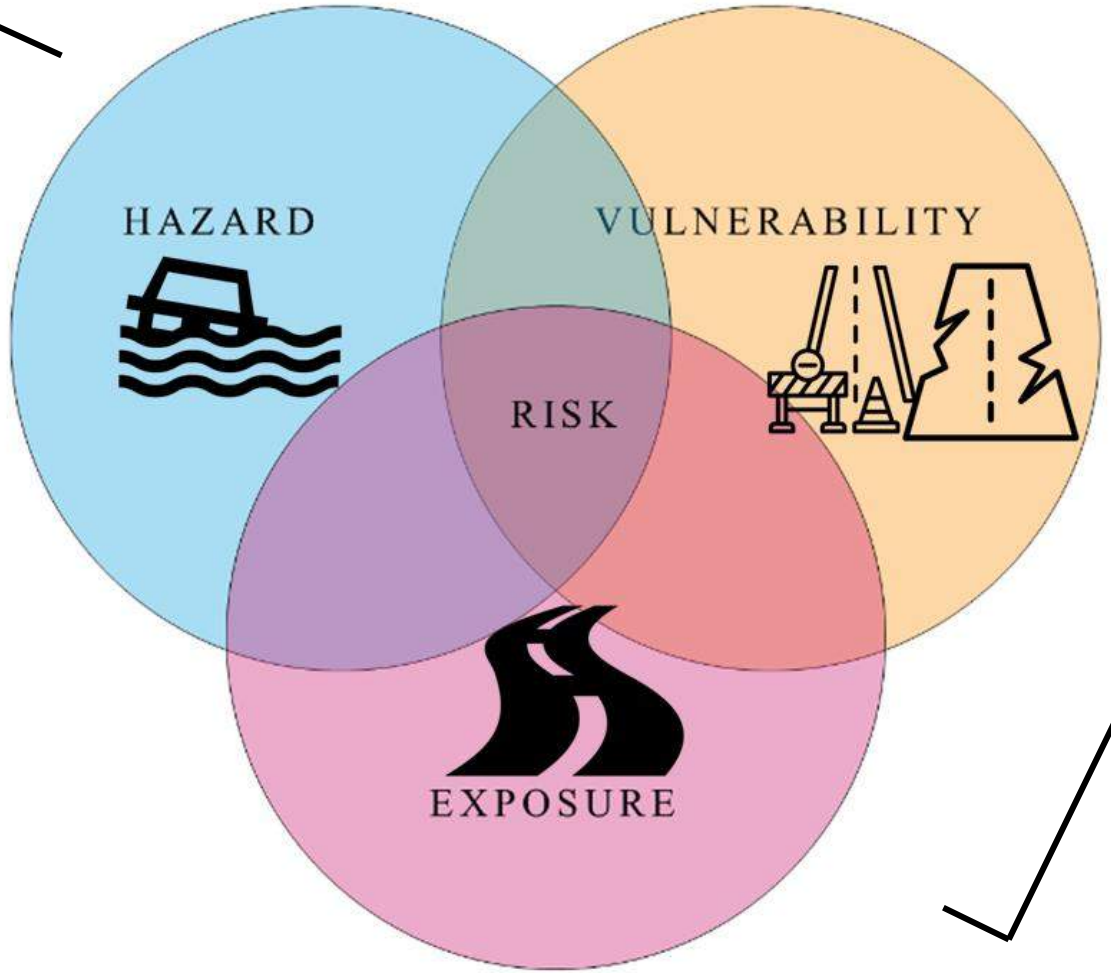
- Flood impacts to roads & bridges, transit routes & bus yards, and rail lines
- Wildfire impacts to roads & bridges, transit routes & bus yards,
- Extreme heat impacts to transit routes

Climate Risk Assessment

Approach

Risk assessment approach

Likelihood



Consequence

Risk assessment approach

Likelihood Key

Likelihood Descriptor	Return period (approx.)
Exceptionally Likely	< 2 yrs
Very Likely	2-10 yrs
Likely	10-50 yrs
Possible	50-250 yrs
Unlikely	> 250 yrs

	Consequence (Impact)					
Likelihood	Temporary	Minimal	Moderate	Significant	Severe	Catastrophic
Exceptionally Likely	Med-High	High	Very High	Very High	Very High	Very High
Very Likely	Med	Med-High	High	Very High	Very High	Very High
Likely	Low-Med	Med	Med-High	High	Very High	Very High
Possible	Low	Low-Med	Med	Med-High	High	Very High
Unlikely	Very Low	Low	Low-Med	Med	Med-High	High

Risk assessment approach

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Likely	Low-Med	Med	Med-High	High	Very High	Very High
Possible	Low	Low-Med	Med	Med-High	High	Very High
Unlikely	Very Low	Low	Low-Med	Med	Med-High	High

What do we want to hear from you?

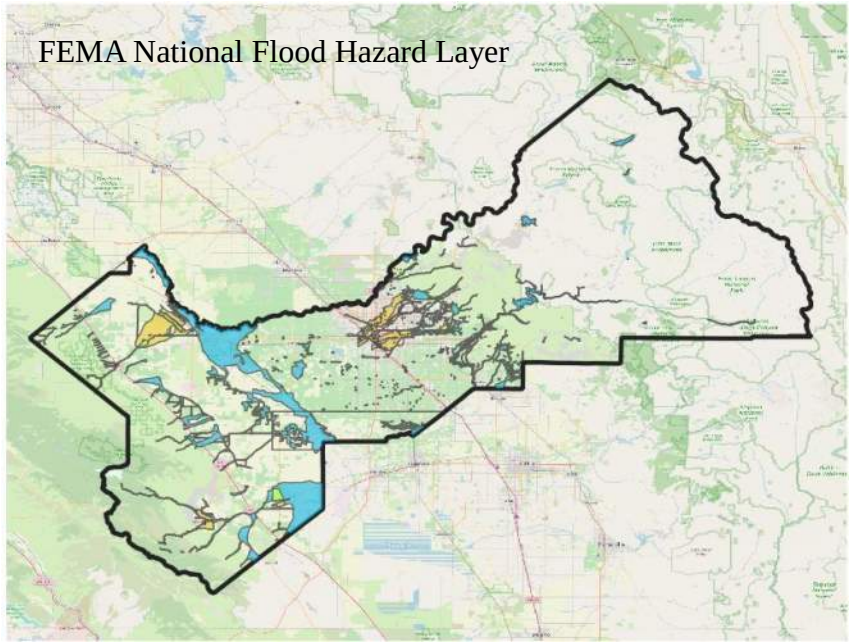
- Does this align with your lived experience with climate hazards?
- Is anything missing?
- What opportunities do you see?

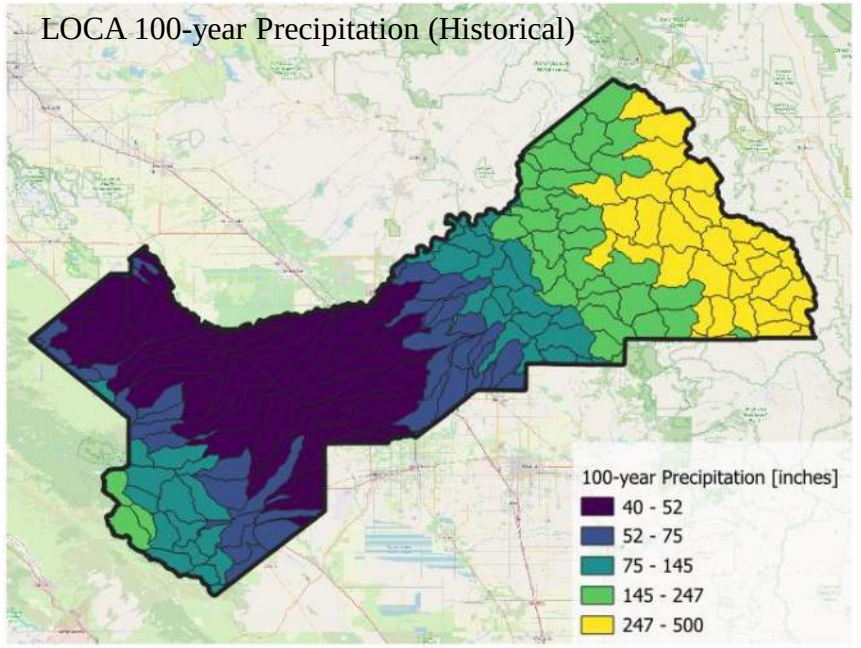
Hazard Data

Present-day and future climate

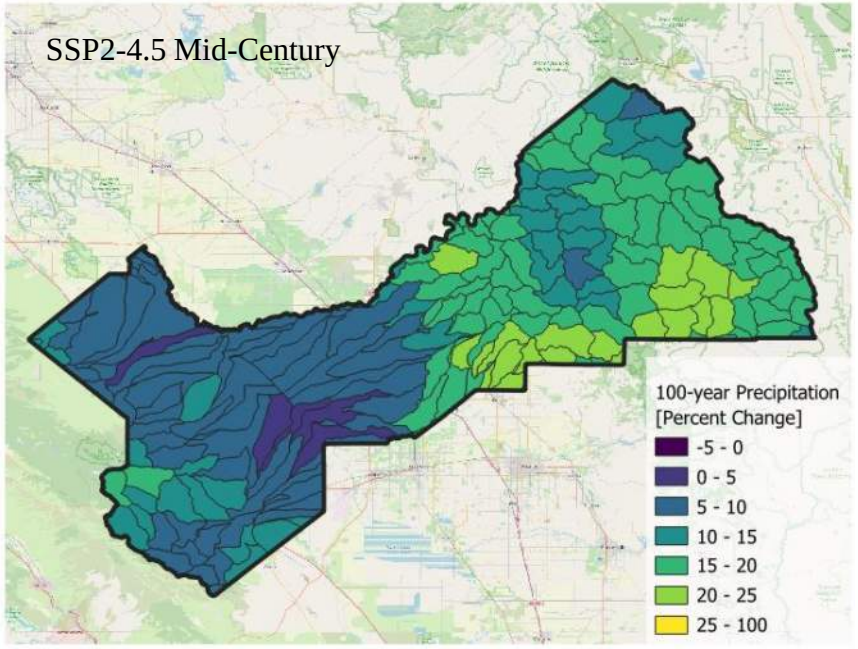
Flood Hazard

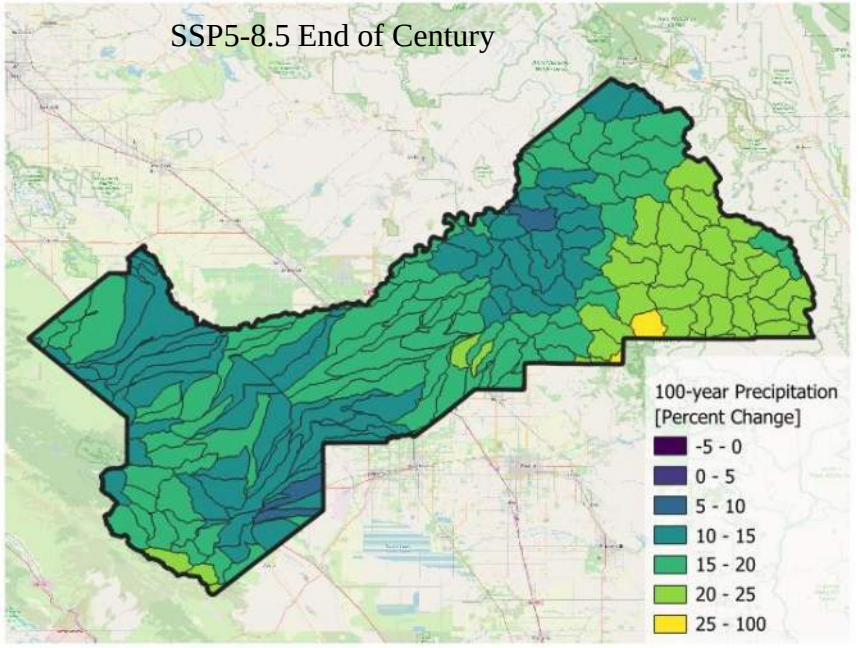
PRESENT DAY





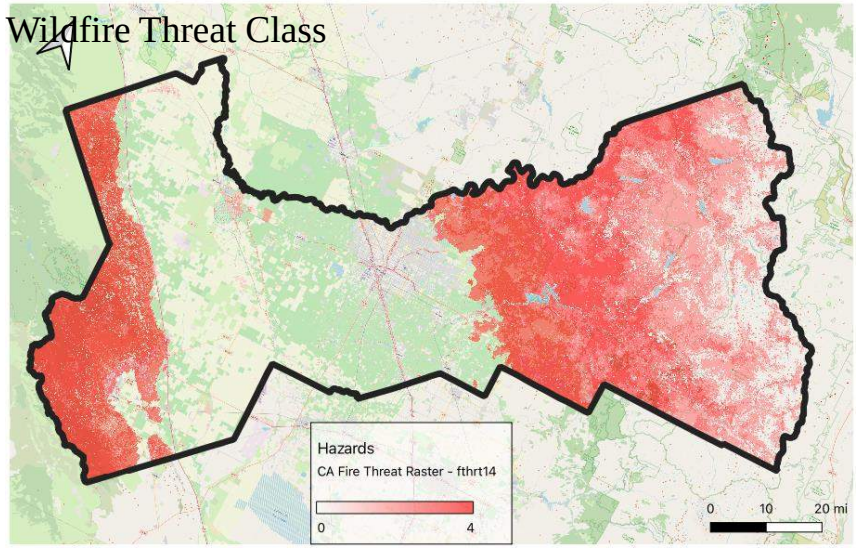
FUTURE CLIMATE INDICATOR: PERCENTAGE CHANGE PRECIPITATION

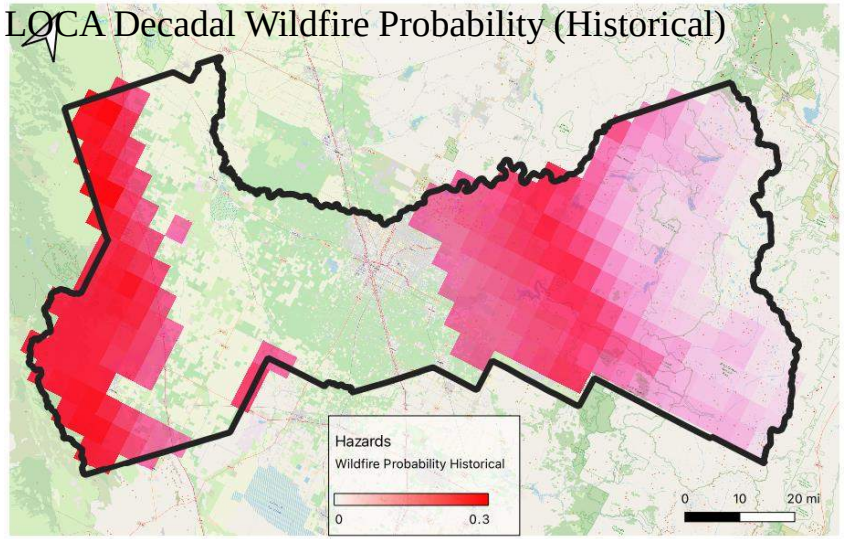




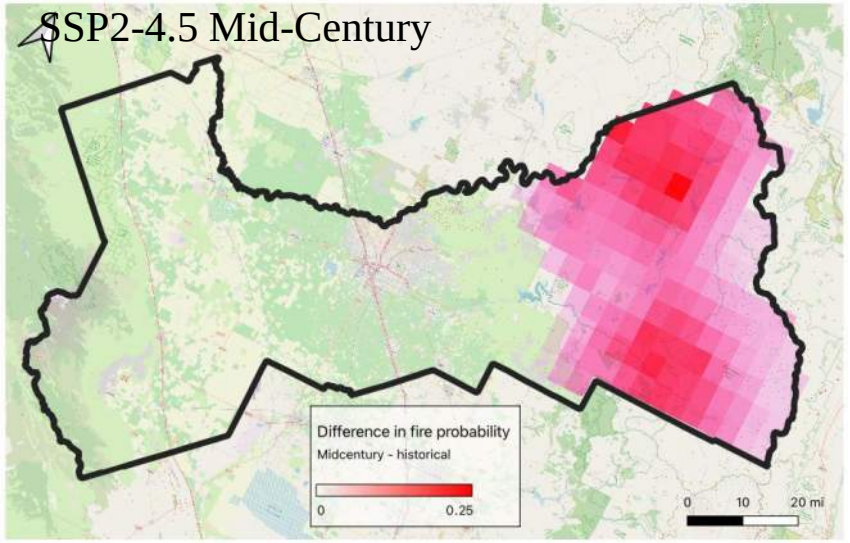
Wildfire hazard

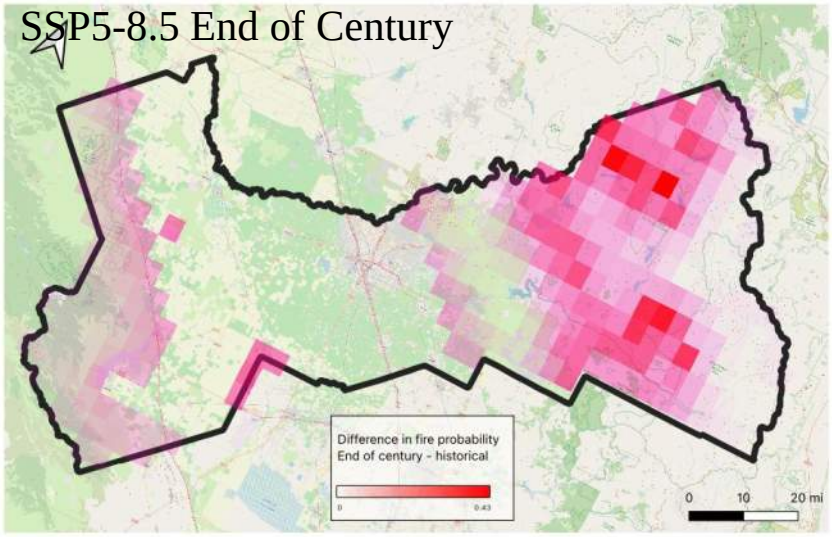
PRESENT DAY





FUTURE CLIMATE INDICATOR: DECADAL WILDFIRE PROBABILITY

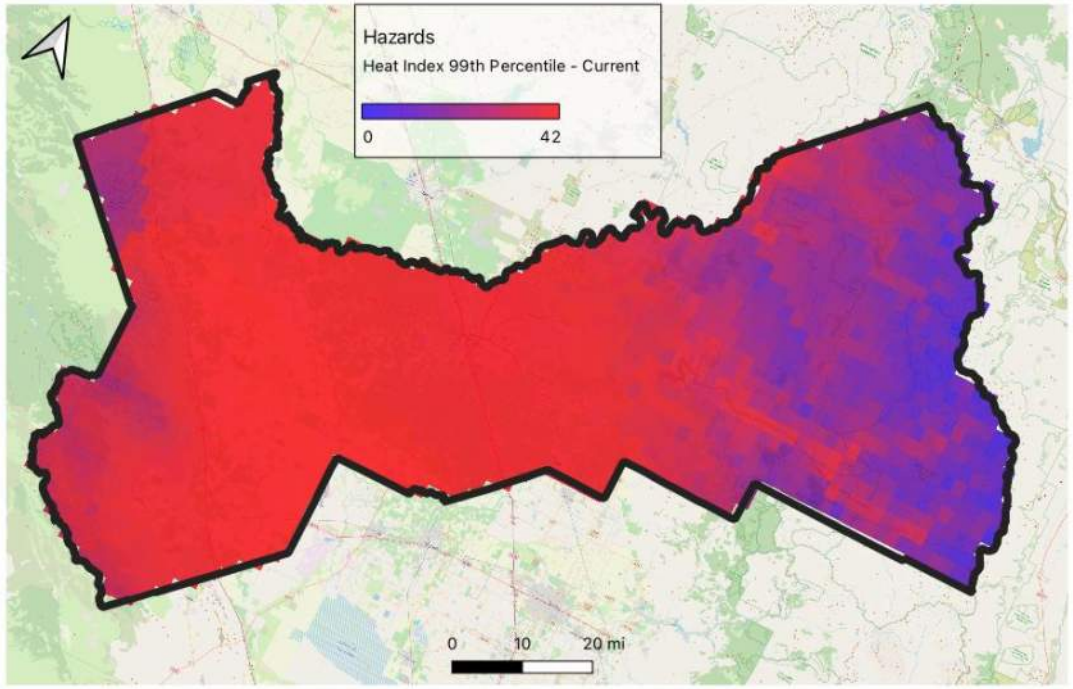




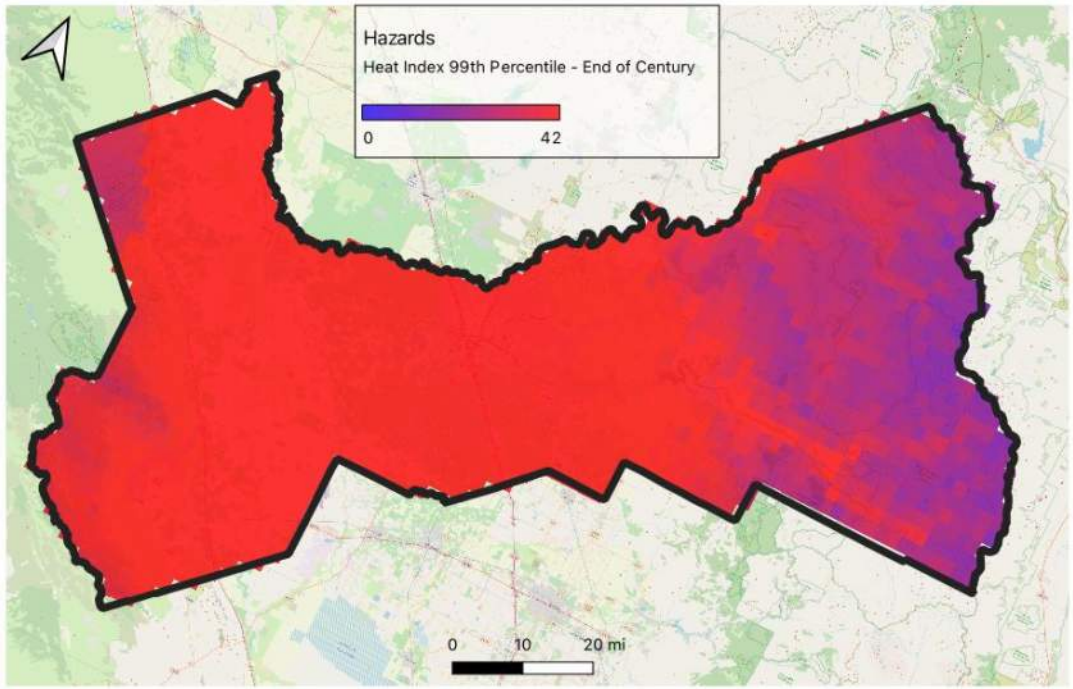
Heat hazard

Present Day + Future: Heat Index

Present Day

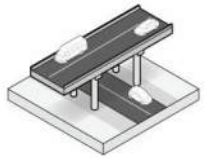


SSP5-8.5 End of Century

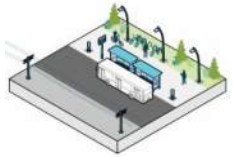


Roads & Bridges

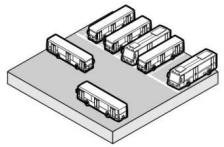
Today’s Focus



ROADS & BRIDGES



TRANSIT NETWORK



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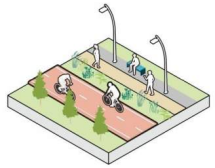
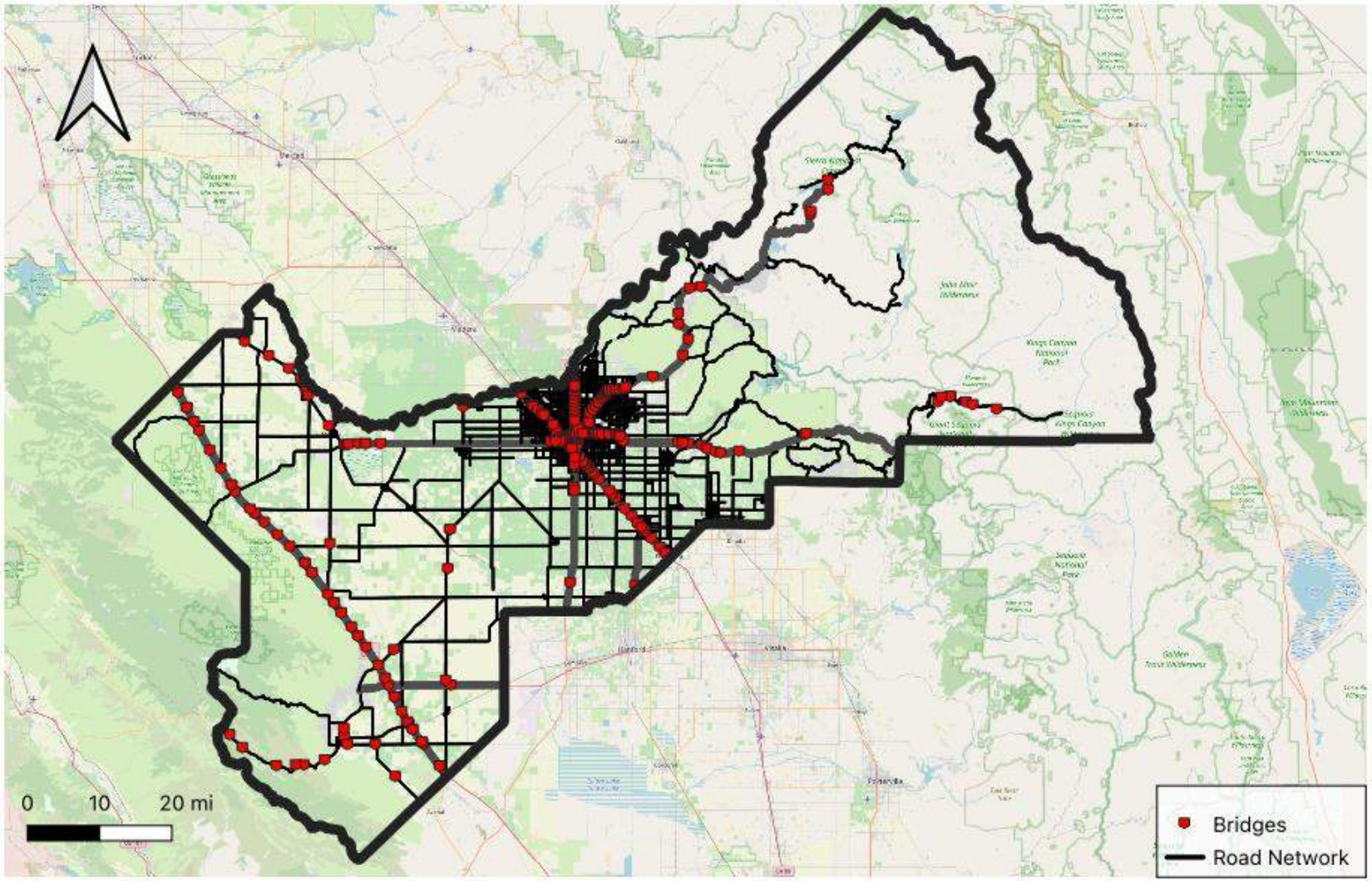


BIKE NETWORK

AIRPORTS

Roads & bridges

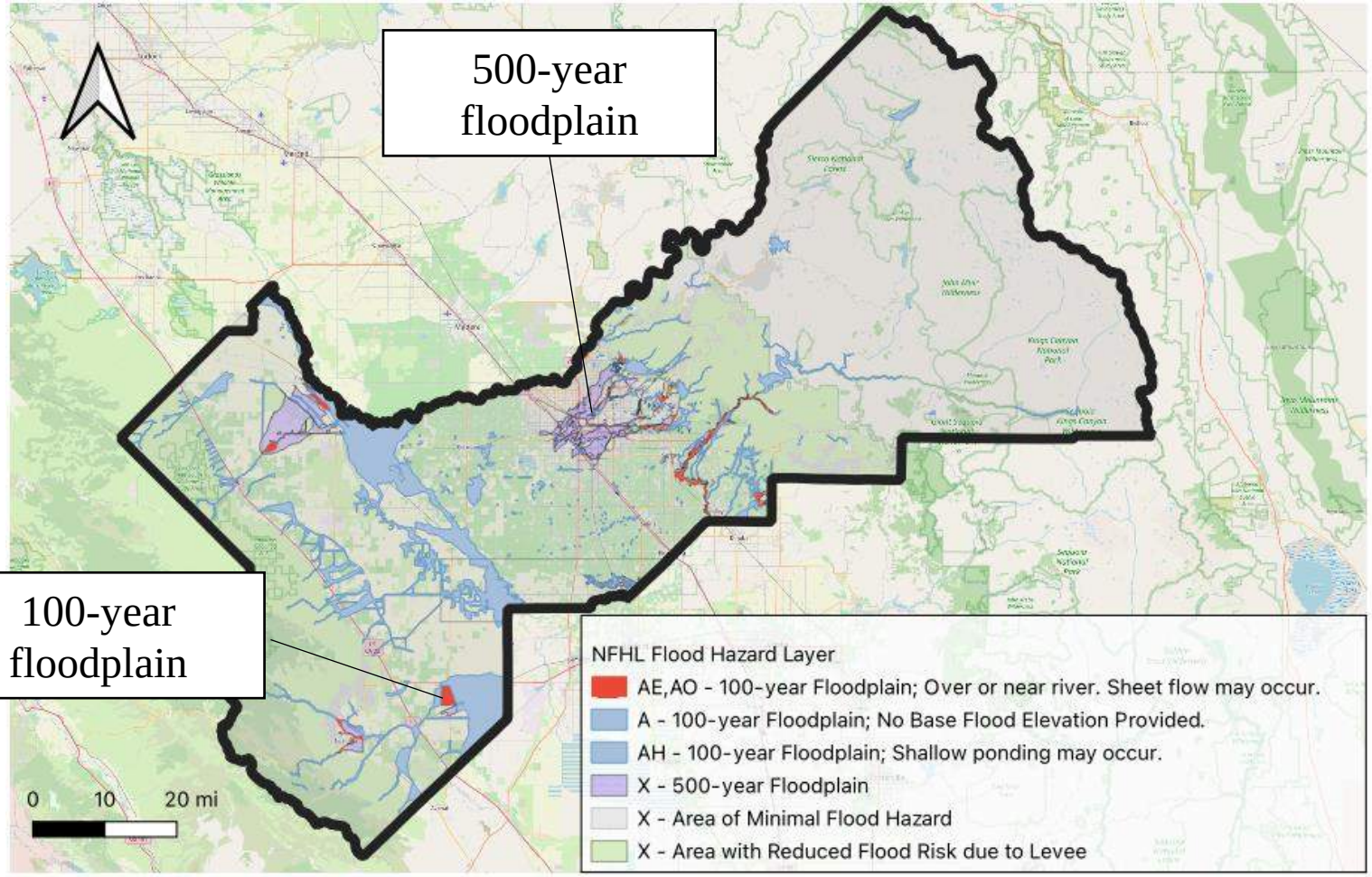
- Focus on primary street network for risk analysis
- Roads over bridges are flagged for the vulnerability and consequence assessment



Flood hazard

FEMA National Flood Hazard Layer | Present Day

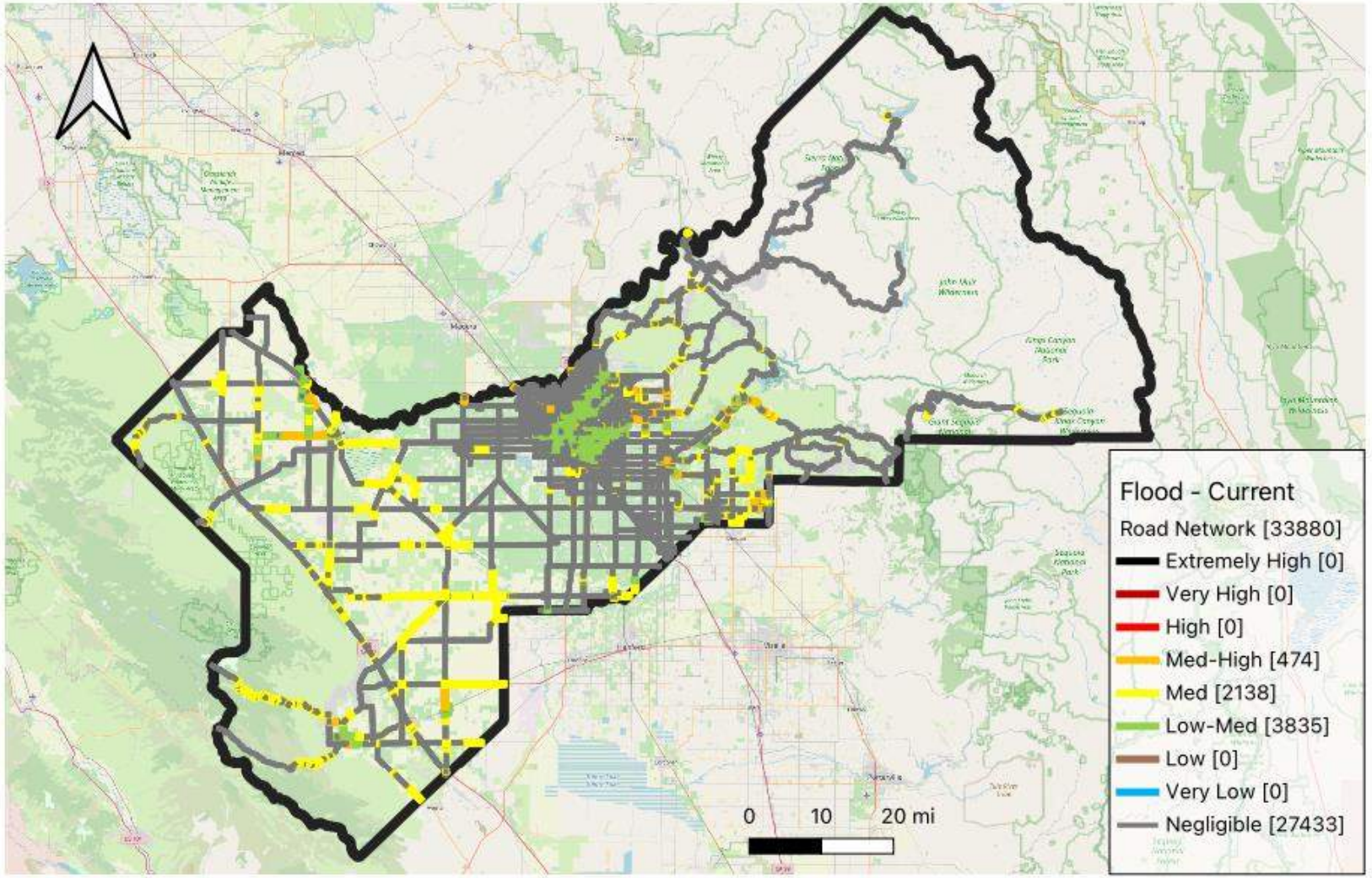
- FEMA NFHL designates zones where extreme flood events may occur.
- Much of Fresno/Clovis is in the 500-year floodplain while much of Western Fresno is in the 100-year floodplain.
- Present day risk (next slide) in this study closely follows FEMA floodplain designations.



Flood impacts on roads & bridges

Downtime Risk | Present Day

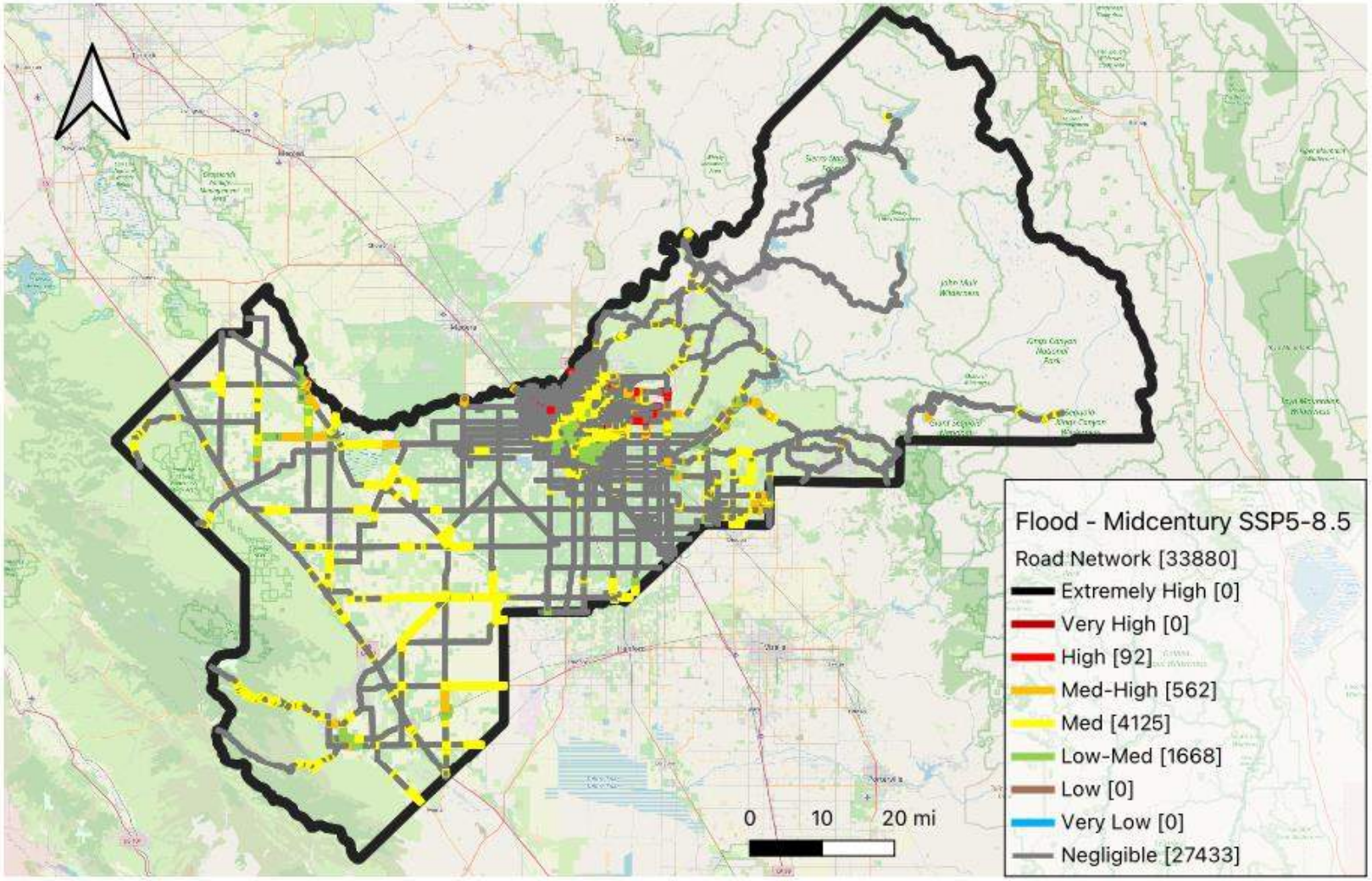
- Flooding can impact roads by creating unsafe driving conditions, closing roads for clearance and/or repairs, or causing washout in extreme cases.
  - Roads over and near rivers are flagged higher due to potential for washout.
- Present day ratings range from ***Low-Med*** to ***Med-High***.



Flood impacts on roads & bridges

Downtime Risk | Midcentury

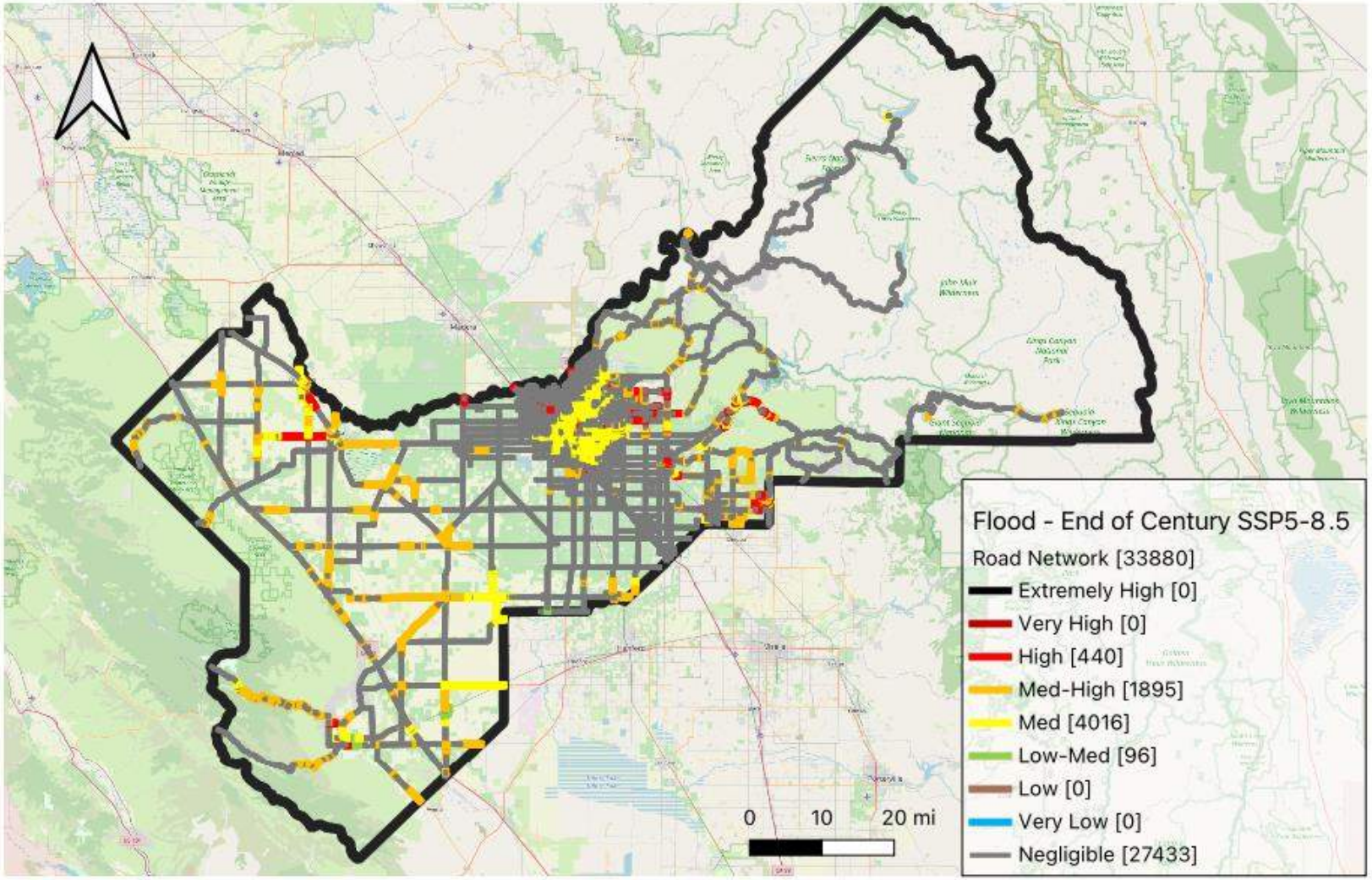
- For certain roads, future flood risk increases due to increasing *frequency* ***and*** *intensity* of precipitation.
- Future flood risk ratings range from *Low-Med* to *High*.



Flood impacts on roads & bridges

Downtime Risk | End of Century

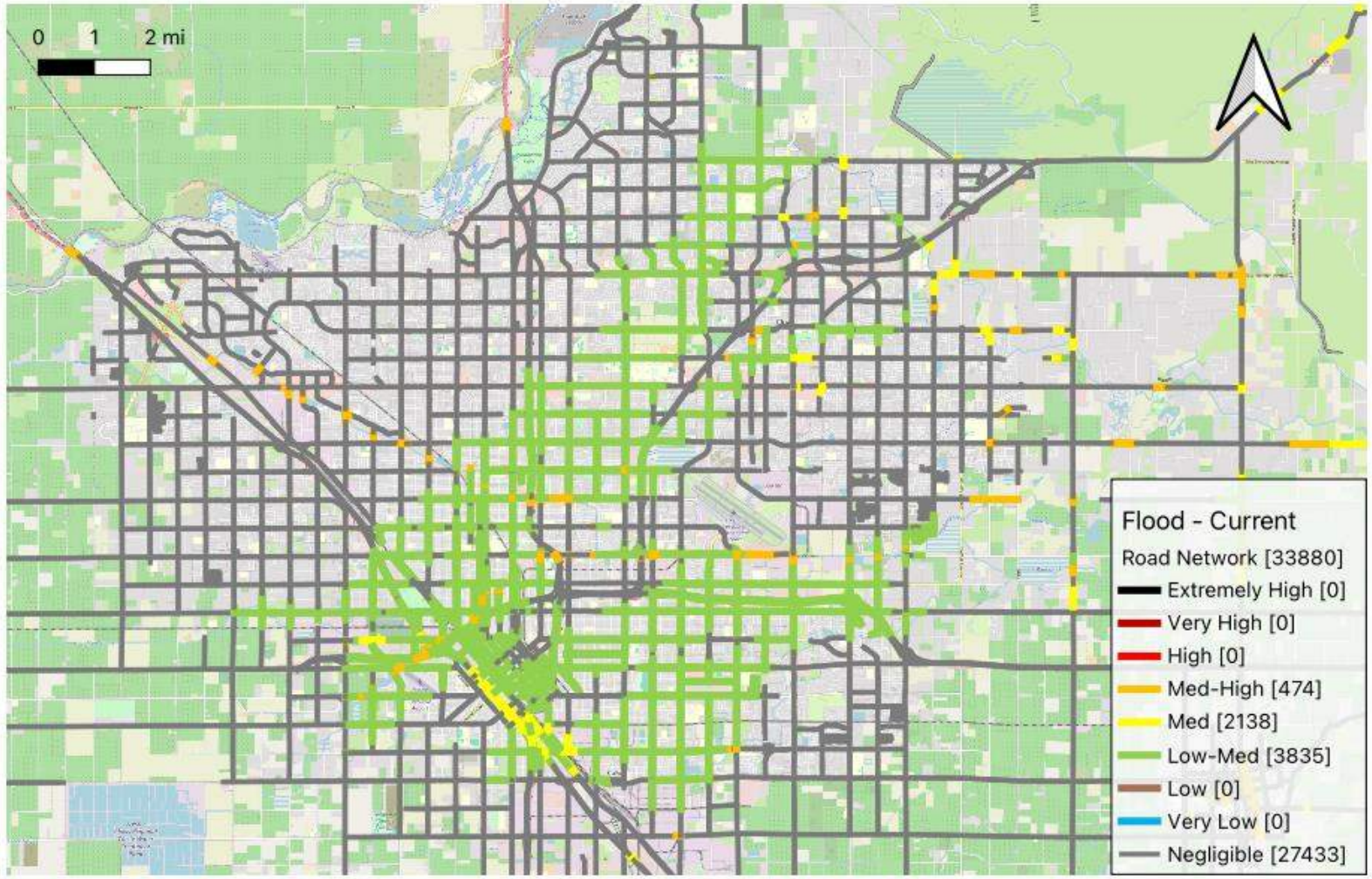
- For certain roads, future flood risk increases due to increasing *frequency* ***and*** *intensity* of precipitation.
- Future flood risk ratings range from *Low-Med* to *High*.
- Regional flood risk profile is higher at end of century compared to mid-century.



Flood impacts on roads & bridges

Downtime Risk | Present Day

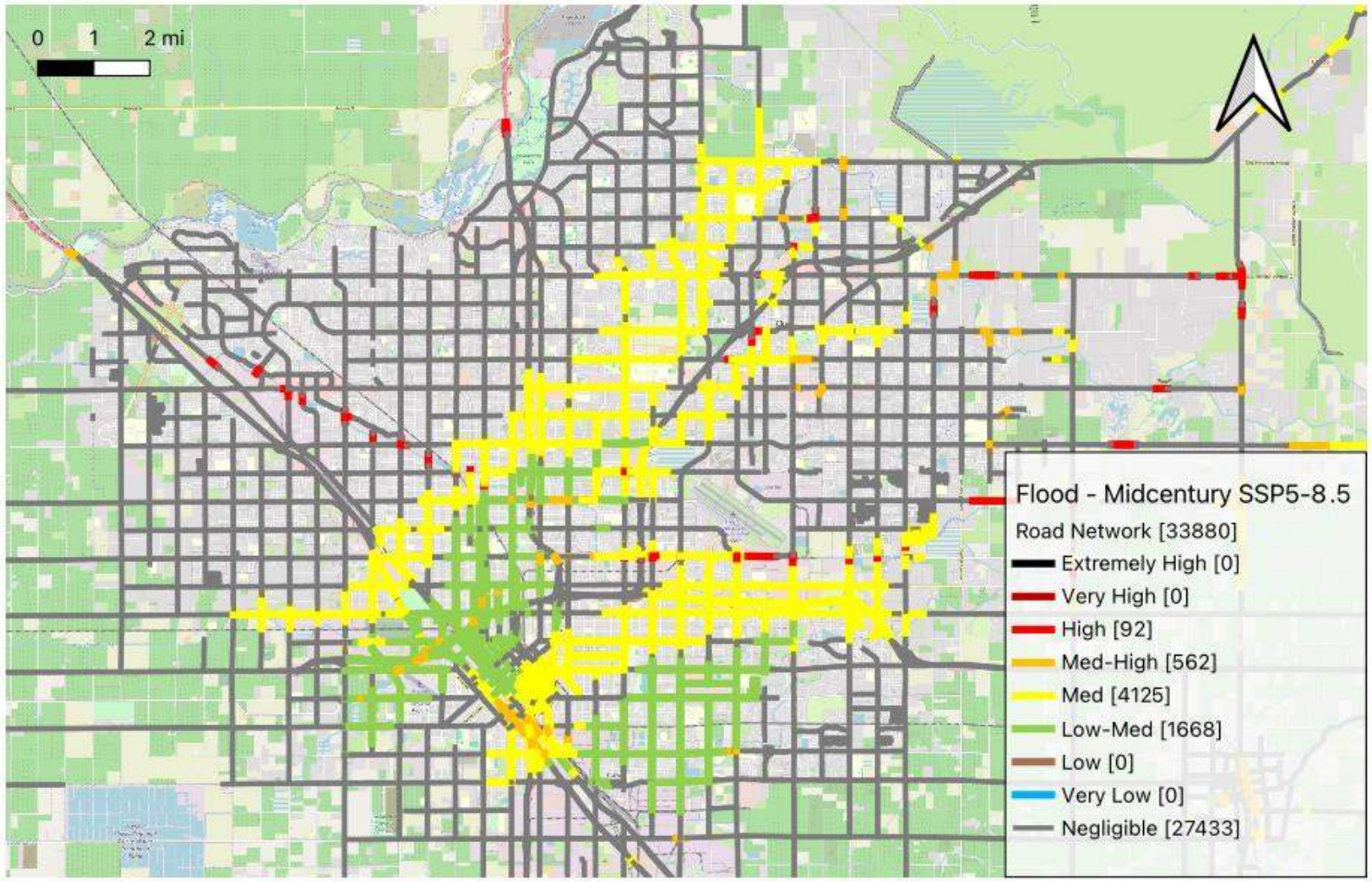
- In Fresno's urban areas, a swath of streets are flagged for Low-Med flood risk due to their overlap with the FEMA 500-year floodplain.
- Flood risk of CA-99 highlighted with Med due to overlap of highway with 100-year floodplain.



Flood impacts on roads & bridges

Downtime Risk | Midcentury

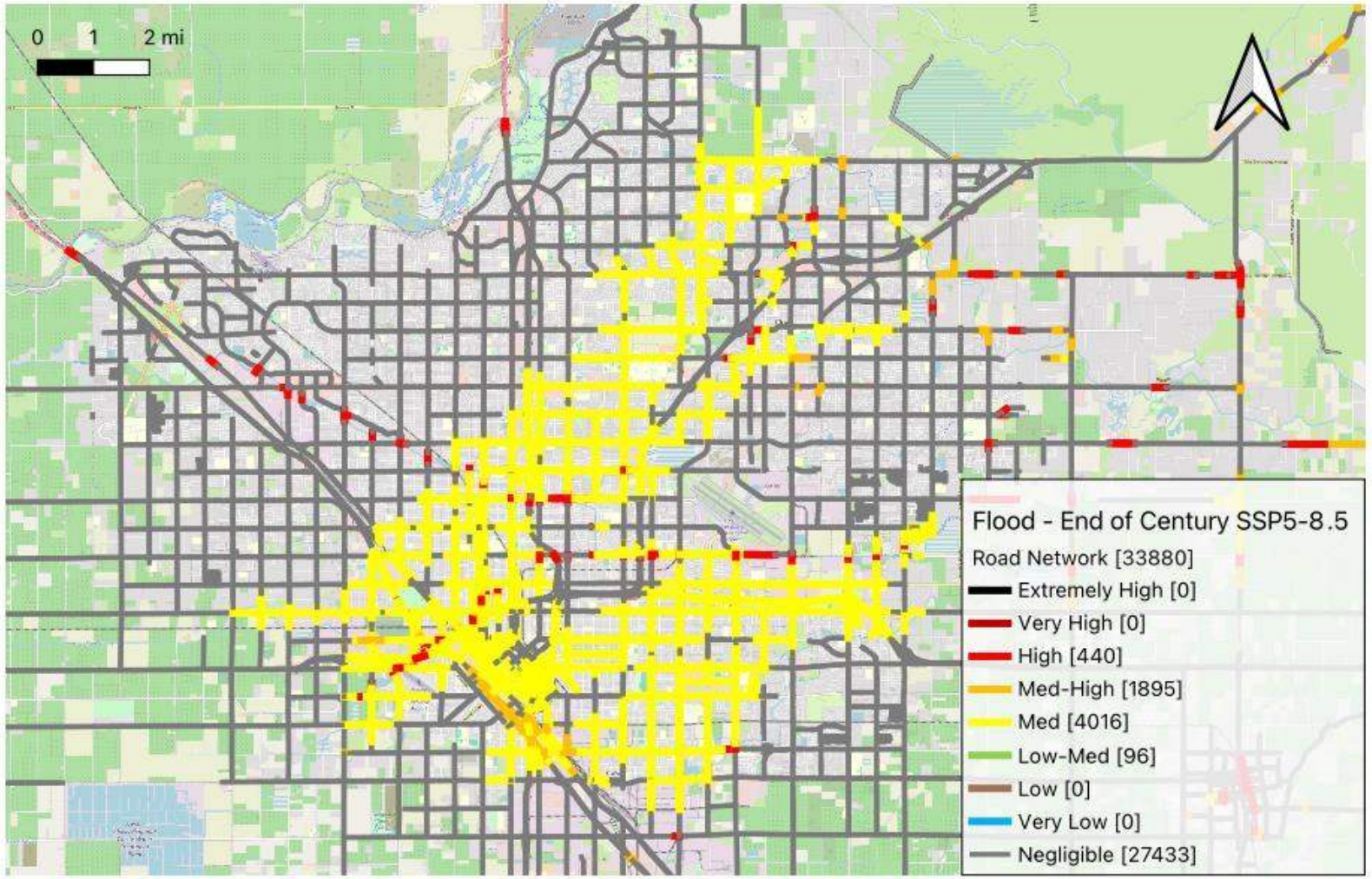
- For certain roads, future flood risk increases due to increasing *frequency* ***and*** *intensity* of precipitation.
- Roads over rivers are particularly highlighted due to increased potential for washout due to heavy rains.



Flood impacts on roads & bridges

Downtime Risk | End of Century

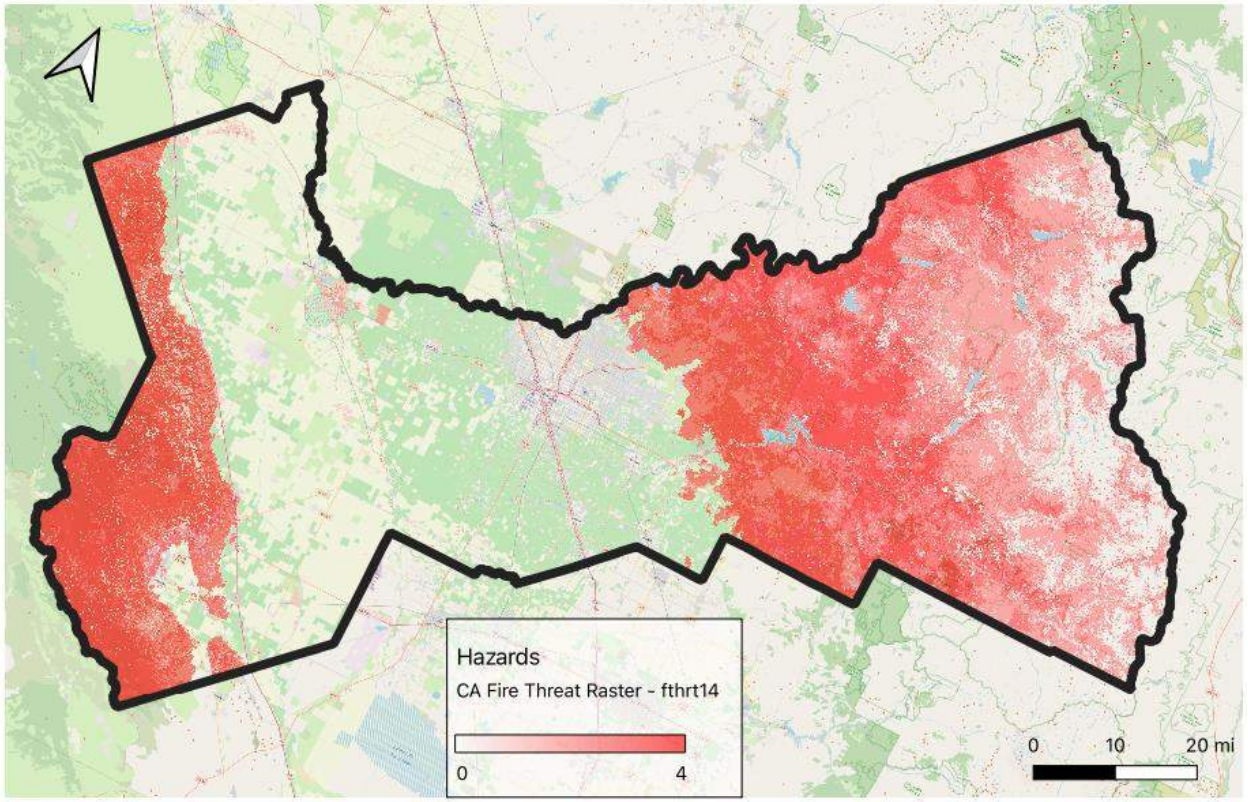
- For most roads with present day flood risk, risk increases 1-2 ratings by the end of the century.
- Flood risk of CA-99 highlighted with Med-High due to overlap of underpass with 100-year floodplain.



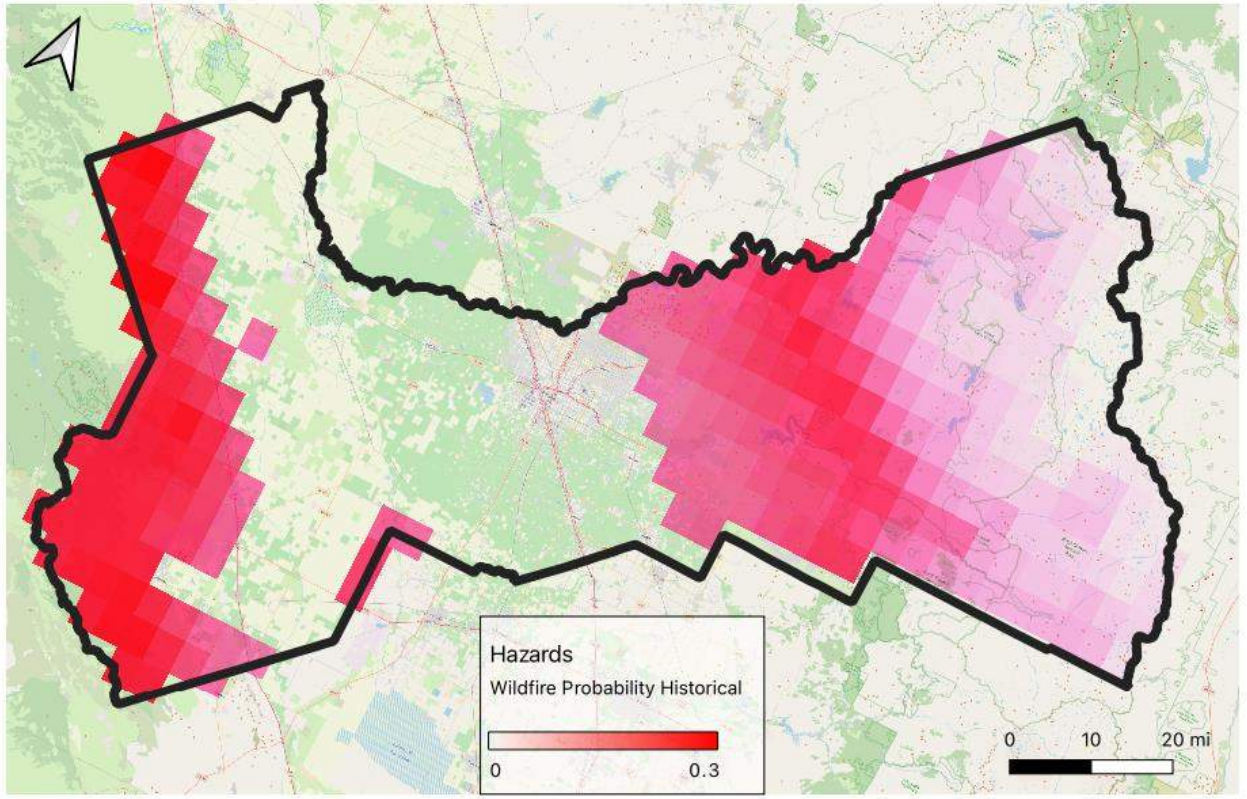
Wildfire hazard

Present Day

Wildfire Threat Class



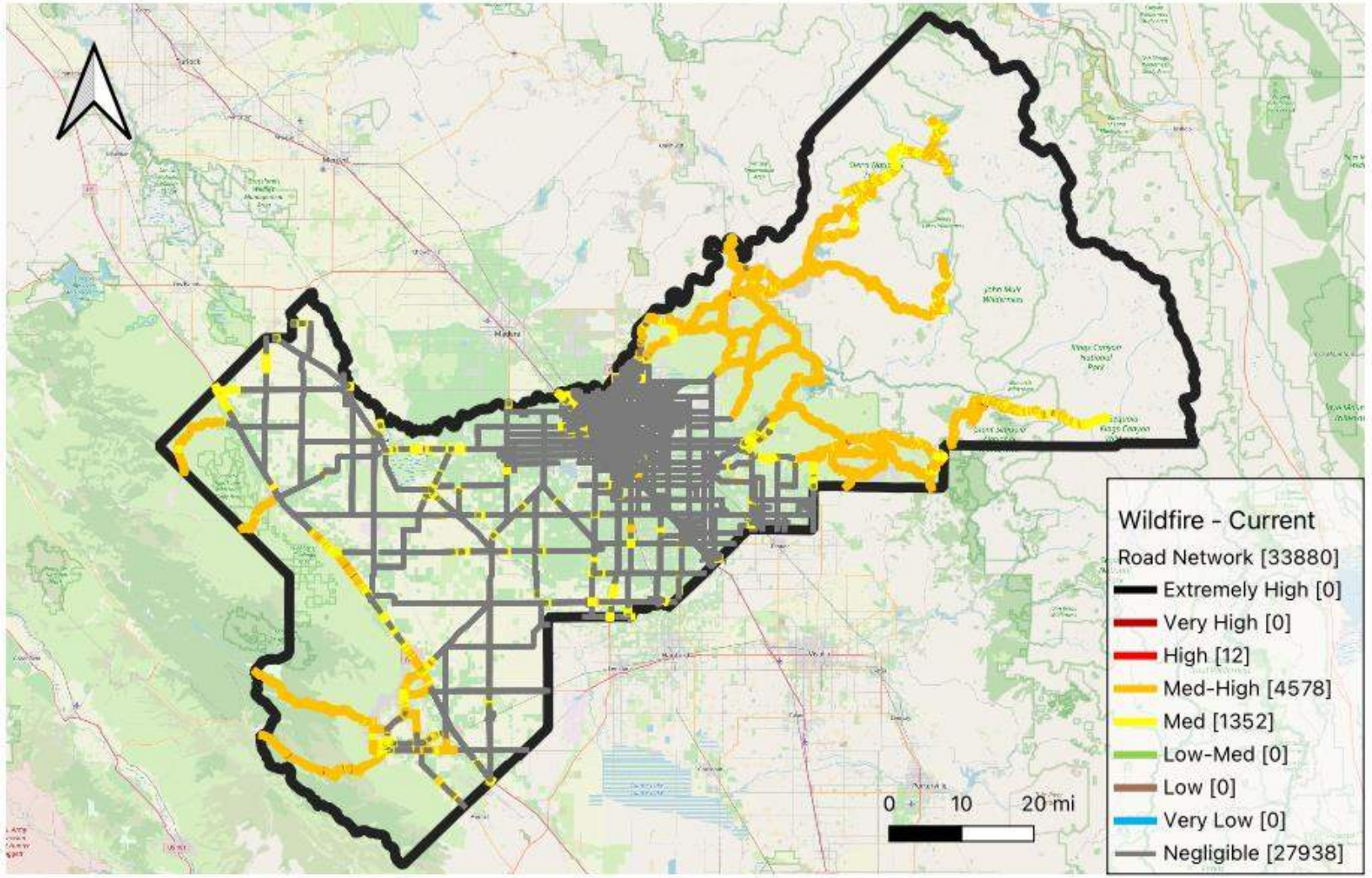
LOCA Decadal Wildfire Probability (Historical)



Wildfire impacts on roads & bridges

Downtime Risk | Present Day

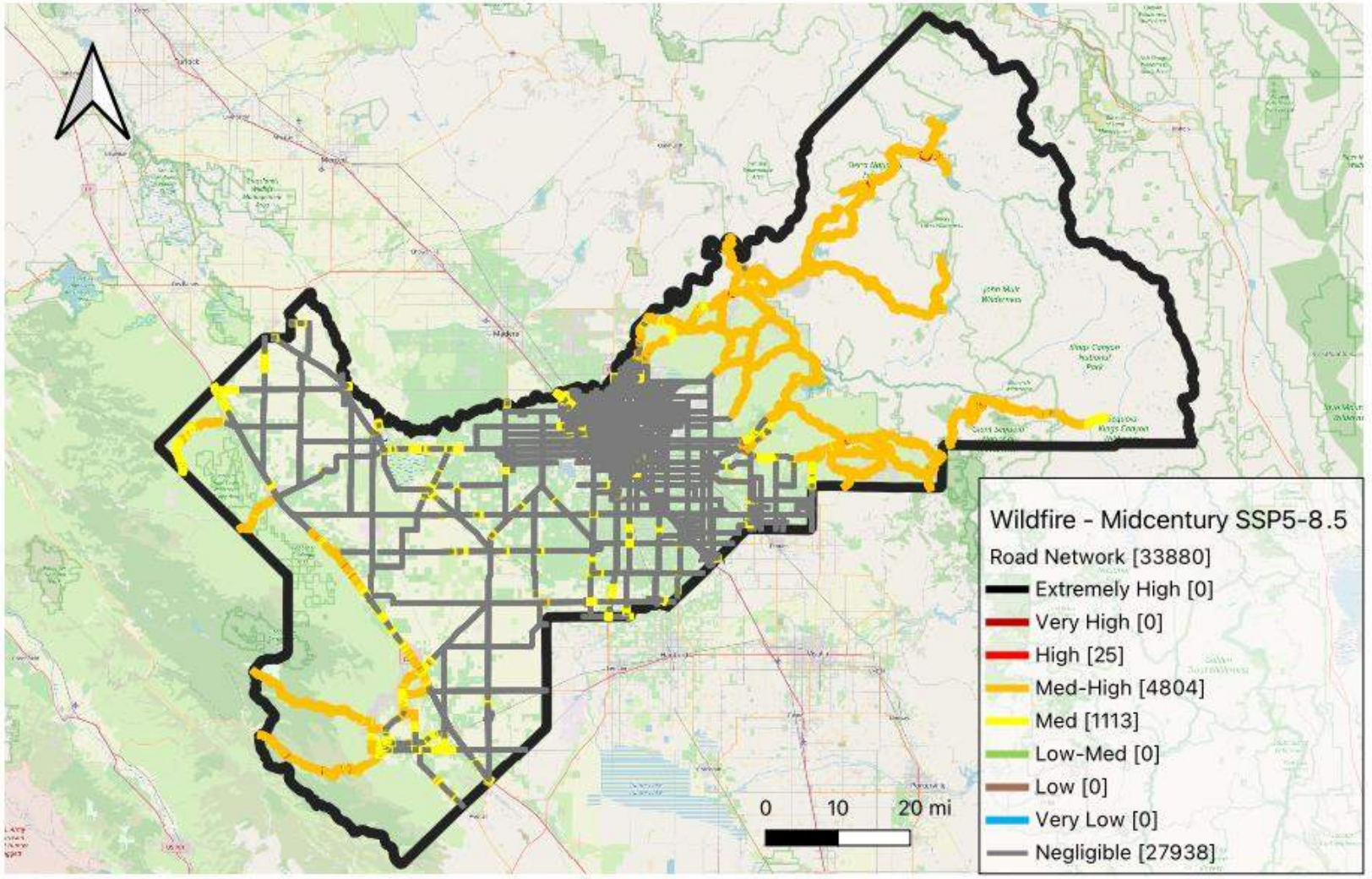
- Wildfire can impact roads by creating unsafe driving conditions, closing roads for clearance and repairs, or causing structural damage to roadside facilities.
- Present day ratings range from ***Med*** to ***Med-High***.



Wildfire impacts on roads & bridges

Downtime Risk | Midcentury

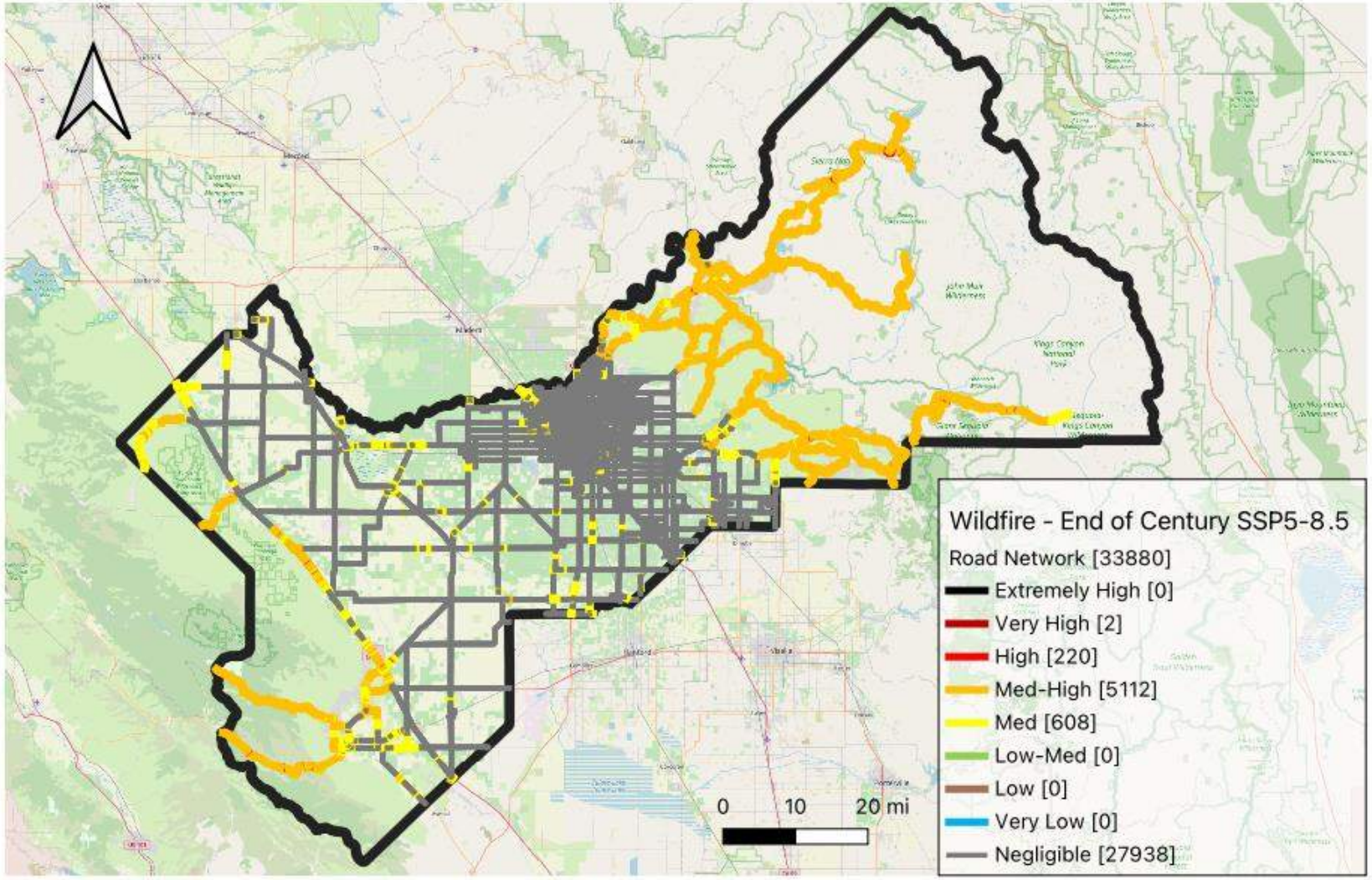
- For certain roads, future wildfire risk increases due to changing land use and climate regimes.
- Future climate (SSP5-8.5) ratings range from ***Med*** to ***High***.



Wildfire impacts on roads & bridges

Downtime Risk | End of Century

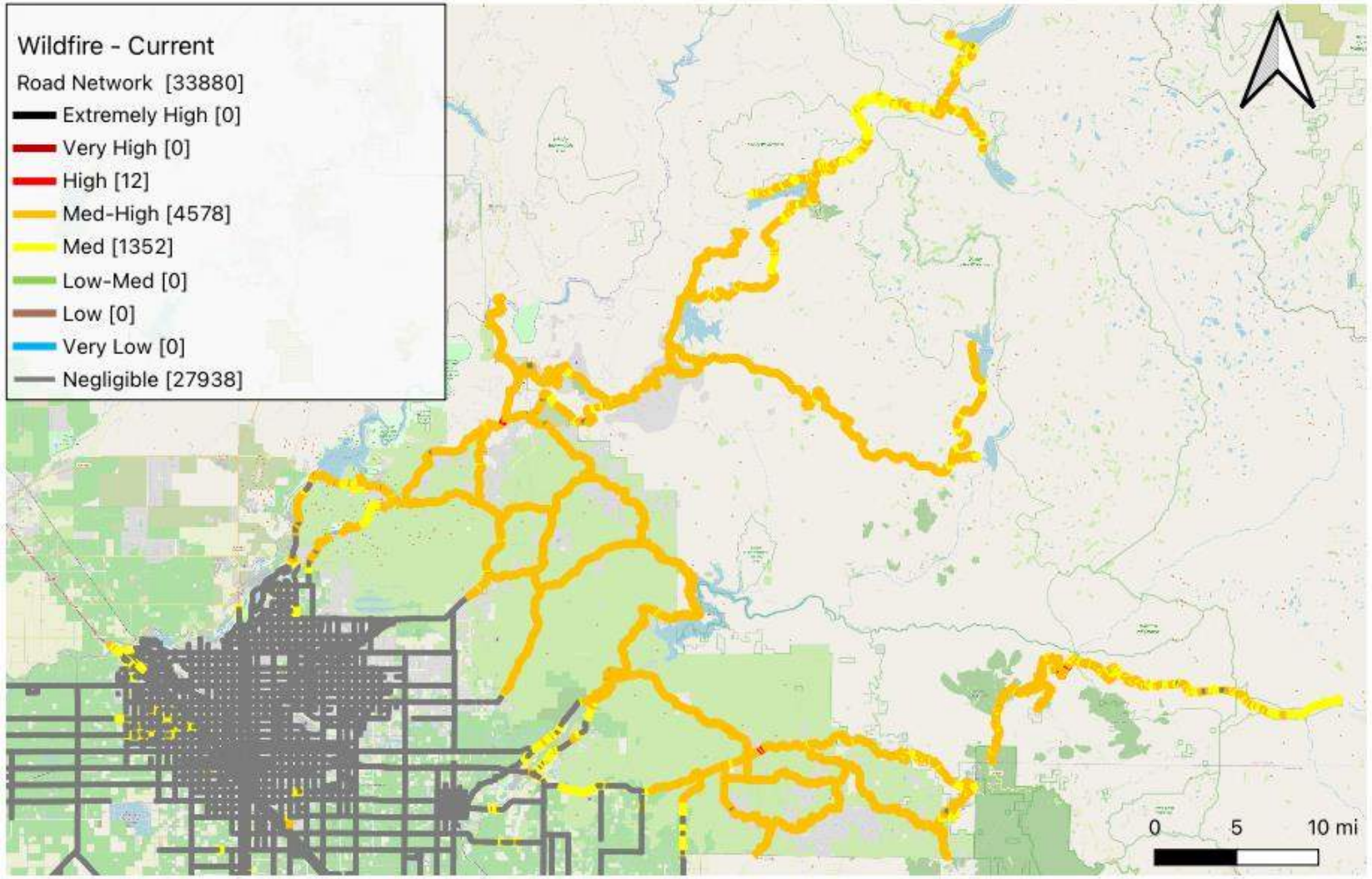
- For certain roads, future wildfire risk increases due to changing land use and climate regimes.
- Future climate (SSP5-8.5) ratings range from ***Med*** to ***High***.
- Regional risk profile is relatively constant across climate scenarios.



Wildfire impacts on roads & bridges

Downtime Risk | Present Day

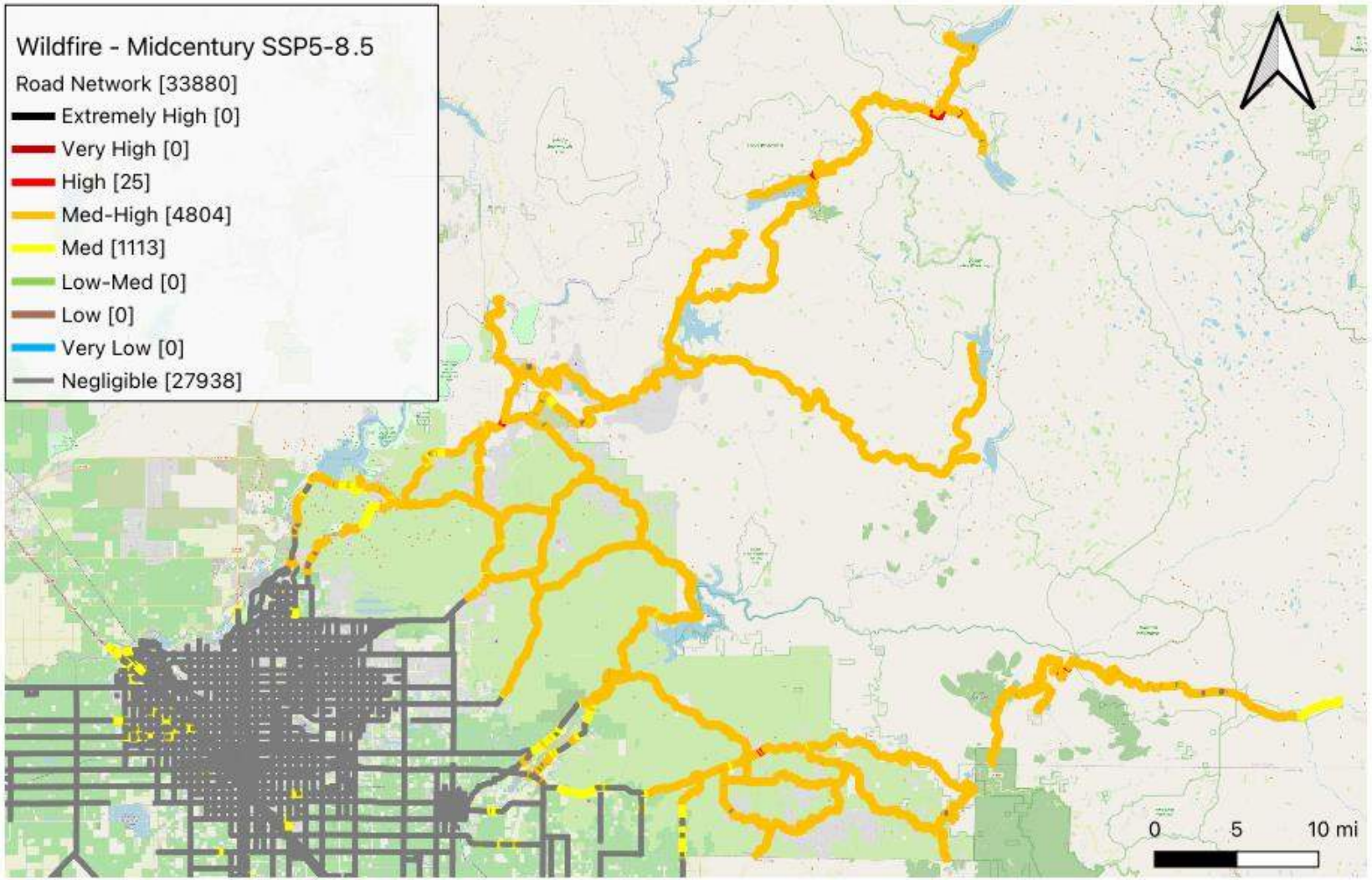
- Mountainous roads are most affected by wildfire hazard.



Wildfire impacts on roads & bridges

Downtime Risk | Midcentury

- Future climate (SSP5-8.5) ratings range from ***Med*** to ***High***.
- Some increase in future risk due to increasing wildfire probability, but the regional wildfire risk profile stays relatively constant in this study.



Wildfire impacts on roads & bridges

Downtime Risk | End of Century

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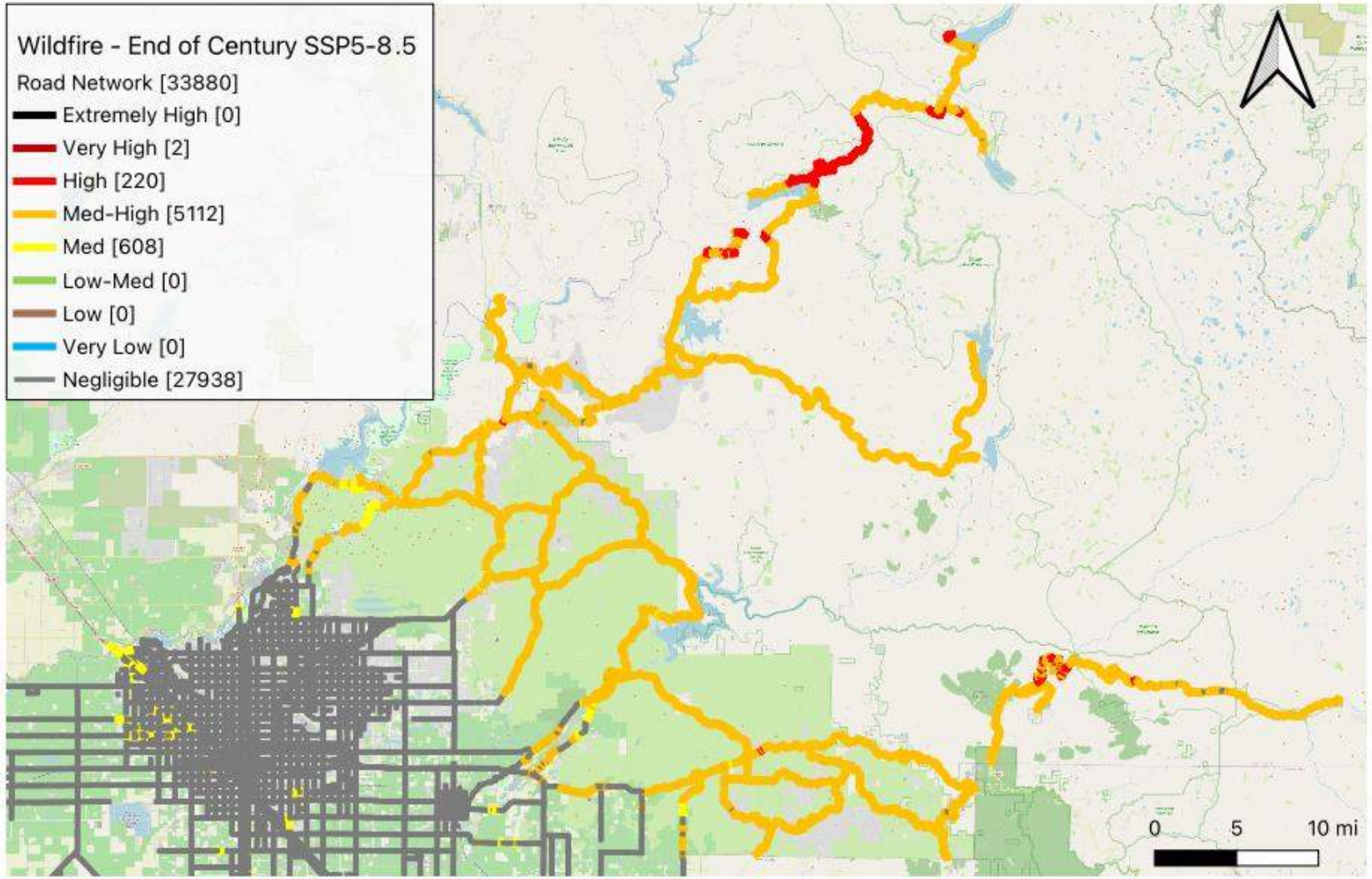
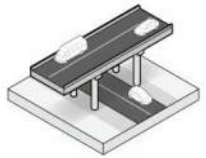
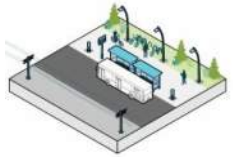
- Some increase in future risk due to increasing wildfire probability, but the regional risk profile stays relatively constant in this study.



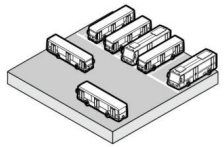
Today’s Focus



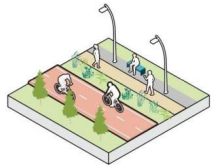
ROADS & BRIDGES



TRANSIT NETWORK



RAIL

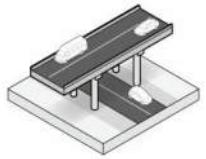


BIKE NETWORK

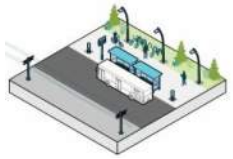
AIRPORTS

Transit routes and bus yards

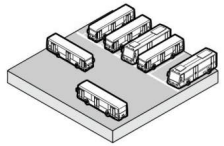
Today’s Focus



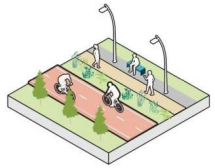
ROADS & BRIDGES



TRANSIT NETWORK



RAIL

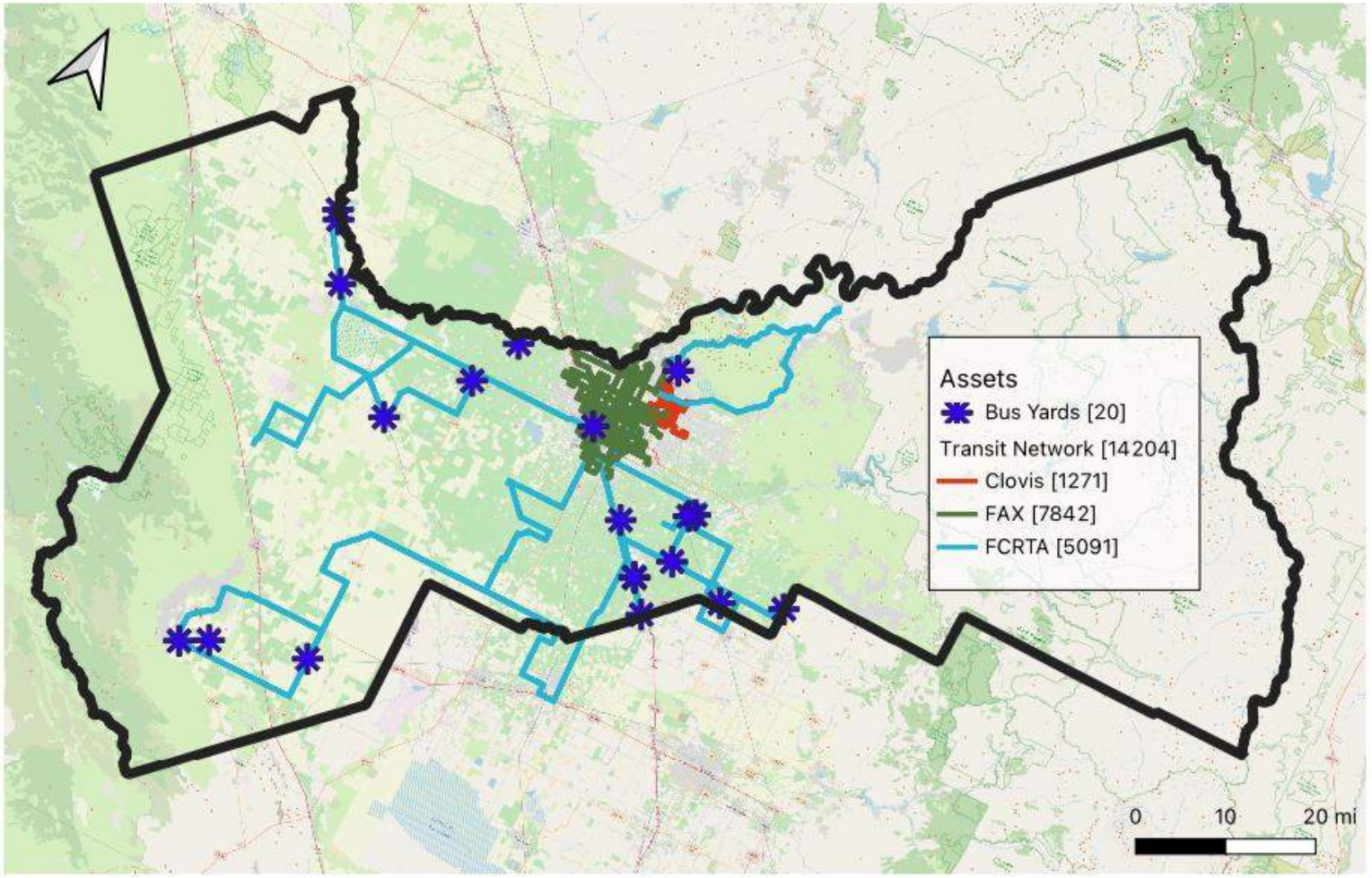


BIKE NETWORK

AIRPORTS

Transit routes + bus yards

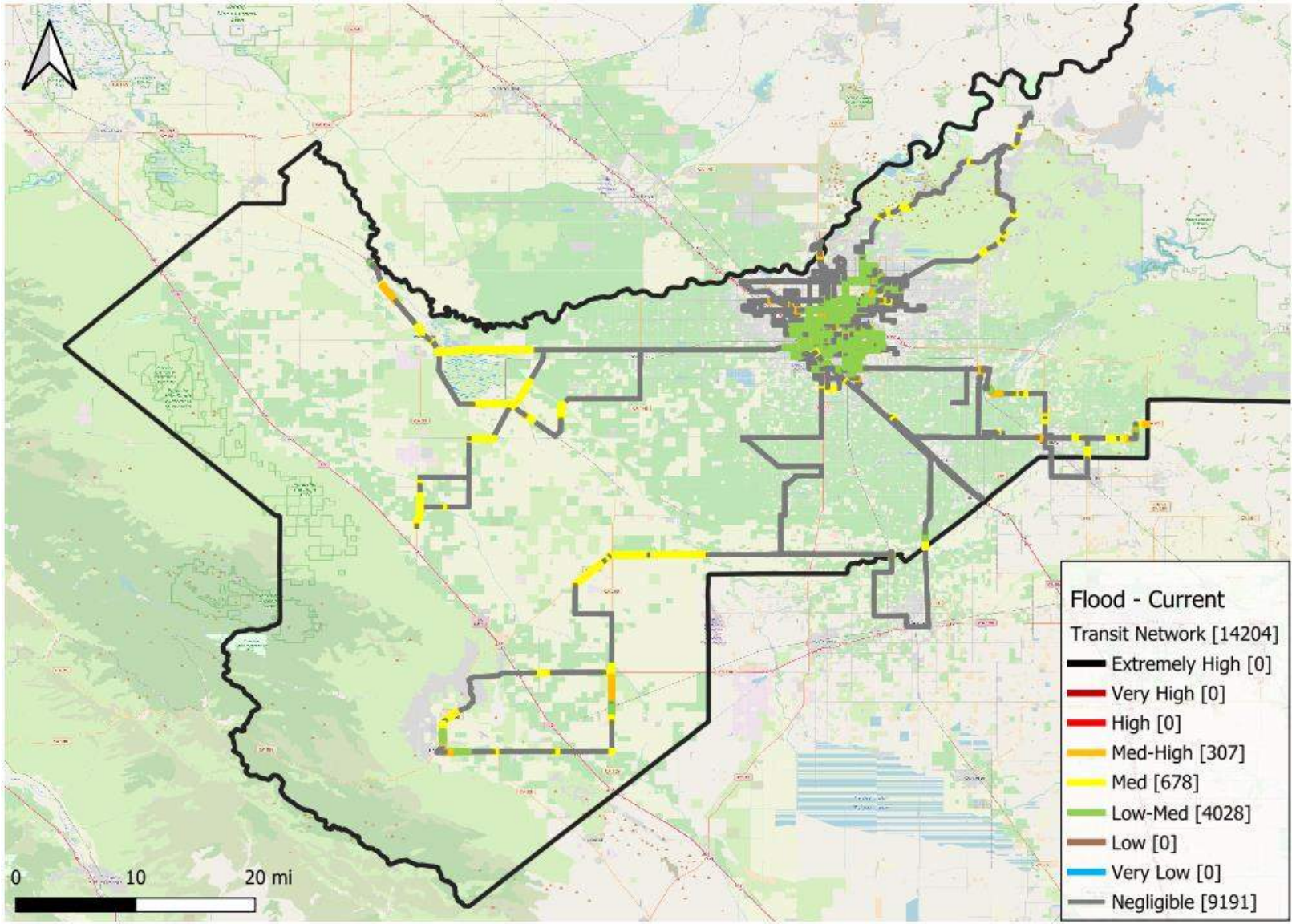
- Transit routes from Clovis, FAX, and FCRTA assessed for physical risk
  - Flood, wildfire impacts on operational downtime
  - Extreme heat impacts on rider thermal comfort
- Bus yards are assessed for their potential to impact transit operations



Flood impacts on transit routes

Downtime Risk | Present Day

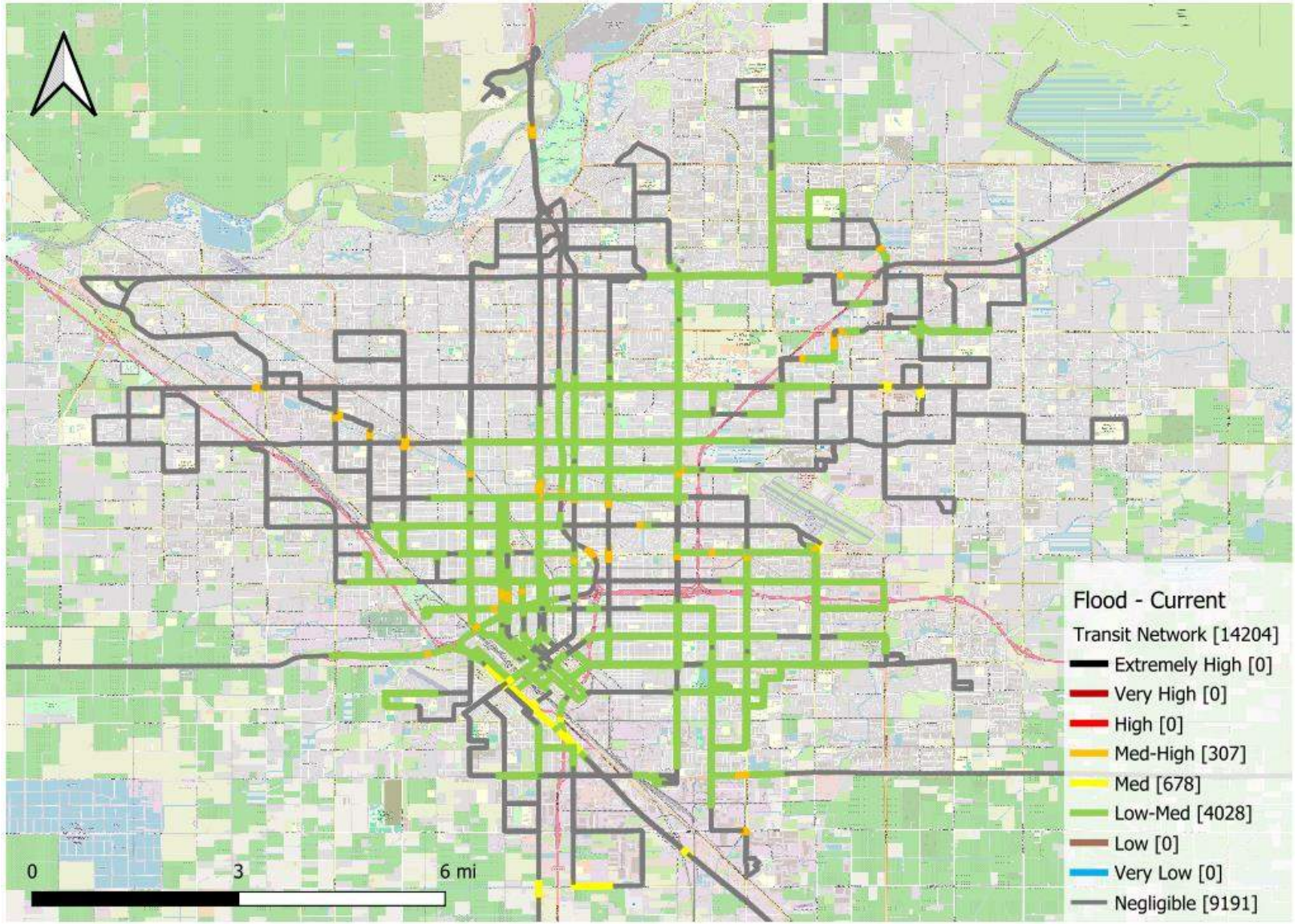
- Flooding can impact roads by creating unsafe driving conditions, closing roads for clearance and/or repairs, or causing washout in extreme cases.
- Present day ratings range from ***Low-Med*** to ***Med-High***.



Flood impacts on transit routes

Downtime Risk | Present Day

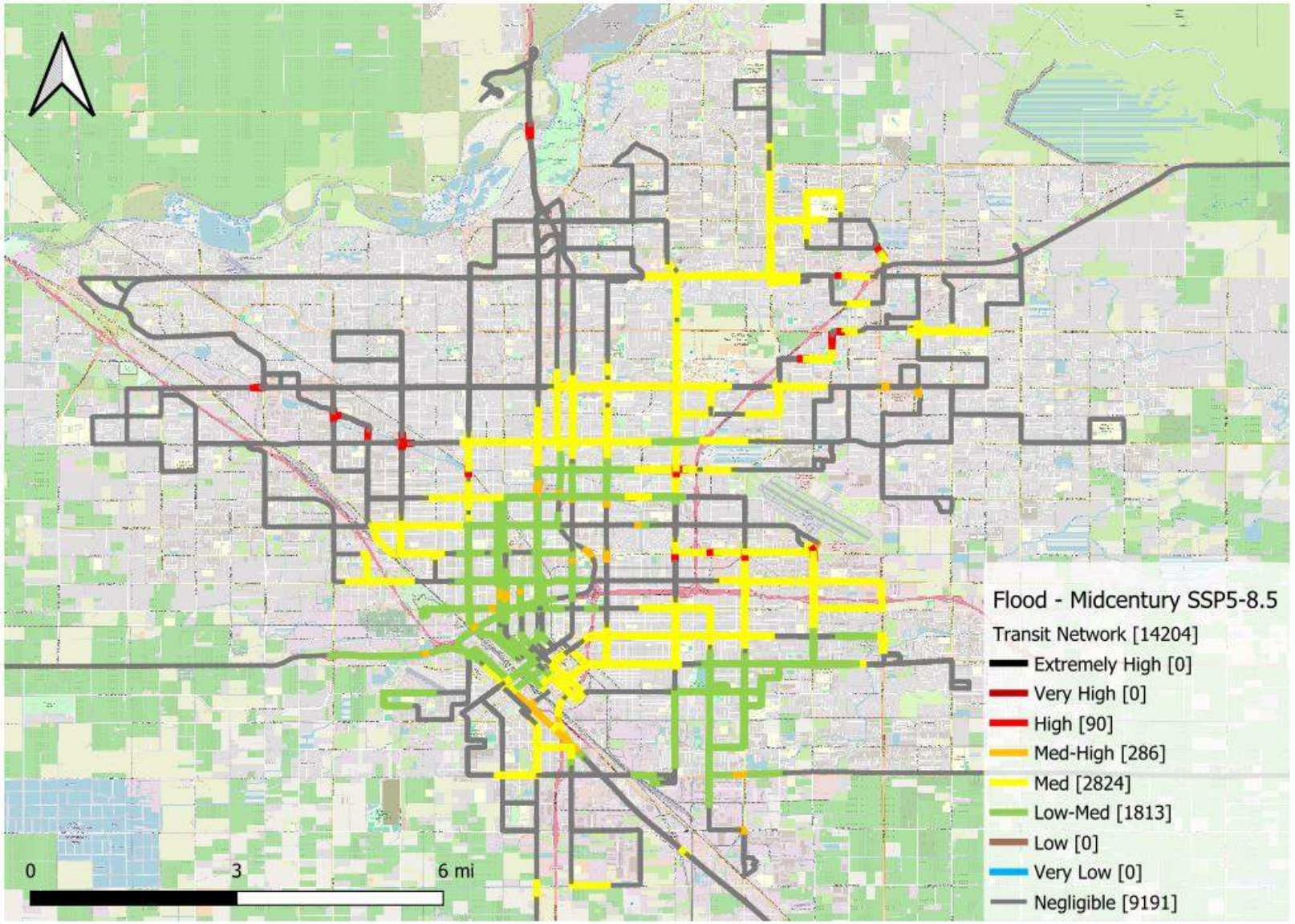
- FAX routes in the center of the city are flagged due to overlap with the FEMA 500-year floodplain.
- Certain segments of transit routes are riskier than others.
- Have you experienced flood impacts to your transit journey and/or operations?



Flood impacts on transit routes

Downtime Risk | Midcentury

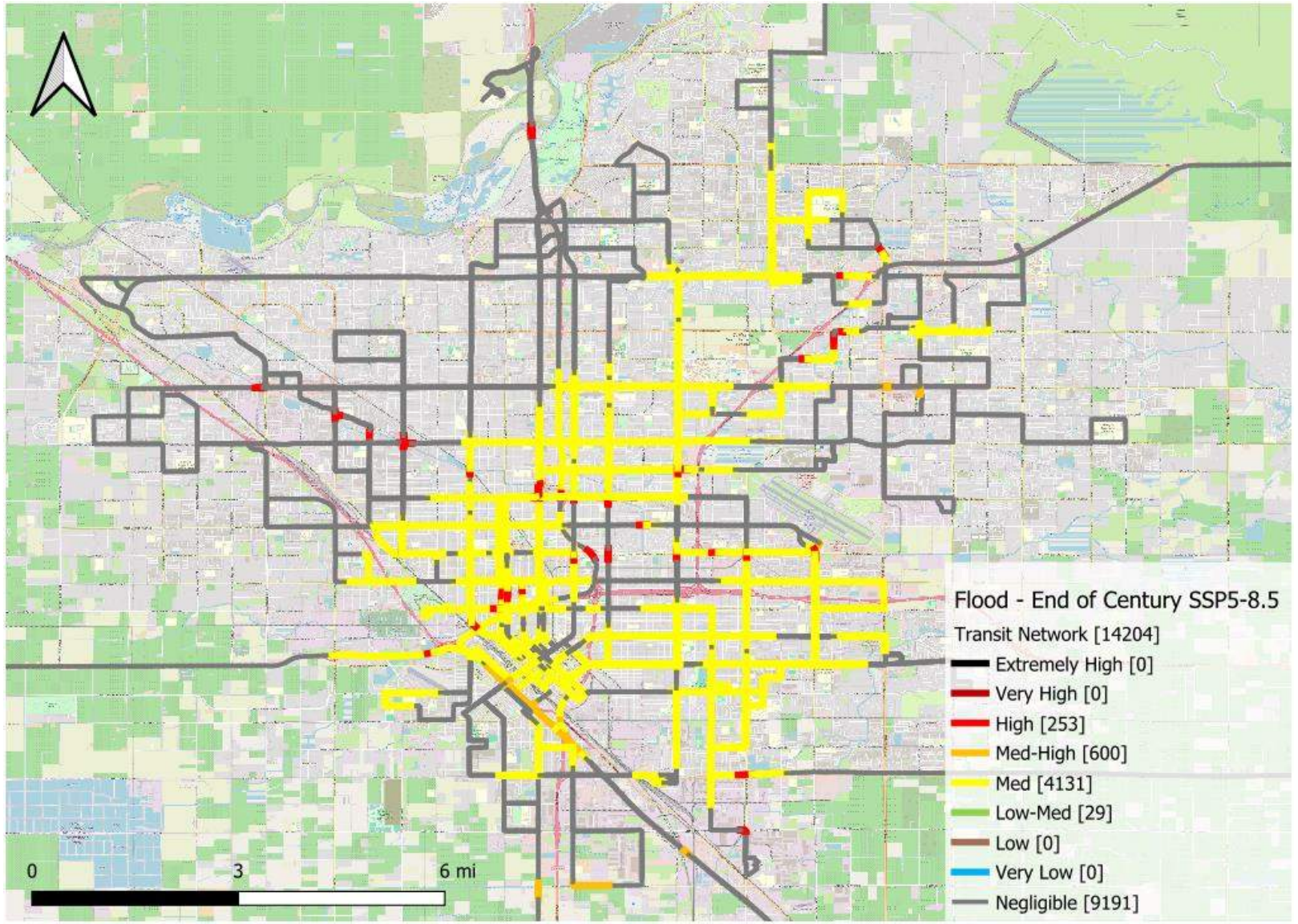
- For certain routes, future flood risk increases due to increasing *frequency* ***and*** *intensity* of precipitation.
- Routes over rivers are particularly highlighted due to increased potential for washout due to heavy rains.



Flood impacts on transit routes

Downtime Risk | End of Century

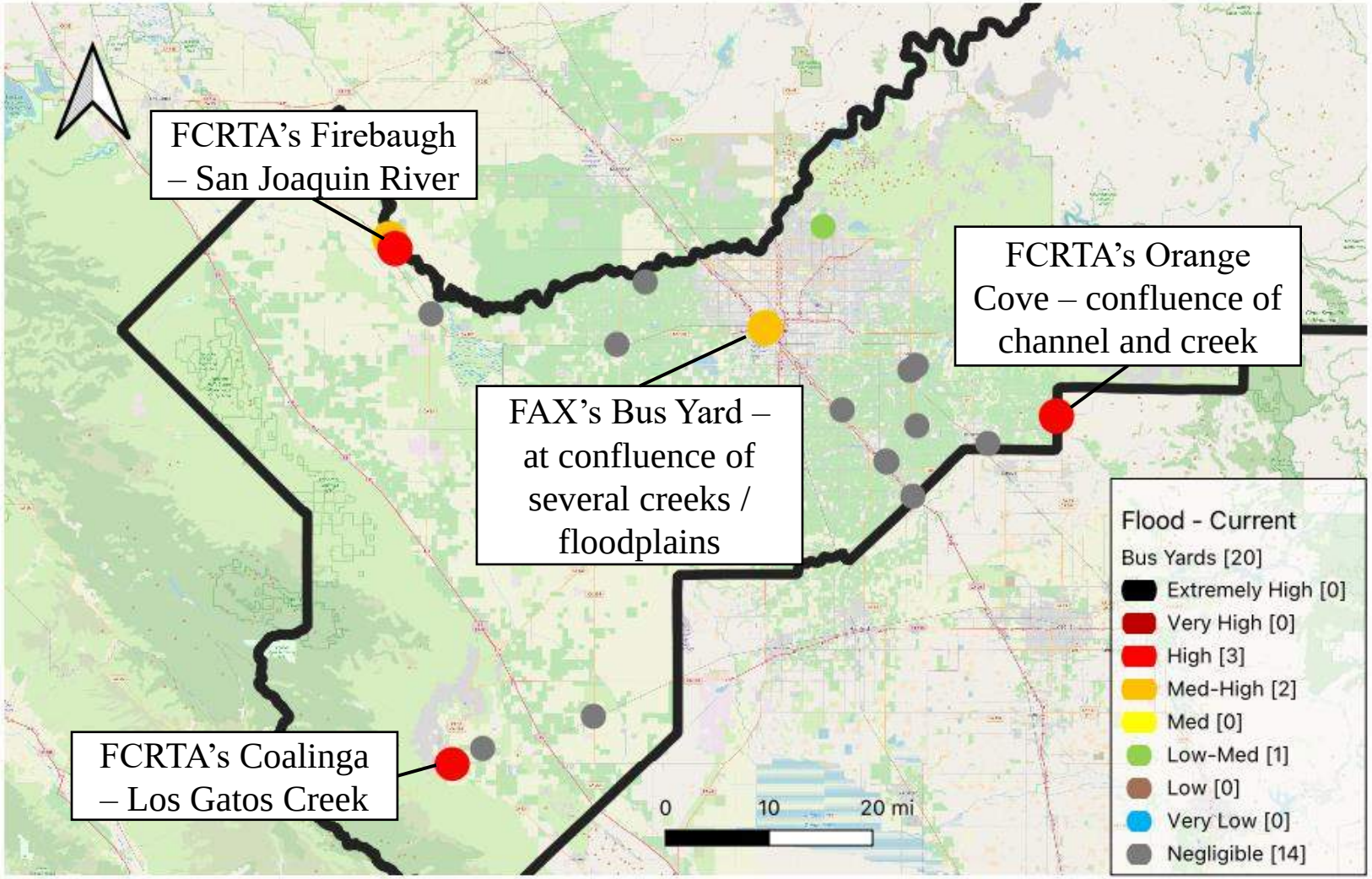
- For routes already flagged with flood risk in the present day, risk increases 1-2 ratings by the end of the century.
- Most routes contain road segments that may flood at least 5x more frequently in the future.



Flood impacts on bus yards

Downtime Risk | Present Day

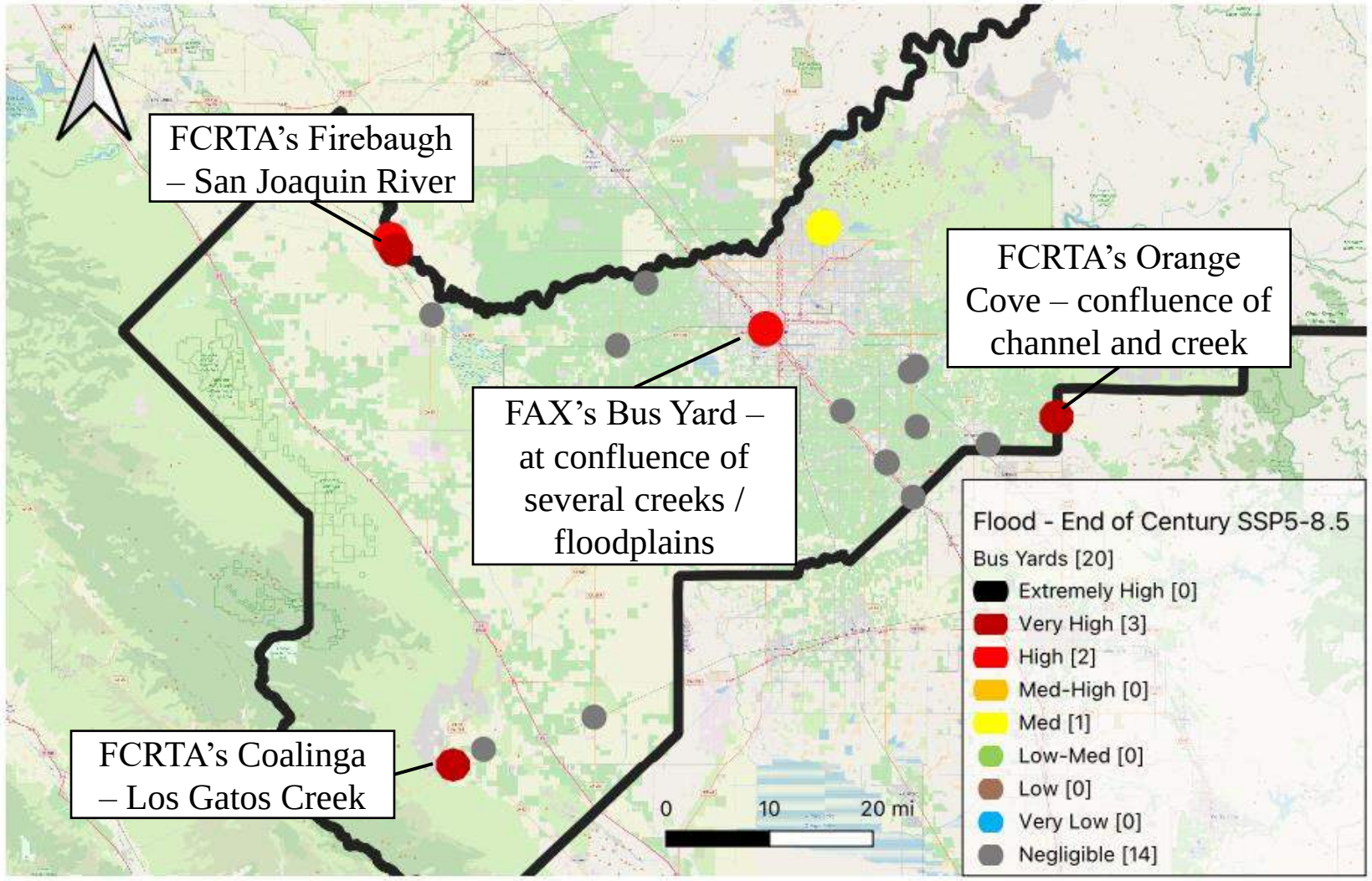
- Flooding can impact bus yards by damaging critical equipment or entering buildings located within.
- Bus yards with infrastructure are flagged with a higher potential for flood risk.
- ~ 25% of bus yards are near rivers or within a FEMA floodplain
- Present day ratings range from ***Low-Med*** *to* ***High***.



Flood impacts on bus yards

Downtime Risk | End of Century

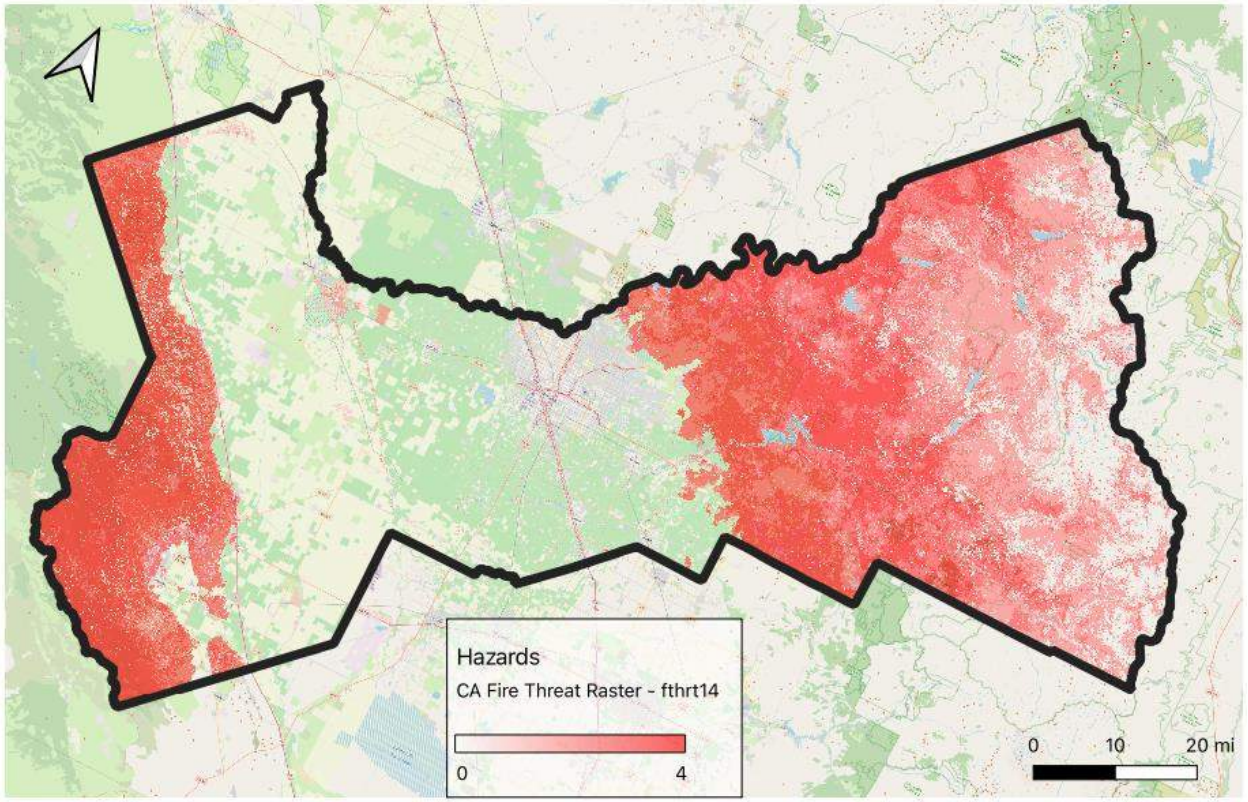
- The increasing intensity and frequency of precipitation increases flood risk at all bus yards by the end of the century.
- Future flood risk ratings range from ***Med*** *to* ***Very High***.



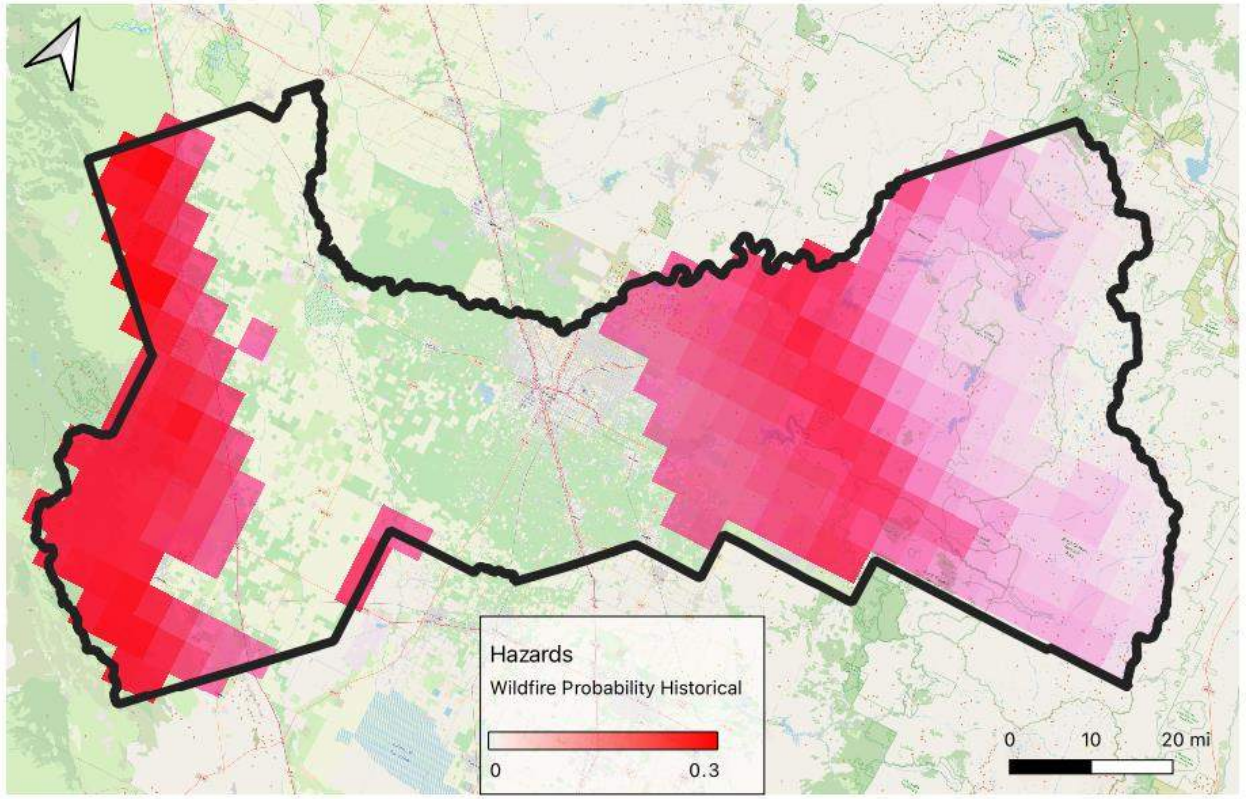
Wildfire hazard

Present Day

Wildfire Threat Class



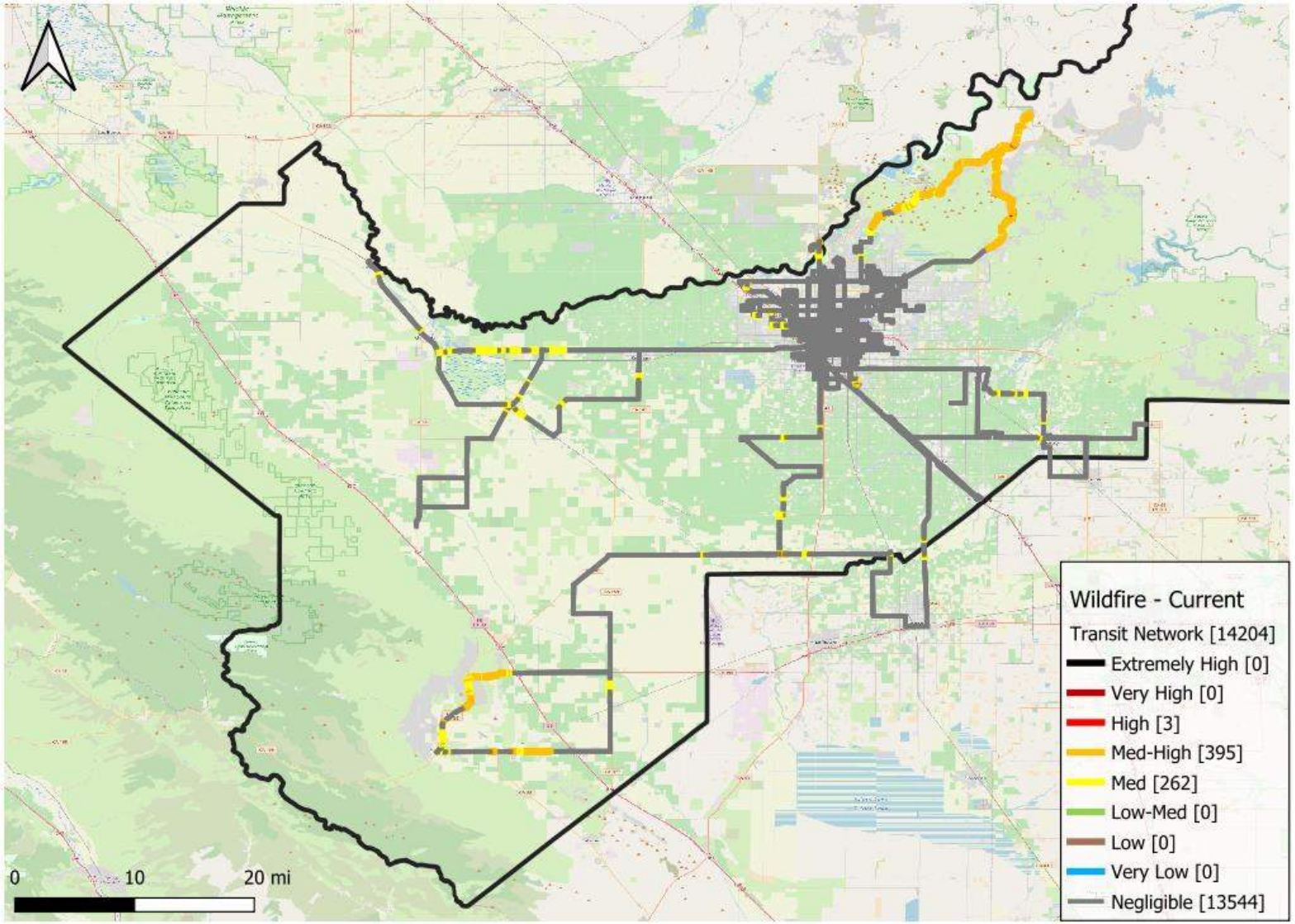
LOCA Decadal Wildfire Probability (Historical)



Wildfire risk to transit routes

Downtime Risk | Present Day

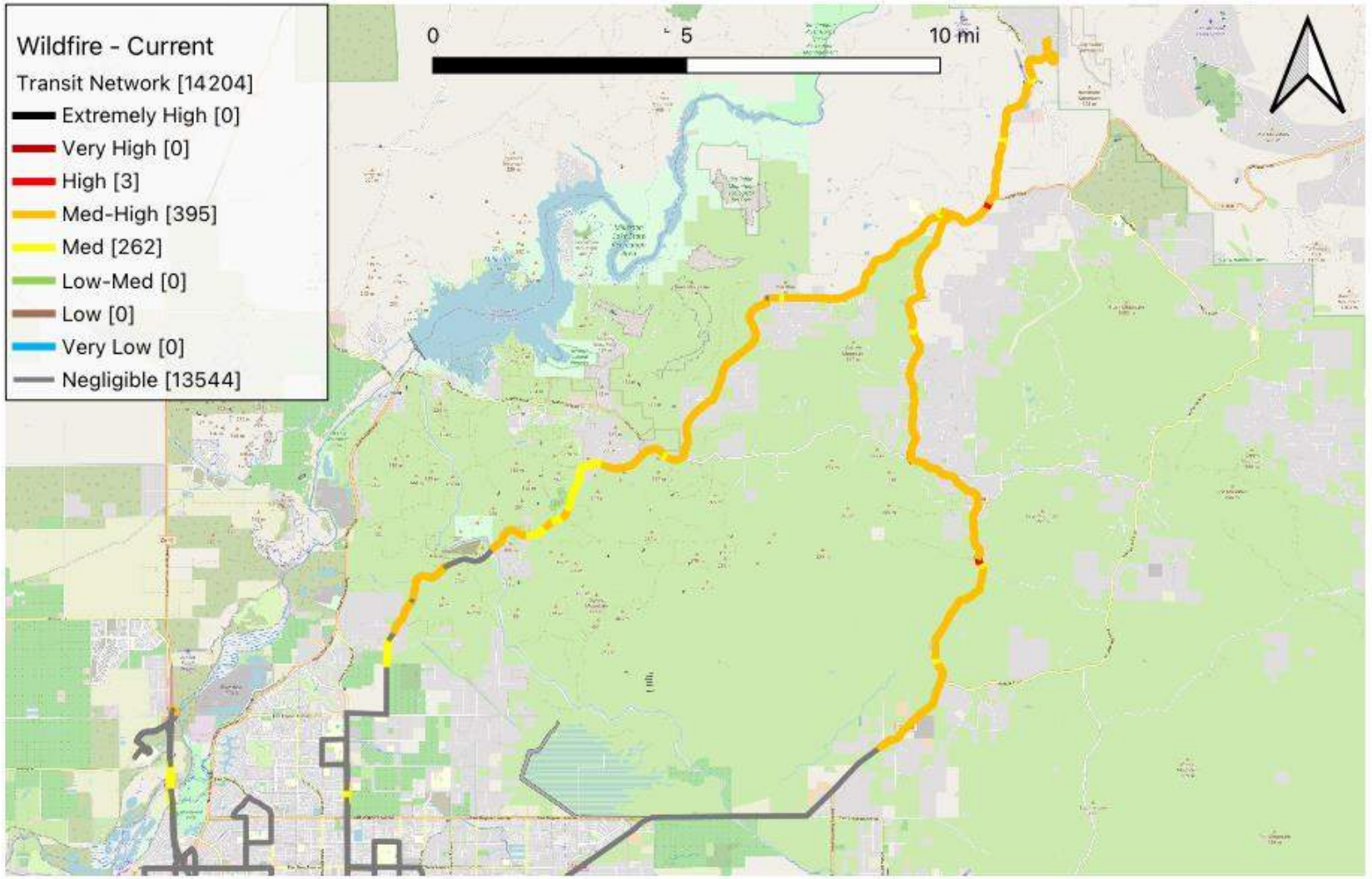
- Wildfire can impact roads by creating unsafe driving conditions, closing roads for clearance and repairs, or causing structural damage to roadside facilities.
- Present day ratings range from ***Med*** to ***High***.
- Mountainous routes and routes traversing more rural areas in Eastern and Western Fresno County have higher wildfire risk.



Wildfire risk to transit routes

Downtime Risk | Present Day

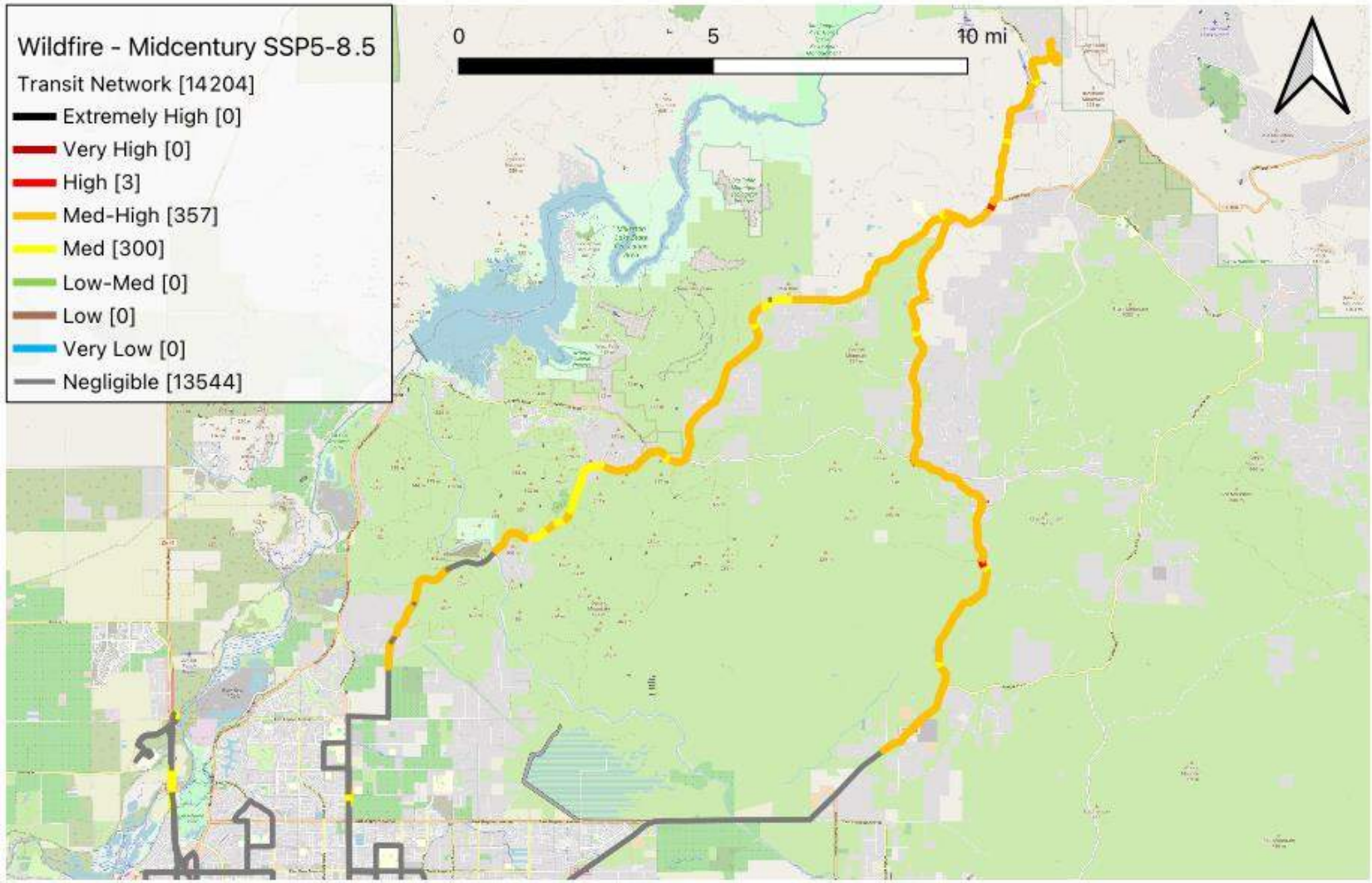
- Auberry Transit is the riskiest route with respect to wildfire, rated ***Med-High*** for most of its length.
- Has wildfire impacted your transit journey and/or operations?



Wildfire risk to transit routes

Downtime Risk | Midcentury

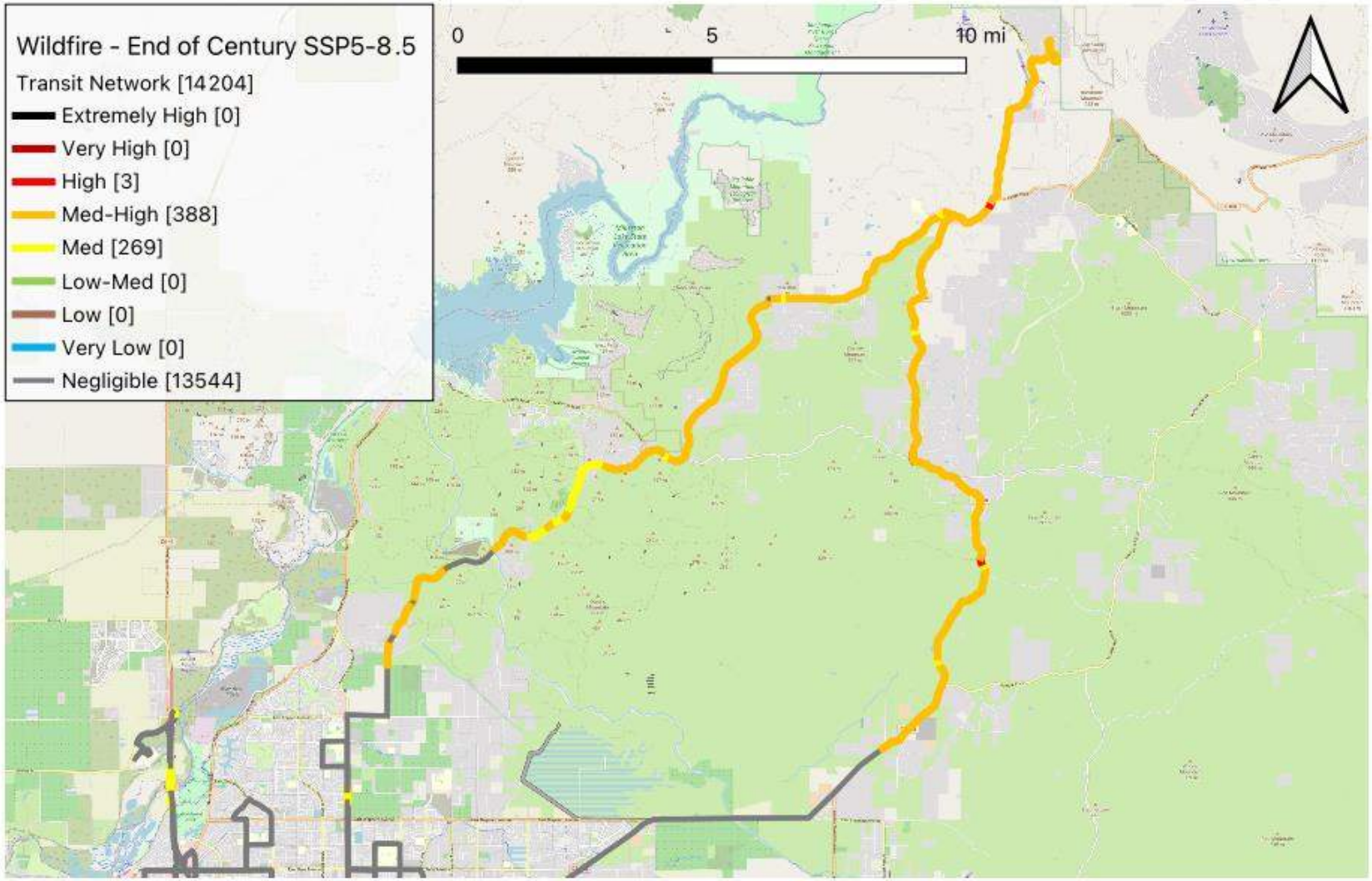
- The risk profile across the Auberry transit route is relatively constant across present and future climate.



Wildfire risk to transit routes

Downtime Risk | End of Century

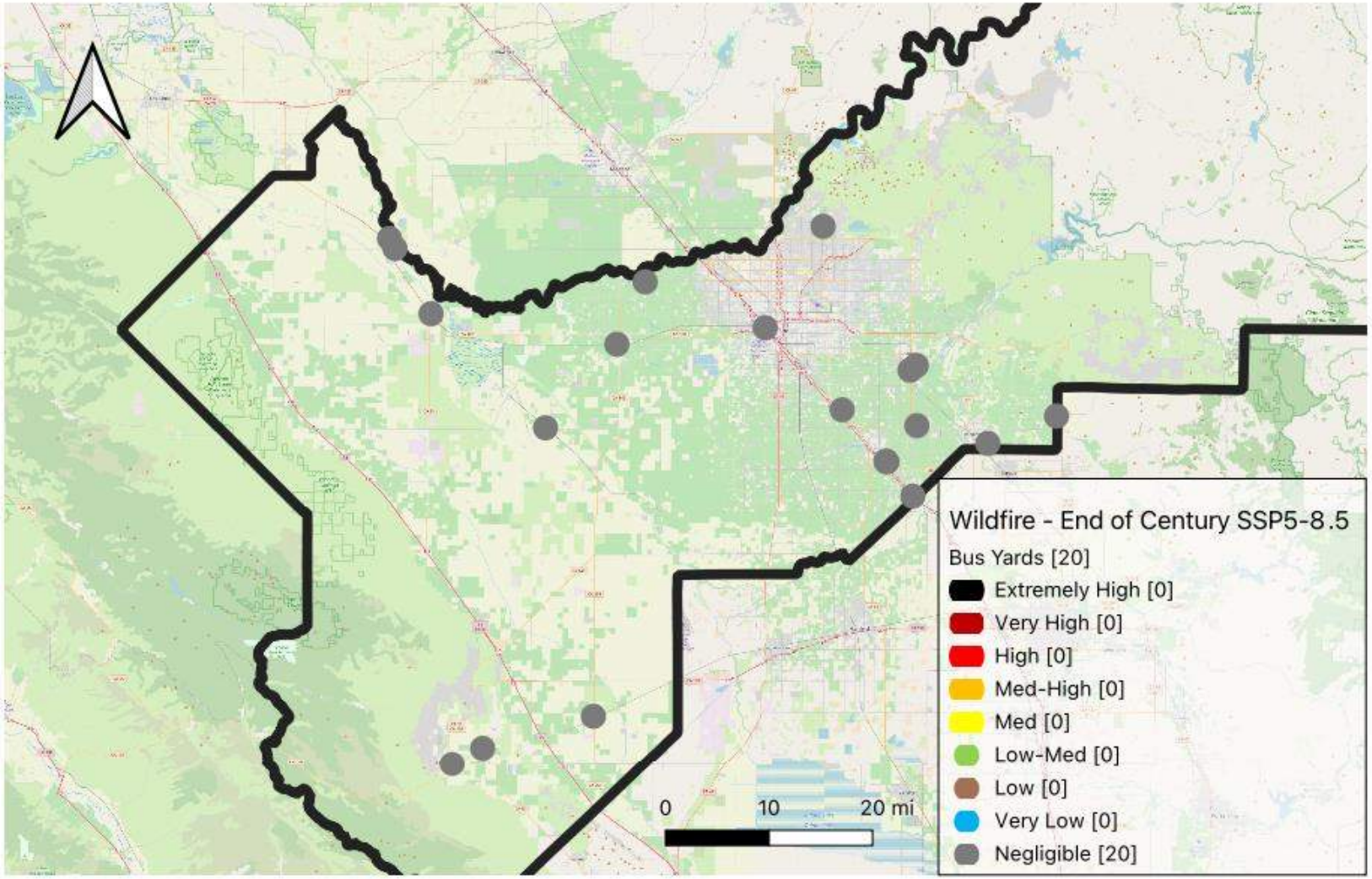
- The risk profile across the Auberry transit route is relatively constant across present and future climate.



Wildfire impacts on bus yards

Downtime Risk | Present Day

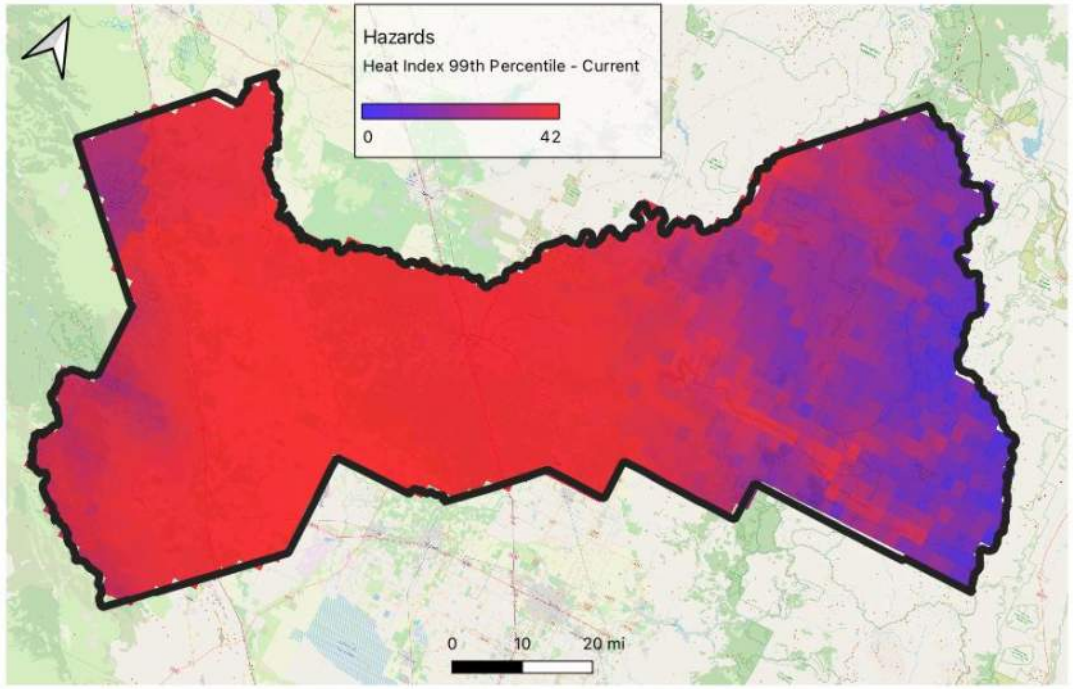
- No bus yards overlap with a wildfire hazard severity zone; therefore, wildfire risk is assessed as *Negligible* for all bus yards.



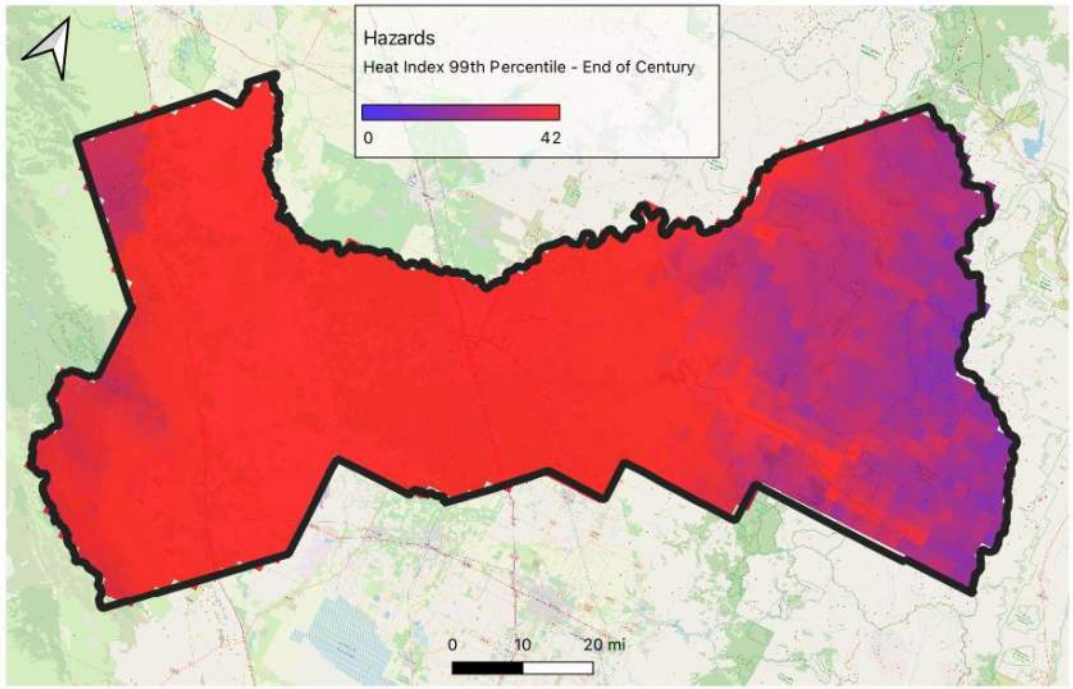
Heat hazard

Present Day + Future: Heat Index

Present Day



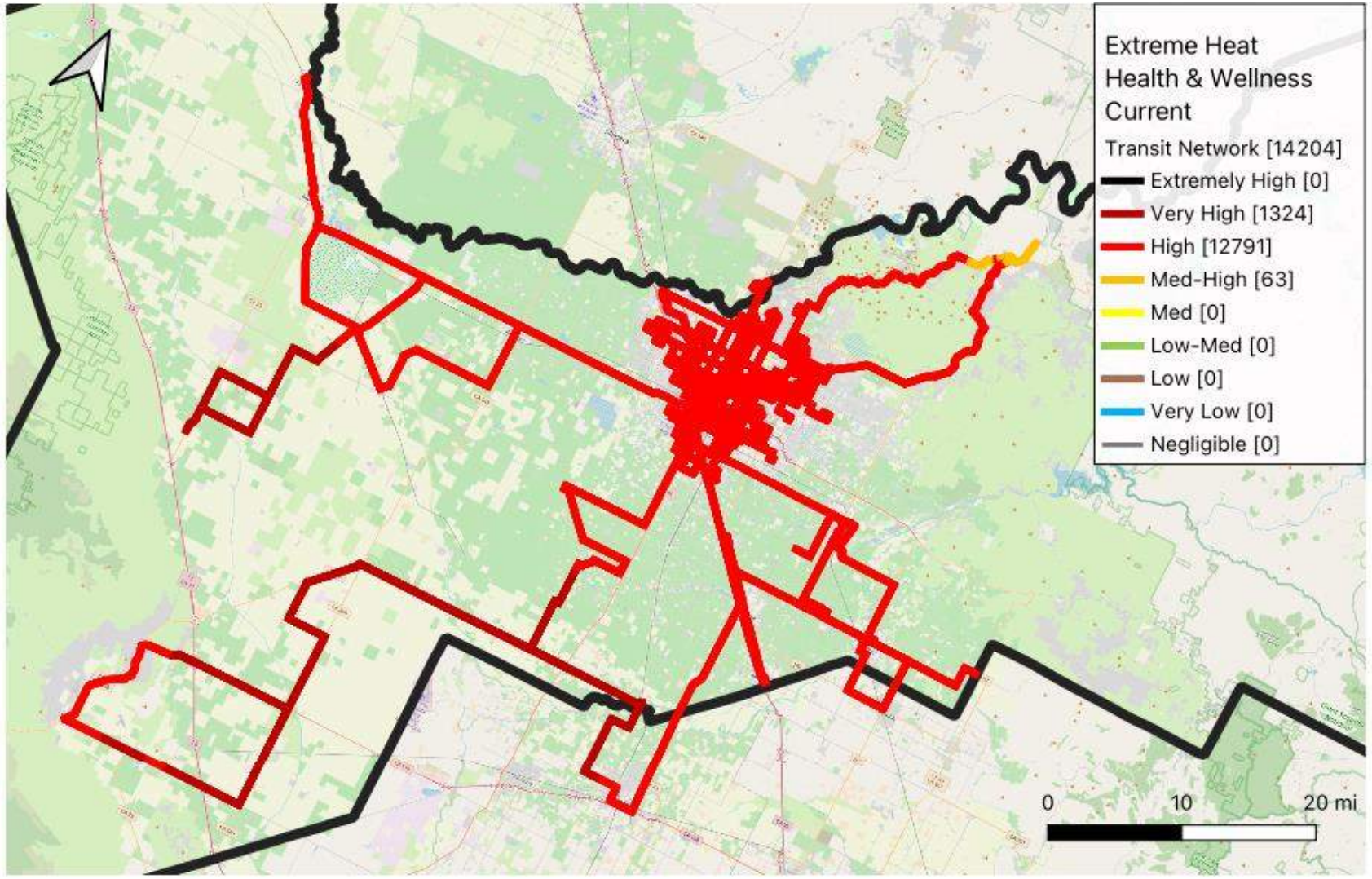
SSP5-8.5 End of Century



Extreme heat impacts for transit riders

Health Risk | Present Day

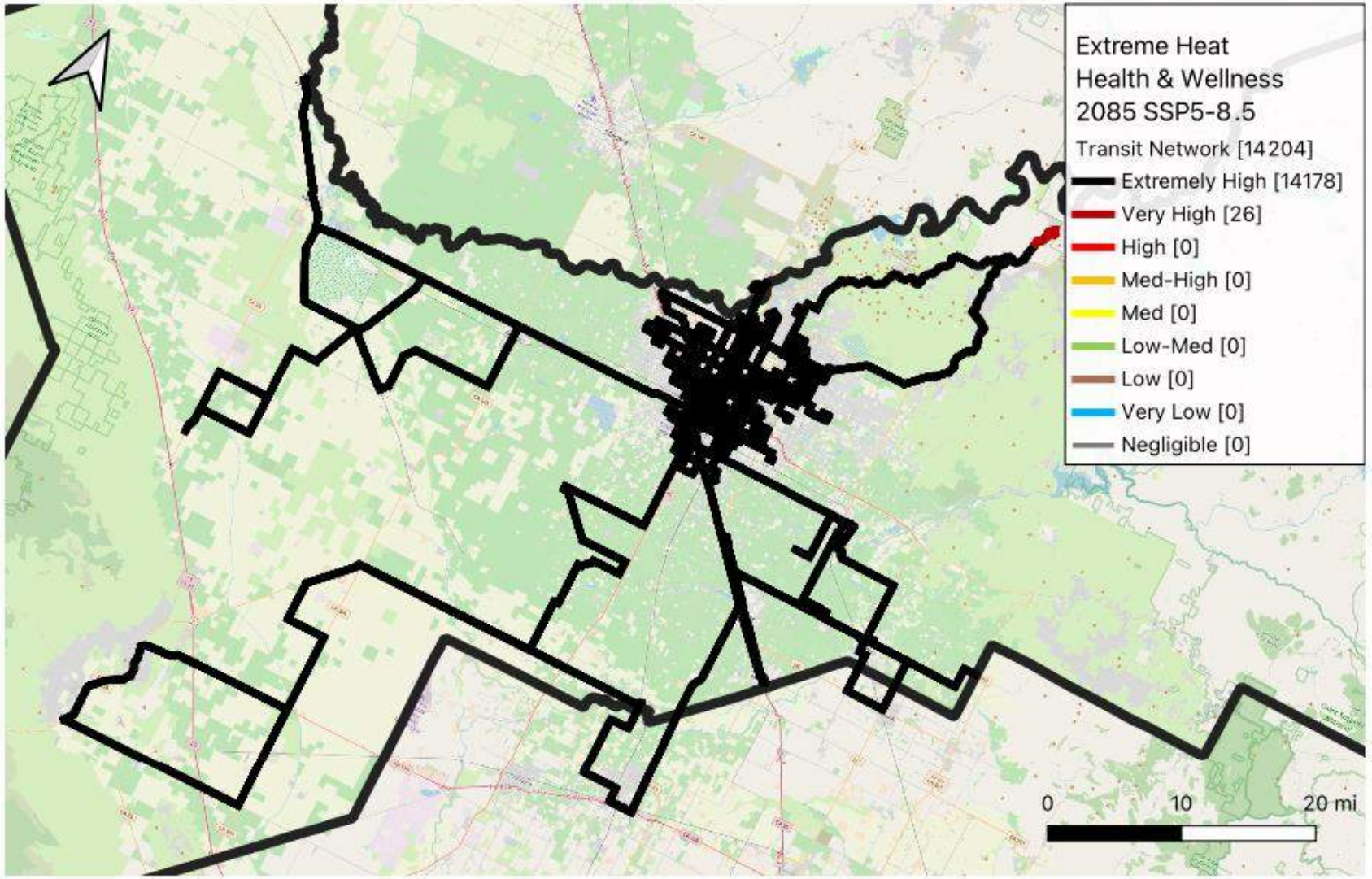
- Due to the regional nature of heat, extreme heat impacts riders of transit routes across the county almost uniformly.
- Extreme heat events are frequent and all transit routes are affected
- Extreme heat risk ranges from *Med-High* to *Very High.* Most routes receive a rating of *High.*



Extreme heat impacts for transit riders

Health Risk | Future Climate

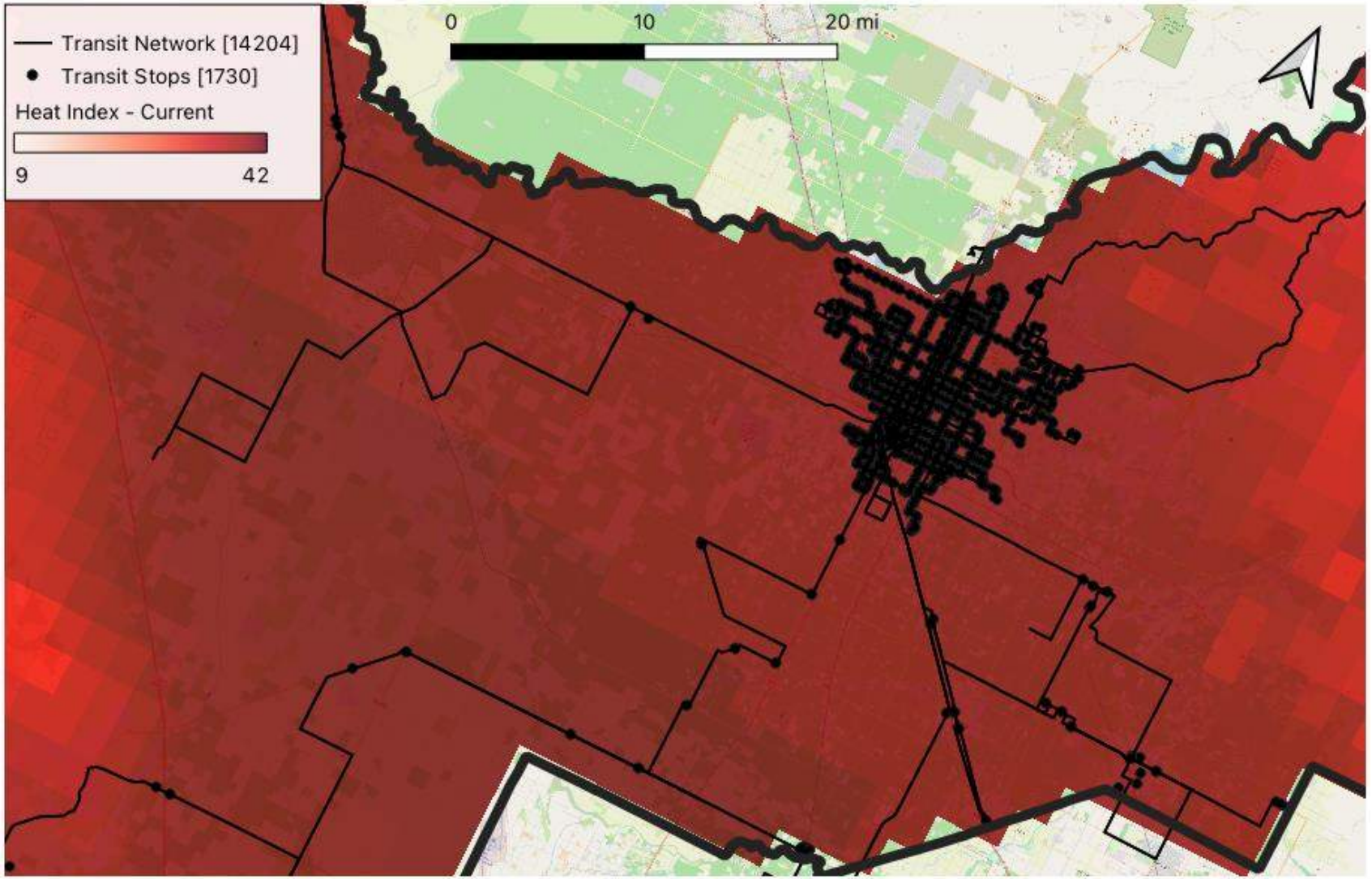
- Due to the increasing intensity and frequency of extreme heat days, extreme heat risk increases to ***Extremely High*** in all future climate scenarios.



Extreme heat impacts for transit riders

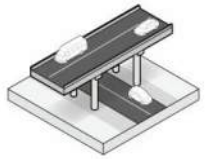
Health Risk | Present Day

- The impact of extreme heat on transit riders can be felt most while they are walking to or waiting at bus stops.
- Transit stops in Fresno are mostly in a high heat zone, up to 108 deg F.

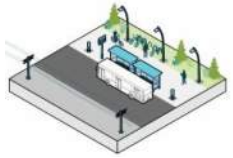


Rail

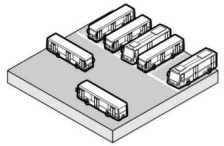
Today’s Focus



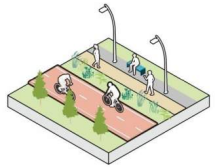
ROADS & BRIDGES



TRANSIT NETWORK



RAIL

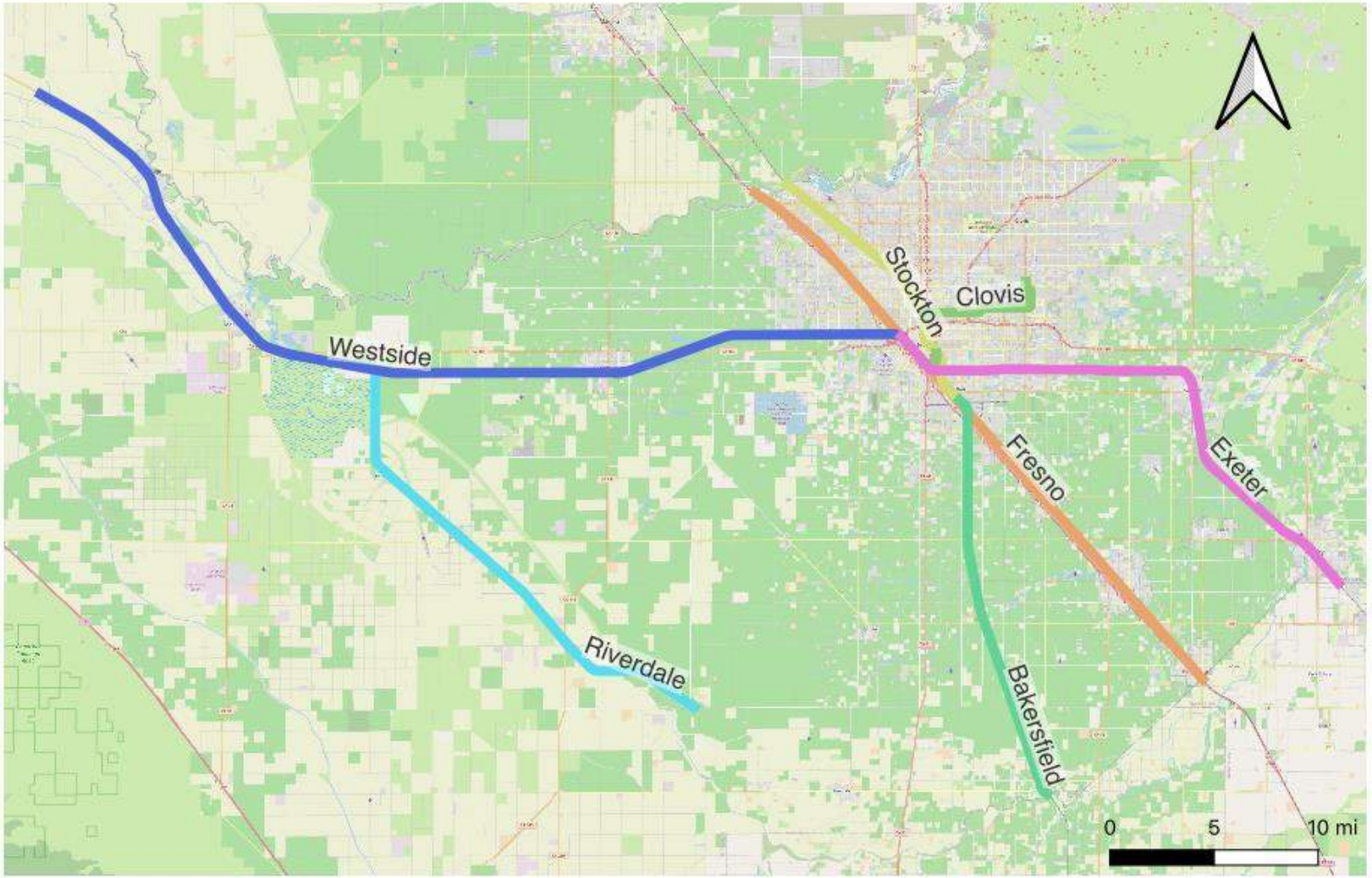


BIKE NETWORK

AIRPORTS

Rail network

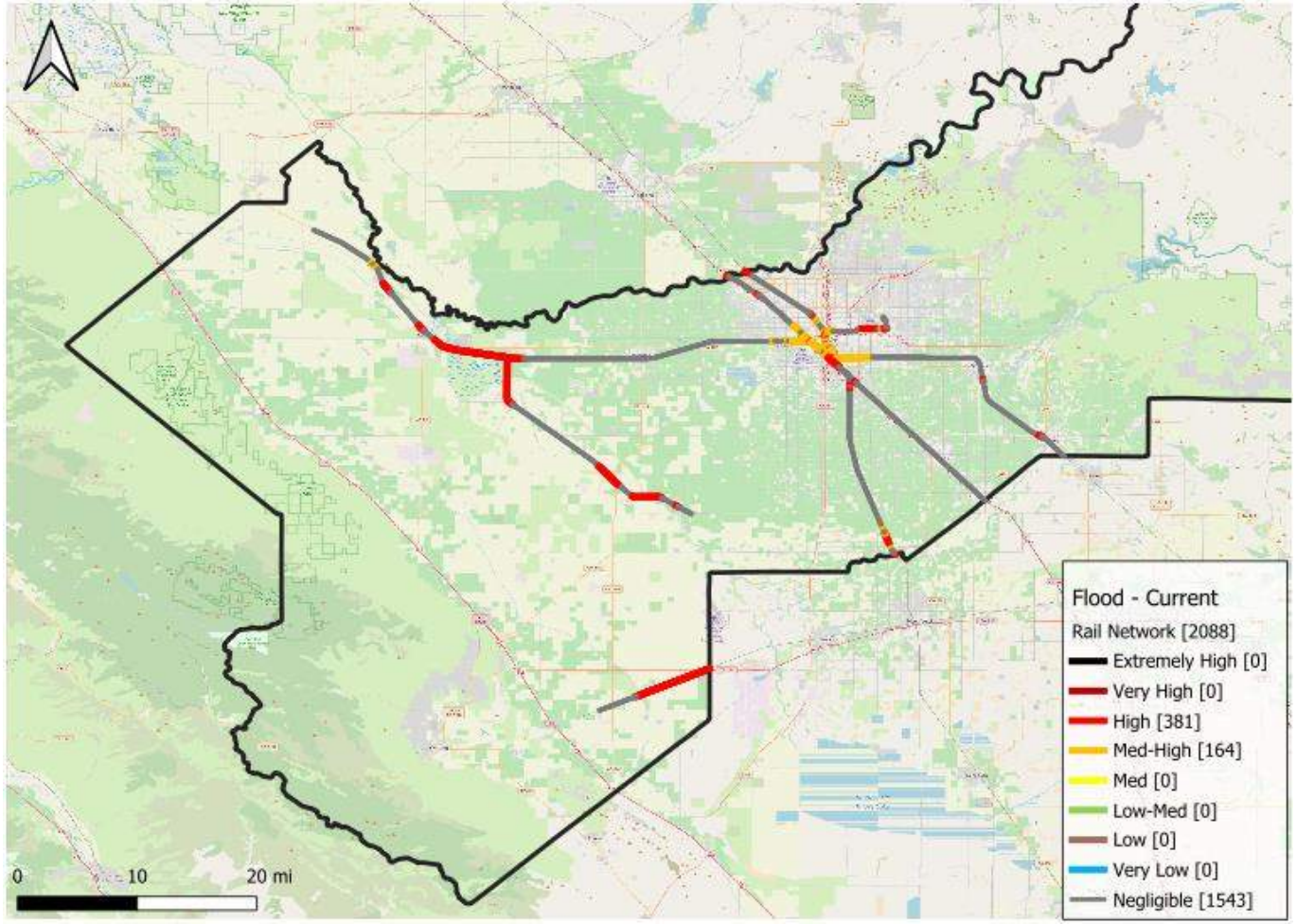
- Focus on 8 rail systems for risk analysis



Flood impacts on rail network

Downtime Risk | Present Day

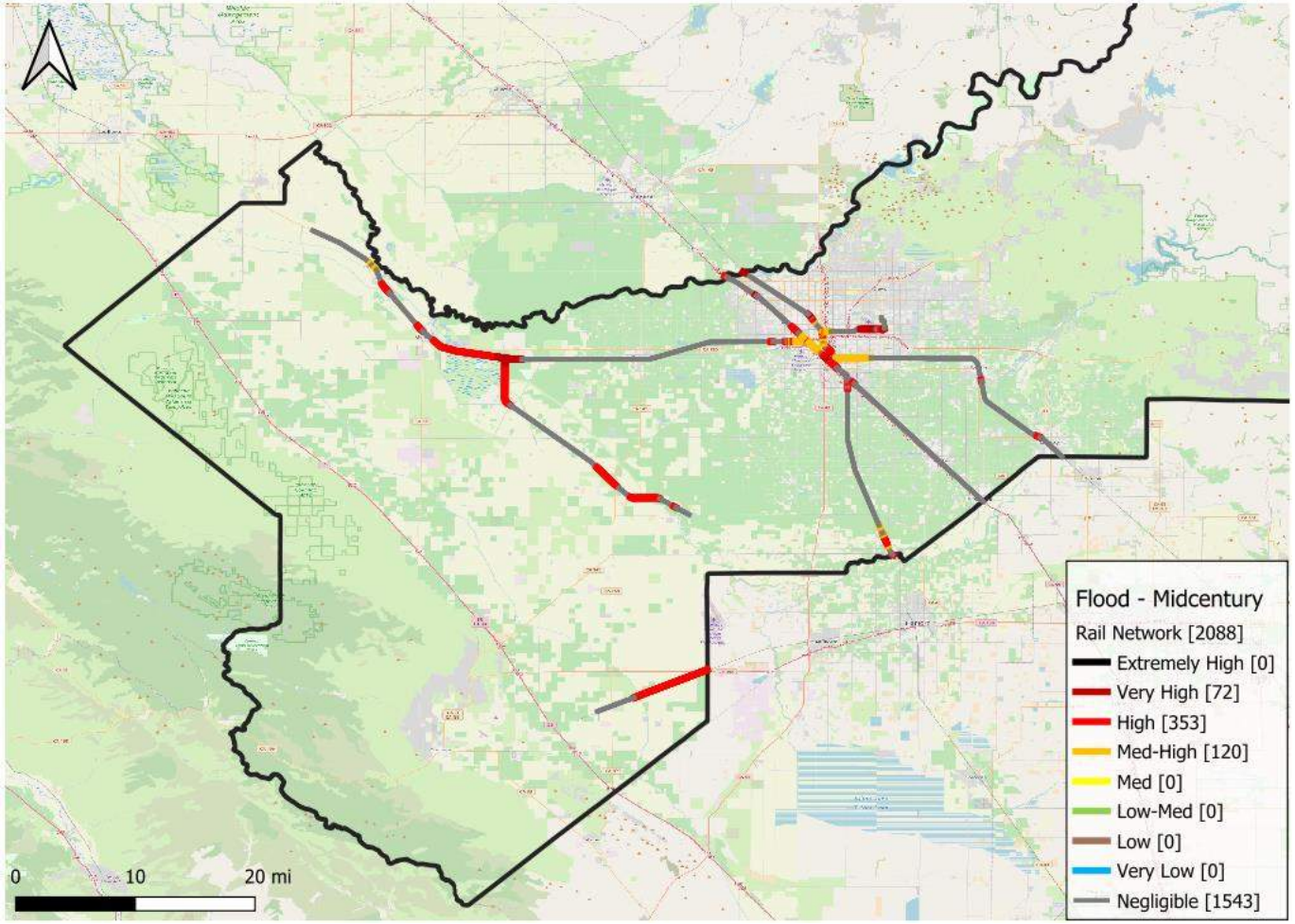
- Flooding can deposit debris on rail tracks, and, if rail lines travel over and near rivers, potential ballast and embankment erosion and scour can occur.
- Both branch and mainlines have flood risk.
- Present day risk ratings range from ***Med-High*** to ***High***.



Flood impacts on rail network

Downtime Risk | Midcentury

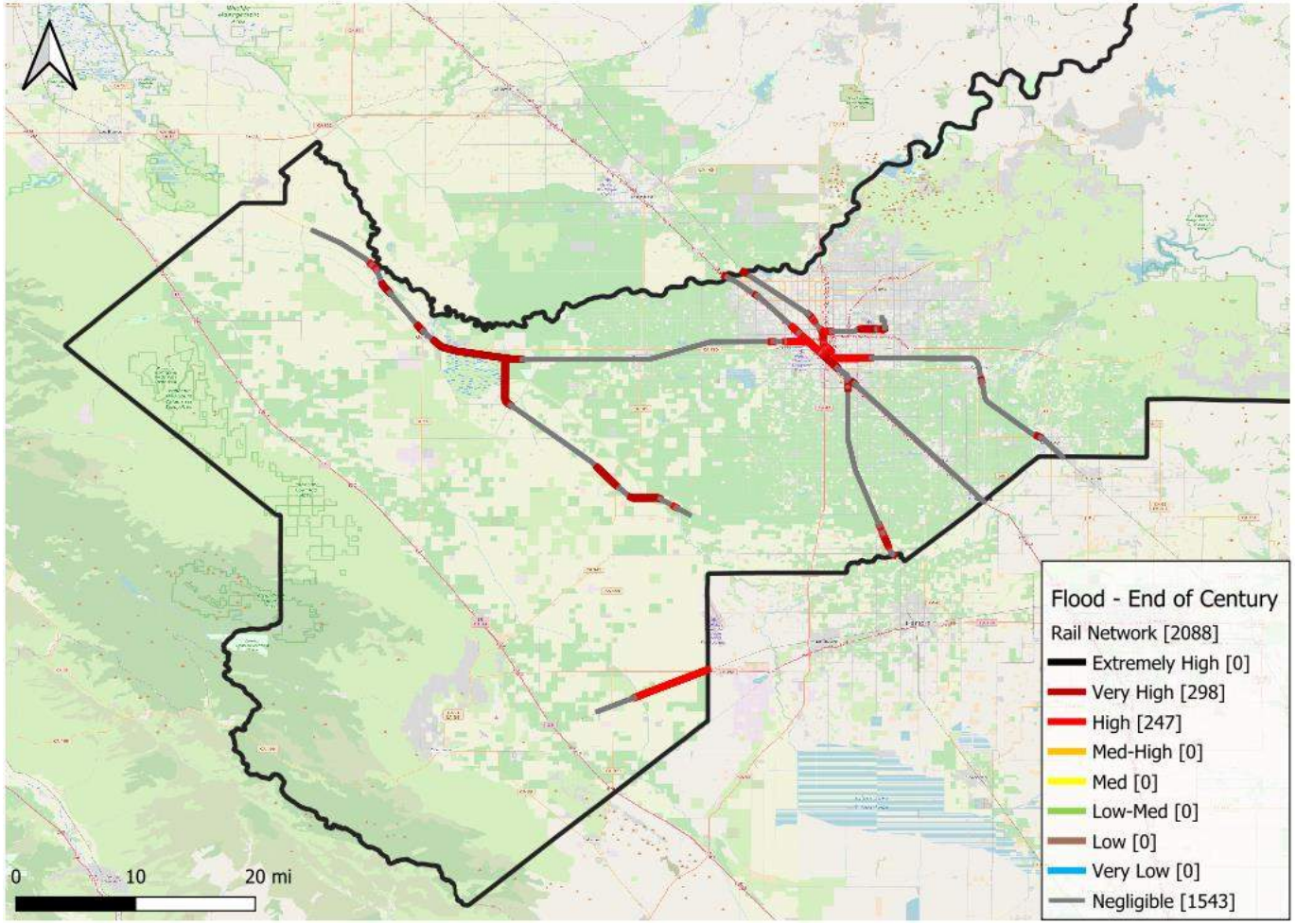
- There is high risk in both rural and urban areas to both main and branch lines.
- Future flood risk ratings range from ***Med-High*** to ***Very-High***.



Flood impacts on rail network

Downtime Risk | End of Century

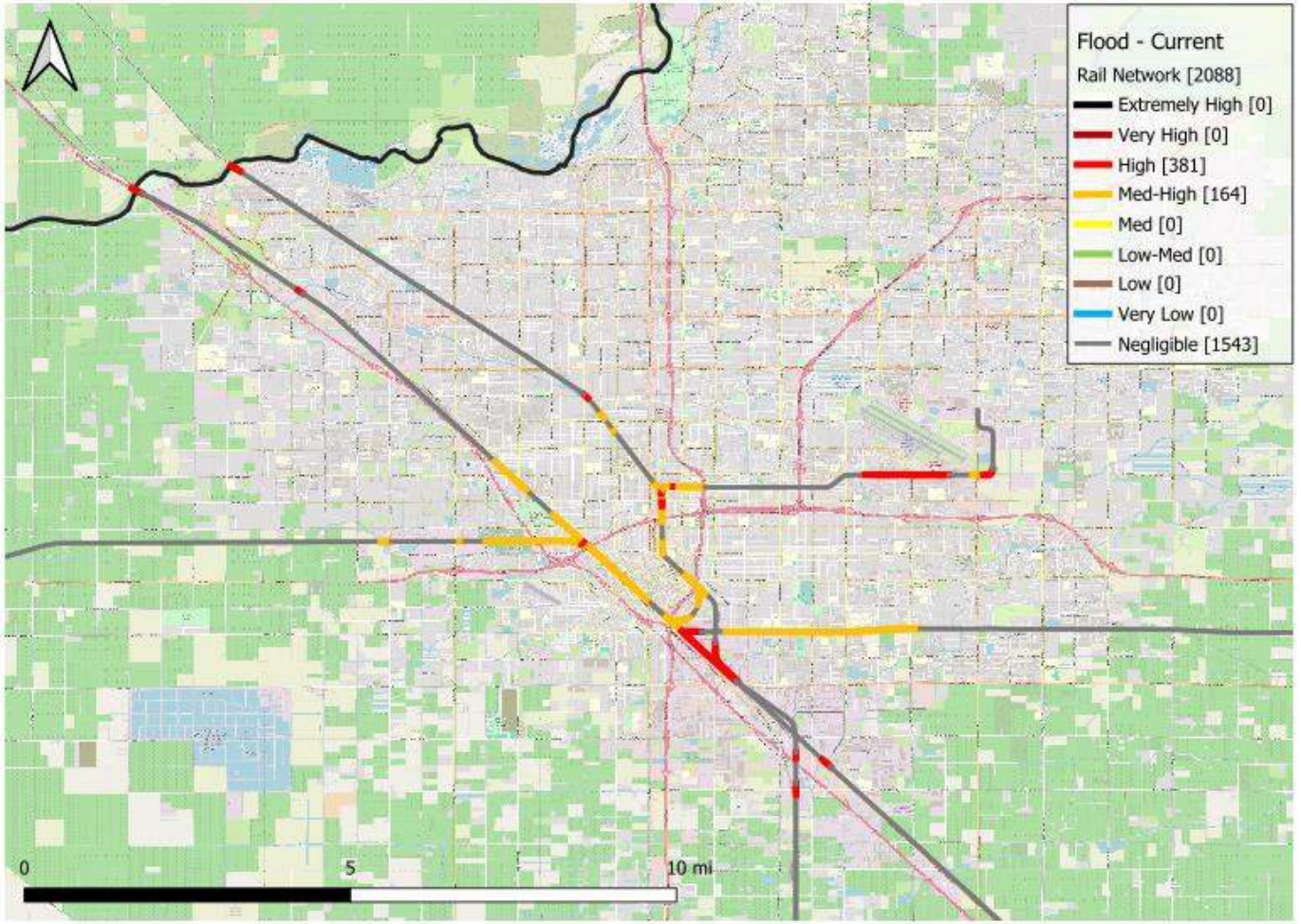
- By the end of the century, most flood risk to rail increases by ~5x due to the increased frequency of extreme precipitation.
- Future flood risk ratings range from ***High*** to ***Very-High***.



Flood impacts on rail network

Downtime Risk | Present Day

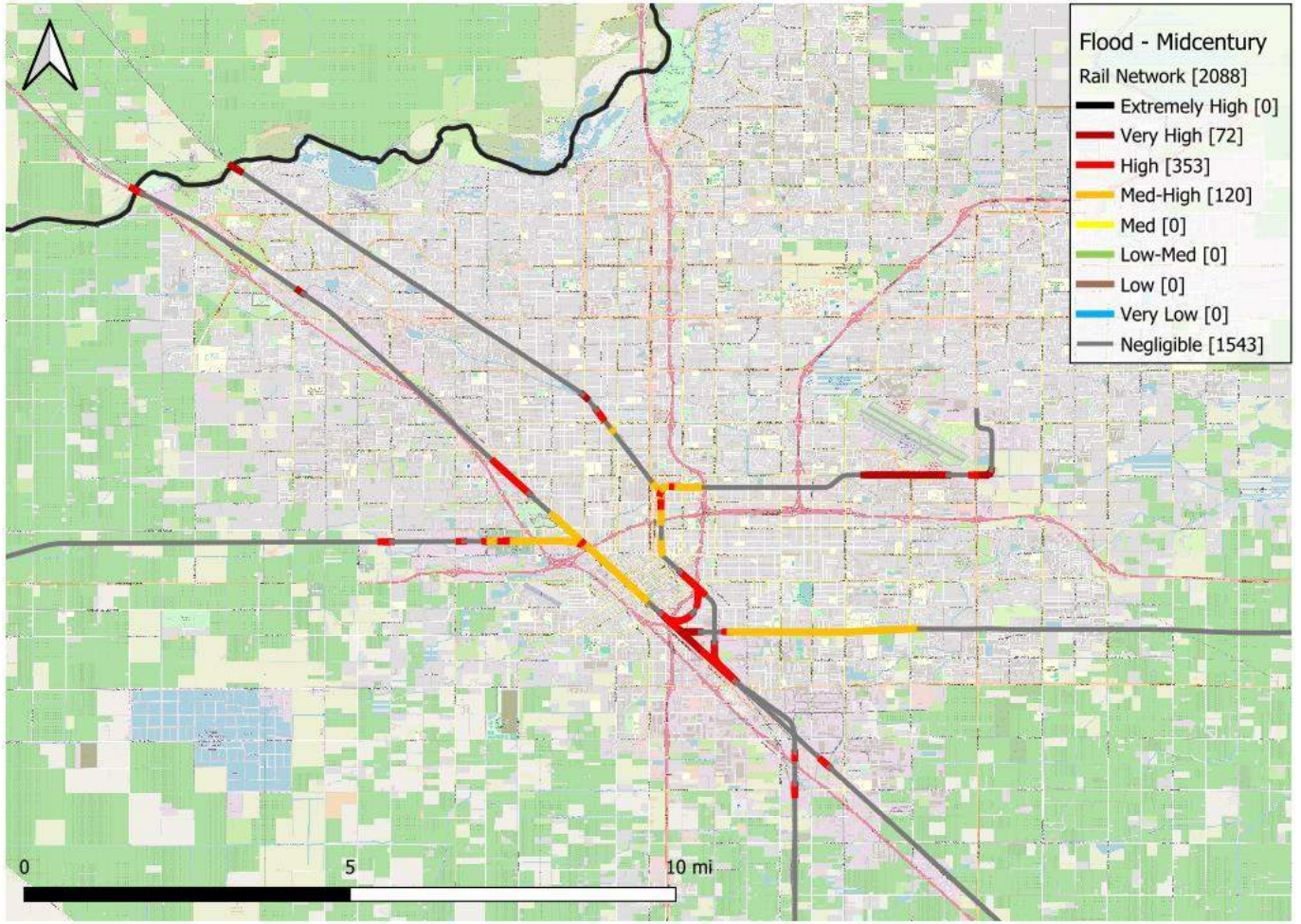
- In Fresno's urban areas, a portion of rail lines are rated ***Medium-High*** risk due to their overlap with the FEMA 500-year floodplain.
- Rail lines are rated ***High*** due to their overlap with the FEMA 100-year floodplain, a more frequent event.



Flood impacts on rail network

Downtime Risk | Midcentury

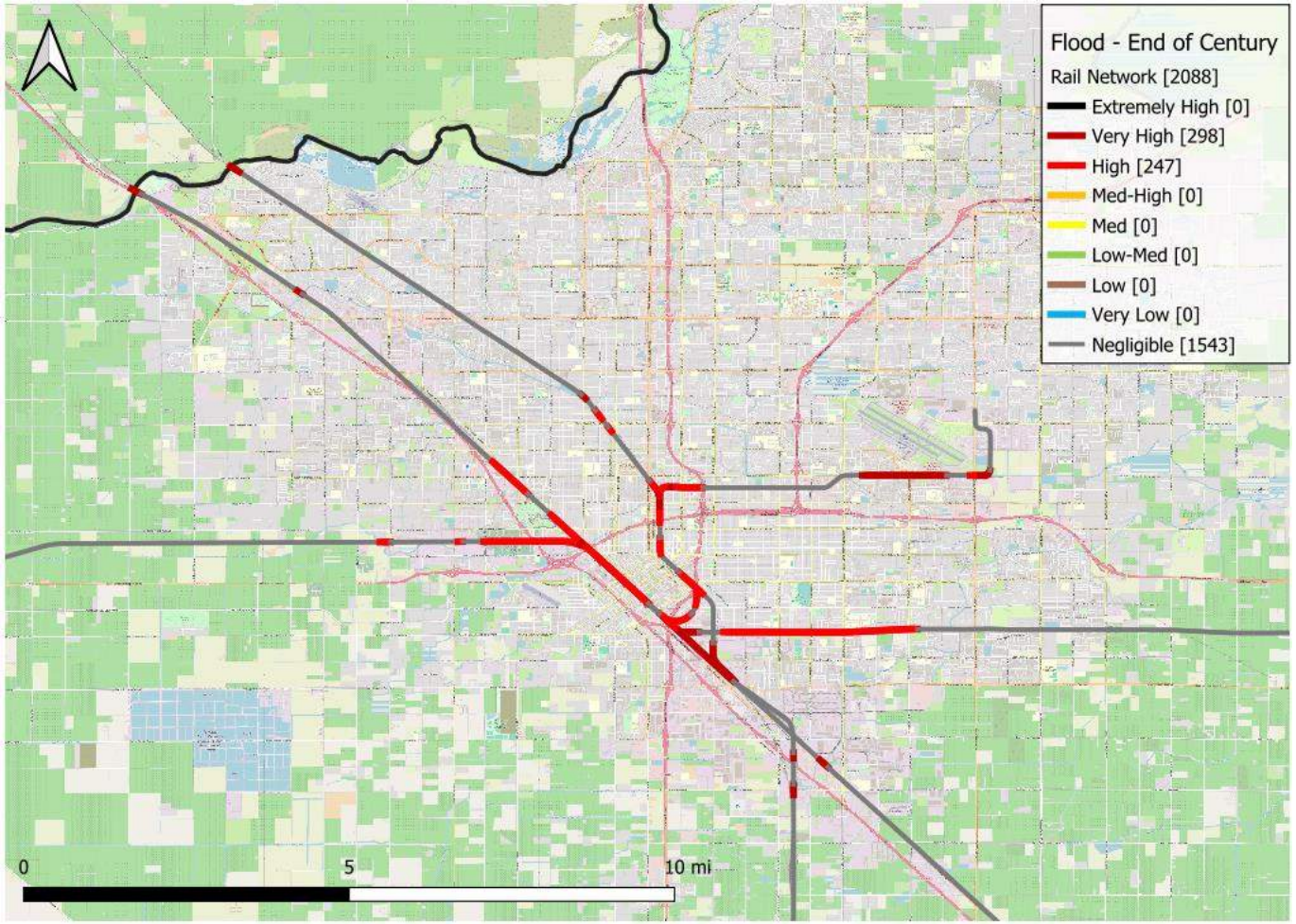
- Like the county-wide rail network, future flood risk ratings on the Fresno rail network range from ***Med-High*** to ***Very-High***.



Flood impacts on rail network

Downtime Risk | End of Century

- By the end of the century, most flood risk increases by ~5x due to the increased frequency of extreme (100-year) precipitation.
- Future flood risk ratings range from ***High*** to ***Very-High*** by the end of the century.



Key Take-aways

Key Takeaways from Risk Assessment Results

- Flood is most concentrated in Fresno, Clovis & western Fresno County.
- Flooding impacts the most assets of all hazards in this study
- In the future, extreme precipitation will increase, and this drives the increase in flood risk in this study.
- Flood impacts can be addressed on a site-specific and regional basis

- Wildfire is a regional hazard constrained to more rural and mountainous areas
- Wildfire risk is similarly highest in these regions.
- In the future, changing weather patterns (drier, hotter climate) are likely to increase the chance of wildfire occurrence in these regions.

- Present-day risk ratings make a strong case already for project prioritization.
- Climate studies like this one can help us plan for the future in a more resilient way.

- Heat is an issue uniformly across the county.
- Climate change impacts heat most directly and significantly of all hazards.
- Extreme temperatures will increase in the future, as will heat risk for all populations
- Any project addressing heat will likely need to include system-wide solutions, such as the first / last mile experience for transit riders.

Project Prioritization

Many worthy projects, limited resources…

Sample “Projects”

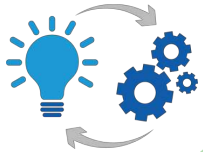
Policies & Programs

- Program to address heat exposure for transit riders
- Update design specifications for roads to account for change in rainfall and fire-resistant materials
- Forest fuel reduction program
- Emergency access improvements program

Infrastructure projects

- Elevating roadways
- Improving drainage systems
- Construct flood protection infrastructure (e.g., floodwalls, levees, dikes)

Evaluation Criteria

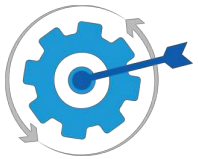


Level of Effectiveness

Solution serves multiple purposes

Equity

Implementation Strategies



Ease of implementation

Alignment with other Fresno COG priorities

Level of Effectiveness

Evaluation Criteria #1

The route/ location connects communities to services (e.g., healthcare, schools)

Number of people served by project (e.g., traffic volumes for road projects, ridership for transit projects)

Project's ability to improve public safety (e.g., roadway safety or evacuation)

Solution serves multiple purposes

Evaluation Criteria #2

The project location is already degraded, or the asset is reaching end of its life cycle

Project results in greenhouse gas reductions or air quality improvements

Project supports the economy (e.g., access to jobs, tourism, regional route)

Equity

Evaluation Criteria #3

Geographic equity
(across Fresno County)

Socioeconomic equity:
the route/location serves environmental justice populations

Implementation considerations

Alignment with other Fresno COG priorities

Cost

The problem can be solved quickly and effectively

Local and/or regional agency partners have capacity to move project forward for funding & implementation

Next Steps

TASK	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
Task 1. Plan & Policy review													
Task 2. Update Weather & Climate Projections													
Task 3. Risk Analysis & Project Identification													
Task 5. Draft Project List													
Task 6. Cost Estimates													
Task 7. Priority Projects for Risk Assessments													
Task 8. Draft Plan													
Task 9. Final Plan & Board Adoption													

Task 4. Collaboration & Outreach

4.1 Outreach Plan													
4.2 Technical & Community WG Meetings				M1		M2		M3		M4			
4.3 Community Outreach													

See you in the new year!

Purpose and use of risk assessment results

Purpose and use of risk assessment results in this study and beyond

- This is a high-level risk assessment using the best publicly available data covering all of Fresno county. Regional data has certain limitations; some relevant to this study are noted below.
- We make judgements about hazard impacts on damage and consequences based on publicly available data. In certain cases (e.g., flooding) the information needed to assess risk more accurately (e.g., flood depth) is not available at a regional scale. Therefore, flood risk is conservatively assessed presuming a few feet of flooding if an asset is within the FEMA floodplain; with higher resolution flood data, certain ratings may decrease.
- For certain hazards (e.g., flooding and wildfire) which do not have explicit future hazard datasets, risk ratings shown are primarily based on present-day hazard data and future climate indicators. In these cases, risk can only be augmented where it already exists (e.g., existing floodplains, existing areas with wildfire threat). Note that climate change can introduce new risk where it does not currently exist, but this study does not cover that scenario.
- Overall, the results of this study should be taken relative to each other and augmented with local knowledge and other factors when utilizing them beyond this study.