



Sacramento Area Council of Governments

Vulnerability and Criticality Assessment

June 2020



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WHAT WE DO

The Sacramento Area Council of Governments (SACOG) is an association of local governments in the six-county Sacramento region. Its members include the counties of El Dorado, Placer, Sacramento, Sutter, Yolo, Yuba and the 22 cities within.

SACOG provides transportation planning and funding for the region and serves as a forum for the study and resolution of regional issues. In addition to preparing the region's long-range transportation plan, SACOG approves the distribution of affordable housing in the region and assists in planning for transit, bicycle networks, clean air and airport land uses.

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Table of Contents

Overview and Summary of Findings	1
Overview.....	1
Key Vulnerabilities.....	1
Methodology.....	3
Purpose	3
Approach.....	3
Indicators	4
Approach Conclusion	26
Analysis Documentation and Replicability	27
Policy Guidance	30
Evaluation of Relevant State and Federal Policies	30
Federal Policy	30
State Policy	30
Comparison of Approach with Existing Guidance	33
Federal Guidance.....	33
State Guidance.....	34
Moving Forward.....	37
Vulnerability and Criticality Assessment Results.....	38
Summarized by Asset Type and Hazard	38
Criticality: Roadways.....	39
Criticality: Transit.....	41
Criticality: Bridges.....	43
Criticality: Airports.....	45
Sea Level Rise: Roadways	47
Sea Level Rise: Transit.....	49
Sea Level Rise: Bridges.....	51
Sea Level Rise: Airports	53
Storm Surge: Roadways.....	55
Storm Surge: Transit.....	57
Storm Surge: Bridges	58
Storm Surge: Airports	60
Wildfire: Roadways.....	61
Wildfire: Transit.....	63
Extreme Temperature: Transit.....	65

Extreme Temperature: Airports	67
Riverine Flooding: Bridges.....	69
Further Considerations and Next Steps.....	71
Additional Considerations.....	71
Next Phase.....	72
Works Cited	74
Appendix	75
Criticality Score Tables	75
Vulnerability Score Tables	87
Exposure Mapping	145
Sea Level Rise	146
Storm Surge	148
Wildfire.....	149
Extreme Temperature	152
Precipitation.....	155

Figures & Tables

Figure 1: Roadway Criticality Scores.....	40
Figure 2: Transit Criticality Scores.....	42
Figure 3: Bridge Criticality Scores.....	44
Figure 5: Airport Criticality Scores.....	46
Figure 6: Roadway Sea Level Rise Vulnerability Scores.....	48
Figure 7: Transit Sea Level Rise Vulnerability Scores.....	50
Figure 8: Bridge Sea Level Rise Vulnerability Scores.....	52
Figure 10: Airport Sea Level Rise Vulnerability Scores.....	54
Figure 11: Roadway Storm Surge Vulnerability Scores.....	56
Figure 12: Bridge Storm Surge Vulnerability Scores.....	59
Figure 13: Roadway Wildfire Vulnerability Scores.....	62
Figure 14: Transit Wildfire Vulnerability Scores.....	64
Figure 16: Transit Temperature Vulnerability Scores.....	66
Figure 17: Airport Temperature Vulnerability Scores.....	68
Figure 18: Bridge Riverine Flooding Vulnerability Scores.....	70
 Table 1: Studied Asset Type-Hazard Combinations.....	 4
Table 2: Prioritization Metrics.....	6
Table 3: Proposed Metric Weights.....	20
Table 4: Proposed Criticality Score Weights.....	25
Table 5: Top Roadway Criticality Scores.....	75
Table 6: Top Transit Criticality Scores.....	81
Table 7: Top Bridge Criticality Scores.....	82
Table 9: Top Airport Criticality Scores.....	86
Table 10: Top Roadway Sea Level Rise Vulnerability Scores.....	87
Table 11: Top Transit Sea Level Rise Vulnerability Scores.....	93
Table 12: Top Bridge Sea Level Rise Vulnerability Scores.....	98
Table 14: Top Airport Sea Level Rise Vulnerability Scores.....	103
Table 15: Top Roadway Storm Surge Vulnerability Scores.....	104
Table 16: Top Bridge Storm Surge Vulnerability.....	109
Table 17: Top Roadway Wildfire Vulnerability Scores.....	110
Table 18: Top Transit Wildfire Vulnerability Scores.....	119
Table 20: Top Transit Temperature Vulnerability Scores.....	126
Table 21: Top Airport Temperature Vulnerability Scores.....	132
Table 22: Top Bridge Riverine Flooding Scores.....	133

Overview and Summary of Findings

Overview

The Sacramento Council of Governments (SACOG) Vulnerability and Criticality Assessment examines how climate-related hazards are expected to affect the SACOG region transportation system through the end of the century. It reviews pertinent information on expected future hazards, including wildfire, riverine flooding, sea level rise and storm surge in the Sacramento-San Joaquin River Delta (the Delta), and extreme heat. At a systemwide scale, it analyzes which assets are most critical to the transportation network and which are most vulnerable to these hazards. Climate and transportation network data applied in this assessment was collected into an "exposure map geodatabase" and "vulnerability and criticality geodatabase" - both of which are explained in more detail in later sections.

This document describes the methodology and results of the systemwide assessment. The first section provides an overview of the key findings of the assessment. The next several sections address the methodology: the first describes the methodology itself and data sources, the second outlines the mechanics and replicability of the analysis, and the third compares the approach with existing guidance and discusses relevant policies. The subsequent section walks through the results in detail. The final section provides other relevant considerations and next steps.

Key Vulnerabilities

Expected changes in wildfire, riverine flooding, Delta sea level and surge, extreme heat, and other hazards pose significant risks to many portions of the regional transportation system and require rethinking of how transportation infrastructure is planned, engineered, and managed. This subsection highlights key findings of the assessment, which was conducted at a system scale.

Several roads in the low-lying Delta area in the southwestern-most extent of the SACOG region are highly exposed and vulnerable to future sea level rise and storm surge. These include portions of State Route (SR) 160 and SR-12, which have relatively low travel volumes but also limited alternate routes. In this area, the Isleton Bridge across the Sacramento River on SR-160 was flagged as highly vulnerable to both sea level rise and surge. The Isleton Road bridge across the Georgiana Slough near Walnut Grove and the SR-12 bridge across the Mokelumne River are highly vulnerable to sea level rise.

Some more trafficked roadway segments, such as Interstate (I) 5 in the Cosumnes River floodplain, are moderately exposed and important to the regional system. Another one of these segments, the I-80 just west of West Sacramento, shows up as highly exposed under some of the sea level rise and surge scenarios analyzed. Some of this is likely due to the road elevation not being captured at a high resolution in the hazard projections, but the high potential consequences if flooding occurs suggests that further investigation is needed along this corridor.

Changing patterns of heavy precipitation and snowmelt pose threats along the region's many rivers and streams. Due to limited data availability, future riverine flooding was only analyzed for bridges. There are many bridges in the region that are vulnerable to future riverine flooding. In general, the assets that were assessed as having the highest exposure were not particularly critical to the regional network. However, many bridges merit facility-level study.

Increased flood threats coupled with potential critical flood infrastructure failure could cause catastrophic consequences to transportation infrastructure and wider communities, particularly in heavily populated areas. This could occur as the result of levee failure along major waterways, such as the Sacramento River, American River, and Feather River. It could also occur due to dam failure or dam releases during high water events. These risks were not the primary focus of this study, and more information is needed to analyze them in greater detail.

Future wildfire risks span large swaths of the region outside of the urban centers and agricultural areas in the Central Valley. As recent devastating wildfires in California have demonstrated, the transportation network in high wildfire risk areas is sparse and there are limited options for evacuation.

Many portions of I-80 from Rocklin eastward and US-50 from Gold River eastward are very vulnerable to wildfire. Aside from these two critical highways, there are numerous other rural mountain roads in the SACOG region identified as highly vulnerable. These include long portions of the rural roads in eastern Yuba County and almost all the rural roads analyzed east of SR-49 on the western face of the Sierra Nevada in El Dorado and Placer Counties. Many shorter segments of roadway farther west in the foothills were identified too. The roadway network used in the analysis did not cover the Lake Tahoe region, which is expected to have high fire risk as well. The analysis also flagged some smaller segments of critical roadway closer to Sacramento; further analysis is needed to determine whether these threats are legitimate or whether the resolution of the future wildfire projections led to “false positives” in the analysis.

Approximately 150 of the transit stops in the SACOG region are exposed to wildfire, but boardings and alightings are relatively low at most of them. Vulnerable locations include: El Dorado Transit and SacRT-operated Folsom State Line stops along the US-50 corridor from Folsom to Pollock Pines; Placer County Transit stops located in areas such as Auburn, Lincoln, and Meadow Vista; and Yuba-Sutter Transit stops concentrated primarily in Olivehurst. Some of these stops are in disadvantaged communities as designated by SACOG or CalEnviroScreen, including several stops in the Placerville and Olivehurst areas.

Extreme temperatures pose health risks at transit stops throughout the region, particularly in the valley areas where greater temperature rise is expected. Criticality-related factors, such as volume and service for disadvantaged communities, are essential factors when prioritizing which stops to focus on. Similarly, almost all the airports in the region, aside from a couple high in the Sierra Nevada, are exposed to high heat that could affect pavements and aircraft operations. In addition, while not the focus of this study, high heat will likely impact the transportation system in other ways, including changing the recommended binder grades for roadway pavement, affecting construction, maintenance, and other outdoor work windows, and exacerbating transportation-related air quality issues.

The findings of this systemwide assessment can be used to prioritize more detailed facility-scale climate change assessments and be applied as inputs into climate change and adaptation alternative analyses at both the system and facility scales. The assessment highlighted the need for better information on different facets of resilience, including both hazard and asset data. The section outlines some of these information gaps and provides suggestions for facility-level analysis in the next phase of SACOG's work.

Methodology

Purpose

There are thousands of transportation assets that will be affected by changing climate conditions in the SACOG region. The primary climate-related hazards include Delta sea level rise and storm surge, wildfire, extreme temperatures, and riverine flooding.

This section describes the approach for understanding climate-related risks to the transportation network in the SACOG region and prioritizing the most vulnerable and critical assets for future action. Specifically, the prioritization approach is intended to identify the relative vulnerability of different transportation assets to climate-related hazards using available information. Higher priority assets can be assessed in further detail to determine how they can be adapted to climate change. The approach incorporates information on hazard likelihood, as well as the asset's criticality and condition. The approach addresses the most important climate-related hazards in the region but could not address the full range of all potential hazards. This does not mean that the risks associated with hazards excluded from the analysis are negligible.

Approach

Agencies can use a few different methods to prioritize projects. There are at least three different prioritization techniques currently in use. These techniques, ordered from lower to higher level of effort, are the (1) risk matrix/heat map approach, (2) the indicators approach, and (3) the risk-based approach.

1. The **risk matrix/heat map approach** involves creating a matrix with one axis qualitatively representing the likelihood of an event (low to high probability categories) and the other representing the consequences (low to high consequence categories). Each asset type-hazard combination is assigned to a cell within the matrix by using professional judgment. High risk asset type-hazard combinations are identified for immediate action.
2. The **indicators approach** involves collecting data on a variety of variables that are deemed relevant to affecting the prioritization. These are then put on a common scale, weighted (if necessary), and used to create a score for each asset. The scores collectively account for all the variables of interest and can be ranked to determine priorities.
3. The most sophisticated approach, the **risk-based approach**, involves an effort to determine the "do-nothing" cost of climate change if no adaptation is undertaken. This is a very data intensive approach as it requires (1) knowledge of the probability of the event happening, (2) an engineering assessment of what damage/disruptions occur when the asset is exposed to a hazard, and (3) economic analysis to determine the costs to repair damage to the asset along with the socioeconomic costs associated with loss of the asset. Because of its data intensiveness, the risk-based approach is rarely used for initial assessments. However, an agency can begin with one of the simpler techniques and lay the groundwork for conversion to a risk-based approach later.

Given the resources and timeframe for this project, an indicators approach was chosen. With the indicators approach, various metrics are used to capture:

- The nature of the asset's exposure to each relevant hazard (timing, severity, and/or extensiveness),

- The consequences of that exposure (in terms of the sensitivity of the asset to damage and/or impacts to the traveling public, such as through the assessment of traffic volumes on the affected roadway) and,
- Programming considerations that affect how rapidly adaptations can be implemented, if necessary.

Ultimately, these metrics were compiled mathematically into a score for each individual asset, that can be ranked to show assets that should be prioritized for detailed study under each hazard. For example, this scoring identifies which bridges are the most vulnerable to riverine flooding hazards out of all the bridges in the region, according to the criteria used in the analysis.

Different metrics were applied to each combination of asset type and hazard. Table 1 lists the hazards and denotes with an "X" the types of assets that are sensitive to each. Each cell marked with an "X" has its own set of metrics. The metrics used were based on what is relevant to prioritizing amongst assets exposed to the indicated hazard. For example, bridge scour ratings are relevant for prioritizing bridges exposed to sea level rise, but would not be relevant for roadways.

Table 1: Studied Asset Type-Hazard Combinations

	Sea Level Rise	Storm Surge	Wildfire	Extreme Heat	Riverine Flooding
Roadways	X	X	X		
Bridges	X	X			X
Airports	X	X		X	
Transit Stops	X	X	X	X	
Light Rail Line	X	X			

Data availability also dictated the selection of some of the asset type-hazard combinations. For instance, riverine flooding also affects roadways, light rail stops, light rail lines, and transit stops. But analyzing future threats to these assets requires remapping floodplains, which is a substantial effort and was not possible for this study. Given the importance of riverine flooding to large portions of the SACOG region, current floodplain information was collected into the vulnerability and criticality geodatabase despite not being part of the prioritization framework. Similarly, landslide susceptibility information was also included in the vulnerability and criticality geodatabase, but the data was not used in the prioritization framework.

Indicators

The number of possible metrics for any given asset type-hazard combination is extensive and can be overwhelming. With any prioritization scheme, a limiting factor is data availability, and the effort is restricted to the best available information. Table 2 lists all the metrics used in the prioritization approach. Also included is a description of each metric, a rationale for inclusion, the data source, other relevant metadata, and the asset type and hazard combinations it is used to assess.

After the metrics were compiled for each asset, each metric was placed on a 0 to 100-point scale where 100 represents that the asset is a priority. With the traffic volume metric, for example, a 0 might be assigned to a minor residential street with extremely low volumes, while a value of 100 would be assigned to the busiest highway in the region. Putting the metrics on a common scale helps reconcile the different units of measurement between metrics.

Table 2: Prioritization Metrics

Metric	Description	Rationale for Inclusion	Input Data Source ¹	Asset Type-Hazard Combinations Applied To					
				Other Metadata: Field Name, Type, Scaling	Roadways	Bridges	Airports	Transit Stops	Light Rail Lines
Recurring damage classification	A classification of if the asset has experienced damage and/or been closed or operated at reduced capacity due to extreme weather events in the past 20-years. Values are provided as 1 or 0 for each asset. A 1 represents that the asset has been damaged by extreme weather events in the past and 0 represents no known asset damages from extreme weather.	Assets that have experienced more issues in the past are likely to experience more issues in the future as climate changes and should be prioritized.	N/A; this data source was unavailable, but it is included in the methodology to make it easier to include in the future	scale_rec_dmg (field name) categorical (field type) scaling: {1(raw value):100 (scaled valued),nan:0} (note: nan indicates null values) unscaled units: binary flag	SLR, Surge, Wildfire	SLR, Surge, Riverine Flooding	SLR, Surge, Extreme Temp.	SLR, Surge, Wildfire, Extreme Temp.	SLR, Surge
Lowest impactful sea level rise (SLR) increment	The lowest Delta SLR increment (0 Ft., 0.8 ft., 1.6 ft., 2.5 ft., 3.3 ft., 4.1 ft., 4.9 ft., 5.7 ft., or 6.6 ft.) that impacts the asset.	Assets that are impacted by lower SLR increments will be impacted first (regardless of SLR scenario) and should be prioritized.	*Climate Central SLR projections	scale_slr_increment categorical scaling:{nan:0,0:100,25:90,50:85,75:75,100:70,125:65,150:60,175:55,200:50,500:25} unscaled units: cm	SLR	SLR	SLR	SLR	SLR

¹ For items marked with "*" in this column: the full citation is included in the exposure map geodatabase.

Metric	Description	Rationale for Inclusion	Input Data Source ¹	Asset Type-Hazard Combinations Applied To					
				Other Metadata: Field Name, Type, Scaling	Roadways	Bridges	Airports	Transit Stops	Light Rail Lines
Percent of segment exposed to 6.6 ft. of SLR	The proportion of the total road or light rail segment length exposed to 6.6 ft. of Delta SLR.	Segments of road that have a greater proportion of their length affected by SLR should be prioritized. 6.6 ft. is used because, of the increments available from Climate Central, it is towards the upper end of the plausible SLR range this century. ²	*Climate Central SLR projections	scale_slrmax_per continuous no scaling unscaled units: %	SLR				SLR
Lowest disconnected impactful sea level rise (SLR) increment	The lowest disconnected Delta SLR increment (0 Ft., 0.8 ft., 1.6 ft., 2.5 ft., 3.3 ft., 4.1 ft., 4.9 ft., 5.7 ft., or 6.6 ft.) that impacts the asset.	Same as Lowest impactful SLR Increment metric. Disconnected areas are important to consider in the Delta, where levees and other barriers that provide flood protection could be vulnerable.	*Climate Central SLR projections	scale_slrd_increment categorical scaling: {nan:0,0:100,25:90,50:85,75:75,100:70,125:65,150:60,175:55,200:50,500:25} unscaled units: cm	SLR	SLR	SLR	SLR	SLR
Percent of segment exposed to 6.6 ft. of disconnected SLR	The proportion of the total road or light rail segment length exposed to 6.6 ft. of disconnected Delta SLR.	Same as Percent of Segment Exposed to 6.6 ft. of SLR metric. Disconnected areas are important to consider in the Delta, where levees and barriers that provide flood protection could be vulnerable.	*Climate Central SLR projections	scale_slrdis_max_per continuous no scaling unscaled units: %	SLR				SLR

² See the high emissions scenario, 1-in-200 chance sea level rise projection for San Francisco at year 2100.
http://www.opc.ca.gov/webmaster/ftp/pdf/agenda_items/20180314/Item3_Exhibit-A OPC SLR Guidance-rd3.pdf

Metric	Description	Rationale for Inclusion	Input Data Source ¹	Asset Type-Hazard Combinations Applied To					
				Other Metadata: Field Name, Type, Scaling	Road-ways	Bridges	Airports	Transit Stops	Light Rail Lines
Lowest impactful SLR increment with 100-year storm surge	The lowest Delta SLR increment (0 ft., 1.6 ft., 3.3 ft., or 4.6 ft.) that impacts the asset during a 100-year storm surge.	Assets that are impacted by storm surge at lower SLR increments will be impacted first (regardless of SLR scenario) and should be prioritized.	*Radke et al., 3Di model, <i>California Energy</i> Commission's Climate Change Center	scale_surge_increment categorical scaling: {nan:0,0:100,50:80,100:60,141:40} unscaled units: cm	Surge	Surge	Surge	Surge	Surge
Percent of segment exposed to a 100-year storm with 4.6 ft. of SLR	The proportion of the total road or rail segment length exposed to a 100-year storm with 4.6 ft. of Delta SLR.	Segments of road that have a greater proportion of their length affected by storm surge should be prioritized. 4.6 ft. of SLR is used because it the highest available increment from Radke et al., it is towards the upper end of the plausible SLR range this century. ³	*Radke et al., 3Di model, <i>California Energy</i> Commission's Climate Change Center	scale_surgemax_per continuous no scaling unscaled units: %	Surge				

³ See the high emissions scenario, 1-in-200 chance sea level rise projection for San Francisco for the year 2080.
[http://www.opc.ca.gov/webmaster/ftp/pdf/agenda_items/20180314/Item3 Exhibit-A OPC SLR Guidance-rd3.pdf](http://www.opc.ca.gov/webmaster/ftp/pdf/agenda_items/20180314/Item3%20Exhibit-A%20OPC%20SLR%20Guidance-rd3.pdf)

Metric	Description	Rationale for Inclusion	Input Data Source ¹	Asset Type-Hazard Combinations Applied To					
				Other Metadata: Field Name, Type, Scaling	Roadways	Bridges	Airports	Transit Stops	Light Rail Lines
Initial timeframe for elevated level of concern for wildfire	The first timeframe (2010-2039, 2040-2069, 2070-2099, or never), under either representative concentration pathway (RCP) 4.5 or 8.5, during which the asset is exposed to a moderate or higher level of concern for wildfire.	Assets that are more likely to be impacted by wildfire sooner should be prioritized.	*Wildfire Model Composite based on wildfire projections from three models: 1) MC2 –EPA Climate Impacts Risk Assessment, developed by John Kim, USFS; 2) MC2 – Applied Climate Science Lab at the University of Idaho, developed by Dominique Bachelet, University of Idaho; and 3) University of California Merced model, developed by Leroy Westerling, UC Merced.	scale_time_elev_burn categorical scaling: {3:100,2:75,1:50} unscaled units: timeframe priority sequence {2010:3,2040:2,2070:1}	Wildfire			Wildfire	

Metric	Description	Rationale for Inclusion	Input Data Source ¹	Asset Type-Hazard Combinations Applied To					
				Other Metadata: Field Name, Type, Scaling	Roadways	Bridges	Airports	Transit Stops	Light Rail Lines
Highest projected wildfire level of concern	The highest level of concern for wildfire (low, moderate, high, or very high) that an asset is exposed to through 2100 under either RCP 4.5 or 8.5.	Assets that have a greater likelihood of experiencing wildfire should be prioritized.	* Wildfire Model Composite based on wildfire projections from three models: 1) MC2 –EPA Climate Impacts Risk Assessment, developed by John Kim, USFS; 2) MC2 – Applied Climate Science Lab at the University of Idaho, developed by Dominique Bachelet, University of Idaho; and 3) University of California Merced model, developed by Leroy Westerling, UC Merced.	scale_cat_burn categorical scaling: {4:100,3:75,2:50,1:25} unscaled units: level of concern (ranging from "very high":4 to "low":1)	Wildfire			Wildfire	
Maximum change in 100-year precipitation depth for the 2010-2039 timeframe x Watershed area	The highest change in 24-hour duration, 100-year precipitation for the drainage basin of the asset in the 2010-2039 timeframe across Global Climate Models (GCMs) and RCPs. This is then multiplied by the drainage basin area.	Assets that have relatively higher precipitation increases in the near-term and larger watersheds should be prioritized (higher precipitation and larger watersheds can both cause heavier riverine flows)	* Processed from comb. of NOAA Atlas 14 and Scripps. USGS Stream Stats used for watershed geometry	scale_riv_area_t1max continuous scaling: log min-max normalization (natural log of max value: 100, ..., natural log of min value: 0) unscaled units: inches per day x square miles		Riverine flooding			

Metric	Description	Rationale for Inclusion	Input Data Source ¹	Asset Type-Hazard Combinations Applied To					
				Other Metadata: Field Name, Type, Scaling	Roadways	Bridges	Airports	Transit Stops	Light Rail Lines
Maximum change in 100-year precipitation x Watershed area	The highest change in 24-hour duration, 100-year precipitation for the drainage basin of the asset across timeframes, GCMs and RCPs. This is then multiplied by the drainage basin area.	Assets that have relatively higher precipitation increases over their lifetimes and larger watersheds should be prioritized (higher precipitation and larger watersheds can both cause heavier riverine flows)	*Processed from comb. of NOAA Atlas 14 and Scripps. USGS Stream Stats used for watershed geometry	scale_riv_area_max continuous scaling: log min-max normalization (natural log of max value: 100,...,natural log of min value: 0) unscaled units: inches per day x square miles		Riverine flooding			
Maximum change in 7-day maximum temperature	The highest change for extreme temperature across timeframes, GCMs, and RCPs. The change in 7-day maximum temperature is a metric used to choose pavement binder grade.	Airports that have relatively higher extreme temperature increases over their lifetimes should be prioritized because change in maximum 7-day temperature could affect pavement life. Higher extreme temperatures may also affect aircraft performance/airport operations if temperatures get hot enough. Many planes have maximum operating temperatures. ⁴	*Comb. of Scripps and Caltrans Climate Change V.A.	scale_mx7day_temp continuous scaling: min-max normalization (max value: 100,...,min value: 0) unscaled units: °F			Extreme Temp		

⁴ For example, over 40 flights were canceled during a heat wave in Phoenix, AZ in 2017. <https://www.npr.org/sections/thetwo-way/2017/06/20/533662790/its-too-hot-for-some-planes-to-fly-in-phoenix>

Metric	Description	Rationale for Inclusion	Input Data Source ¹	Asset Type-Hazard Combinations Applied To					
				Other Metadata: Field Name, Type, Scaling	Roadways	Bridges	Airports	Transit Stops	Light Rail Lines
Highest Annual Number of Heat Health Events in 2011-2030 timeframe	The projected number of Heat Health Events (heat events that generate public health impacts) in the 2011-2030 timeframe across GCMs, and emissions scenarios.	Assets where users are exposed to heat health events in the near term should be prioritized.	California Heat Assmt. Tool	scale_hhe_p1mx continuous scaling: min-max normalization (max value: 100, min value: 0) unscaled units: # events				Extreme Temp.	
Highest Annual Number of Heat Health Events	The projected number of Heat Health Events (heat events that generate public health impacts) across timeframes and GCMs and emissions scenarios.	Assets where users are exposed to heat health events in the asset lifetime should be prioritized.	California Heat Assmt. Tool	scale_hhe_mx continuous scaling: min-max normalization (max value: 100, min value: 0) unscaled units: # events				Extreme Temp.	
Bridge substructure condition rating	The National Bridge Inventory (NBI) substructure condition rating assigned to the bridge. Possible values range from 9 to 2 with lower values indicating poorer condition. Culverts (code value N, not applicable) are not included nor are bridges closed to traffic (code values 0 and 1).	Poor bridge substructure condition can contribute to failure during extreme weather events. Thus, bridges with poor substructure condition should be prioritized.	National Bridge Inventory (NBI) (Item 60)	scale_Bsubstruct_cond categorical scaling: {'9':0,'8':10,'7':30,'6':50,'5':60,'4':70,'3':80,'2':90,'1':100,'0':100,'N':0,nan:50} unscaled units: see NBI coding guide ⁵		Surge, Riverine Flooding			

⁵ See NBI coding guide for more information: <https://www.fhwa.dot.gov/bridge/mtguide.pdf>

Metric	Description	Rationale for Inclusion	Input Data Source ¹	Asset Type-Hazard Combinations Applied To					
				Other Metadata: Field Name, Type, Scaling	Roadways	Bridges	Airports	Transit Stops	Light Rail Lines
Channel and channel protection condition rating	The NBI channel and channel protection condition rating assigned to the asset. Possible values range from 9 to 2 with lower values indicating poorer condition. Assets with code values N (not applicable because not over water) are not included nor are assets closed to traffic (code values 0 and 1).	Poor channel or channel protection conditions can contribute to failure during extreme weather events. Thus, assets with poor channel or channel protection conditions should be prioritized.	NBI (Item 61)	scale_Bchannel_cond categorical scaling: {'9':0,'8':15,'7':30,'6':45,'5':60,'4':75,'3':90,'2':100,'1':100,'0':100,'N':0,nan:50} unscaled units: see NBI coding guide		Riverine Flooding			

Metric	Description	Rationale for Inclusion	Input Data Source ¹	Asset Type-Hazard Combinations Applied To					
				Other Metadata: Field Name, Type, Scaling	Roadways	Bridges	Airports	Transit Stops	Light Rail Lines
Scour rating	The NBI scour critical bridge rating assigned to the bridge. Possible values range from 8 to 2 with lower values indicating greater scour concern. Bridges coded N (not over waterway), U (unknown foundation), T (over tidal waters with minimal concern), or 9 (bridge foundations on dry land) will be assigned a value of 6, a moderate value assigned to bridges where no scour analysis has been performed. This reflects the possibility that higher flood levels could cause scour at these facilities which heretofore had not been studied for scour because of a belief that flooding wouldn't affect them.	Excessive scour of bridge foundations makes bridges more prone to failure during extreme weather events. Thus, bridges with a high amount of scour should be prioritized.	NBI (Item 113)			SLR, Surge, Riverine Flooding			

Metric	Description	Rationale for Inclusion	Input Data Source ¹	Asset Type-Hazard Combinations Applied To					
				Other Metadata: Field Name, Type, Scaling	Roadways	Bridges	Airports	Transit Stops	Light Rail Lines
Bridge waterflow capacity	NBI Item 71 on Waterway Adequacy to approximate waterflow capacity under the bridge. Values range from 9 to 2 with lower values indicating smaller capacity.	Bridges with lower waterflow capacity should be prioritized.	NBI (Item 71)			SLR, Surge, Riverine Flooding			
Link Volume	For roadways, this is the SACSIM 2036 roadway volume. For transit stops, this is the SACSIM 2036 boardings and alightings. For light rail, this is the SACOG volumes provided with the light rail shapefile. For bridges, this is the NBI future ADT and future ADT years used to adjust the future volumes to a common year of 2036 across the assets.	The consequences of weather-related failures/disruptions (from either extreme events or more frequent maintenance needs) are greater for assets that convey a higher volume of traffic. Thus, assets associated with higher volumes should be prioritized.	SACOG SACSIM travel model for roadways, transit stops, and light rail. NBI (Items 114 and 115) for bridges.	scale_fac_vol continuous scaling: min-max normalization (max value: 100, ..., min value: 0) unscaled units: volume (differs by mode; see Description column for details)	SLR, Surge, Wildfire	SLR, Surge, Riverine Flooding		SLR, Surge, Wildfire, Extreme Temp.	SLR, Surge
Airport Class	The airport class code associated with the asset. Values range from 1 to 5, with 1 representing the most intensive uses.	Airports with more intensive uses (e.g., primary hubs) should be prioritized as an extreme weather disruption to such hubs would impact a higher proportion of overall travel.	Caltrans Public Use Airports shapefile	scale_airport_class categorical scaling: {1:100,2:75,3:50,4:25,5:0} unscaled units: Caltrans airport CLASSCODE			SLR, Surge, Extreme Temp.		

Metric	Description	Rationale for Inclusion	Input Data Source ¹	Asset Type-Hazard Combinations Applied To					
				Other Metadata: Field Name, Type, Scaling	Roadways	Bridges	Airports	Transit Stops	Light Rail Lines
NBI Bypass, Detour Length	The NBI Bypass, Detour Length (XXX kilometers) assigned to the bridge. It represents the total additional travel for a vehicle which would result from a closing of the bridge. Values range from 000 up to a maximum of 199 kilometers.	The greater the detour length around the asset (should it need to be closed due to an extreme weather event) the lower the network redundancy. Assets with low network redundancy should be prioritized.	NBI (Item 19)	scale_Bdetour continuous scaling: min-max normalization (max value: 100, min value: 0) unscaled units: kilometers		SLR, Surge, Riverine Flooding			
Nodal density (density of centerline network nodes within 0.5 miles)	The density of roadway network intersections (i.e., nodes) within a 0.5-mile buffer of the asset. Units are nodes per square mile. Buffers are clipped to the SACOG region.	Nodal density is a proxy for network redundancy. Assets with low network redundancy should be prioritized because they are more critical to the transportation network. If these assets were damaged or disrupted, travelers would need to take longer detour routes and/or travel further to reach a different transit stop.	SACOG Regional Centerline Roadway network	scale_node_dens continuous scaling: percentile ranking (min value: 100, max value: 0) unscaled units: # nodes within .5 miles	SLR, Surge, Wildfire			SLR, Surge, Wildfire, Extreme Temp	

Metric	Description	Rationale for Inclusion	Input Data Source ¹	Asset Type-Hazard Combinations Applied To					
				Other Metadata: Field Name, Type, Scaling	Road-ways	Bridges	Airports	Transit Stops	Light Rail Lines
Dwelling and employment density	The Metropolitan Transportation Plan (MTP)/ Sustainable Communities Strategy (SCS) dwelling and employment density within a quarter mile buffer of the asset, aggregated by area weighted mean (AWM).	Assets in areas of higher dwelling and employment density should be prioritized because they are more critical to the transportation network. These assets are used by more people to travel to/from their homes and employment than assets in lower dwelling and employment areas.	SACOG MTP/SCS	scale_popemp_dens continuous scaling: min-max normalization (max value: 100, min value: 0) unscaled units: dwellings plus employment density AWM within 0.25 mile	SLR, Surge, Wildfire	SLR, Surge, Riverine Flooding		SLR, Surge, Wildfire, Extreme Temp	SLR, Surge
Asset within SACOG Low Income High Minority Community	Whether an asset at least partially overlaps a SACOG Low Income High Minority Area, as defined in the Equity and Choice chapter of SACOG's 2016 MTP/SCS. This metric is binary, with 1 indicating an overlap and 0 indicating no overlap.	Disadvantaged communities tend to be more vulnerable to weather-related events, and assets serving these communities should be prioritized. This is a SACOG indicator of disadvantaged communities.	SACOG	scale_In_LI_HM categorical scaling: {1:100,nan:0} unscaled units: binary flag	SLR, Surge, Wildfire	SLR, Surge, Riverine Flooding		SLR, Surge, Wildfire, Extreme Temp.	SLR, Surge
CalEnviroScreen Percentile Score	The percentile CalEnviroScreen score density within a quarter mile buffer of the asset, aggregated by area weighted mean. Values range from 0 to 100, with the most disadvantaged communities receiving larger scores.	Disadvantaged communities tend to be more vulnerable to weather-related events, and assets serving these communities should be prioritized. This is a State indicator of disadvantaged communities.	California OEHA	Scale_CES_awm continuous no scaling unscaled units: % AWM within 0.25 miles	SLR, Surge, Wildfire	SLR, Surge, Riverine Flooding		SLR, Surge, Wildfire, Extreme Temp.	SLR, Surge

Metric	Description	Rationale for Inclusion	Input Data Source ¹	Asset Type-Hazard Combinations Applied To					
				Other Metadata: Field Name, Type, Scaling	Roadways	Bridges	Airports	Transit Stops	Light Rail Lines
Percent of Households with No Vehicle	The percent of households with no vehicle within a quarter mile buffer of the asset, aggregated by area weighted mean.	Assets serving communities with high proportion of individuals without vehicle access should be prioritized because these people will be more disadvantaged in terms of transportation opportunities. Many may be transit dependent and would be significantly affected by disruptions to their transit stop/route.	American Community Survey	scale_ noveh_awm continuous no scaling unscaled units: % AWM within 0.25 miles	SLR, Surge, Wildfire	SLR, Surge, Riverine Flooding		SLR, Surge, Wildfire, Extreme Temp.	SLR, Surge

Asset Prioritization Scoring

Once the metrics were placed on a common scale, weights were assigned based on the relative importance of each metric to the overall risk. Table 3 shows the weights for each metric. After the weights were assigned, they were multiplied by the scaled scores. These products were then summed for each asset type-hazard combination (i.e. each column in Table 3). Then, a final re-scaling of the results was done to ensure that the final scores were all on a 0-to-100 scale for each asset. Larger numbers on the scale (i.e., closer to 100) represent higher priority (more vulnerable) assets.

After these scaled scores were developed, they were categorized into ten equal intervals, so that categories with scores 90-100 were assigned a 10, scores 80-90 were assigned a 9, and so on. This classification of results helped remove some of the potentially confusing and misleading precision of the numeric scores.

The final product of this approach is a prioritized listing of assets with a separate ranking for each asset type-hazard combination. For example, all bridges are prioritized based on their vulnerability to riverine flooding. Likewise, there are separate prioritized lists for bridges vulnerable to sea level rise and to storm surge.

As described in other portions of this section, the indicator-based prioritization is a helpful tool given the number of different assets, hazard types, and information sources needed to assess relative vulnerability. But it should not be mistaken as a complete understanding of risks facing those assets. It's a tool for system-level analysis that needs to be accompanied with professional judgement and on-the-ground context. It is useful in that it can prioritize areas of concern at a system-wide scale and can help identify at-risk assets that should be examined individually at a facility-level.

Criticality and Hazard & Sensitivity Scoring

In addition to the overall asset prioritization, asset criticality scores were developed. These scores are like the asset priority scores for the different hazards, but they only include metrics related to asset criticality (e.g., link volume, CalEnviroScreen rating). The scores are intended to convey a sense of relative importance of different assets, compared to other assets of the same type across the transportation network. Table 4 shows the metric weights for each asset criticality score. The next section discusses options for further investigating network criticality.

Furthermore, for each asset type-hazard combination, hazard & sensitivity scores were developed. The hazard & sensitivity scores are developed from the metrics that relate to future climate hazards the metrics that define an asset's existing condition, which could affect its susceptibility to climate change. These hazard-specific scores complement the criticality scores and include the metrics relating to exposure and sensitivity for asset type-hazard combination (i.e., all the non-criticality scores). They are scored together because they demonstrate an asset's relative likelihood of being affected by future climate change. By examining these scores alone, SACOG can understand which assets are most likely to be affected by climate change. When combined with the criticality scores, SACOG can understand which assets have higher risk from climate change.

Table 3: Proposed Metric Weights

	Delta Sea Level Rise				
	Roadways	Airports	Bridges	Transit Stops	Light Rail Line
Hazards					
Recurring damage classification	15%	15%	15%	15%	15%
Lowest impactful sea level rise (SLR) increment	20%	40%	25%	40%	20%
Percent of segment exposed to 6.6 ft. of SLR	20%	--	--	--	20%
Lowest disconnected impactful sea level rise increment	5%	10%	5%	5%	5%
Percent of segment exposed to 6.6 ft. of disconnected SLR	5%	--	--	--	5%
Consequences - Sensitivity					
Bridge capacity	--	--	20%	--	--
Consequences - Criticality					
Link Volume	20%	--	20%	20.0%	25%
Airport class	--	35%	--	--	--
NBI Bypass, Detour Length	--	--	5%	--	--
Nodal density (density of centerline network nodes within 0.5 miles)	5%	--	--	2.5%	--
MTP/SCS dwelling and employment density (AWM within 0.25 miles)	2.5%	--	2.5%	2.5%	2.5%
Asset within SACOG Low Income High Minority community	2.5%	--	2.5%	2.5%	2.5%
CalEnviroScreen Score (AWM within 0.25 miles)	2.5%	--	2.5%	2.5%	2.5%
Percent of Households with No Vehicle (AWM within 0.25 miles)	2.5%	--	2.5%	5.0%	2.5%
Total	100%	100%	100%	100%	100%

	Delta Surge				
	Roadways	Airports	Bridges	Transit Stops	Light Rail Line
Hazards					
Recurring damage classification	15%	15%	10%	15%	15%
Lowest impactful increment of SLR/storm surge	25%	50%	40%	50%	25%
Percent of road segment exposed to 4.6 feet of surge	25%	--	--	--	25%
Consequences - Sensitivity					
Bridge substructure condition rating	--	--	3%	--	--
Scour rating	--	--	5%	--	--
Bridge capacity	--	--	20%	--	--
Consequences - Criticality					
Link Volume	20%	--	10%	20%	25%
Airport class	--	35%	--	--	--
NBI Bypass, Detour Length	--	--	5%	--	--
Nodal density (density of centerline network nodes within 0.5 miles)	5%	--	--	2.5%	--
MTP/SCS dwelling and employment density (AWM within 0.25 miles)	2.5%	--	1%	2.5%	2.5%
Asset within SACOG Low Income High Minority community	2.5%	--	2.5%	2.5%	2.5%
CalEnviroScreen Score (AWM within 0.25 miles)	2.5%	--	2.5%	2.5%	2.5%
Percent of Households with No Vehicle (AWM within 0.25 miles)	2.5%	--	1%	5.0%	2.5%
Total	100%	100%	100%	100%	100%

	Wildfire	
	Roadways	Transit Stops
Hazards		
Recurring damage classification	15%	15%
Initial timeframe for elevated level of concern for wildfire	25%	25%
Highest projected wildfire level of concern	25%	25%
Consequences - Criticality		
Link Volume	20%	20%
Nodal density (density of centerline network nodes within 0.5 miles)	5%	2.5%
MTP/SCS dwelling and employment density (AWM within 0.25 miles)	2.5%	2.5%
Asset within SACOG Low Income High Minority community	2.5%	2.5%
CalEnviroScreen Score (AWM within 0.25 miles)	2.5%	2.5%
Percent of Households with No Vehicle (AWM within 0.25 miles)	2.5%	5%
Total	100%	100%

	Riverine Flooding Bridges
Hazards	
Recurring damage classification	10%
Maximum change in 100-year precipitation for the 2010-2039 timeframe	15%
Maximum change in 100-year precipitation	15%
Consequences - Sensitivity	
Bridge substructure condition rating	2.5%
Channel and channel protection condition rating	2.5%
Scour rating	5%
Bridge capacity	30%
Consequences - Criticality	
Link Volume	10%
NBI Bypass, Detour Length	5%
MTP/SCS dwelling and employment density (AWM within 0.25 miles)	1%
Asset within SACOG Low Income High Minority community	2%
CalEnviroScreen Score (AWM within 0.25 miles)	1%
Percent of Households with No Vehicle (AWM within 0.25 miles)	1%
Total	100%

	Extreme Temp	
	Transit Stops	Airports
Hazards		
Recurring damage classification	15%	15%
Maximum change in 7-day maximum temperature	--	50%
Highest Annual Number of Heat Health Events in 2011-2030 timeframe	25%	--
Highest Annual Number of Heat Health Events	25%	--
Consequences - Criticality		
Link Volume	20%	--
Airport class	--	35%
Nodal density (density of centerline network nodes within 0.5 miles)	2.5%	--
MTP/SCS dwelling and employment density (AWM within 0.25 miles)	2.5%	--
Asset within SACOG Low Income High Minority community	2.5%	--
CalEnviroScreen Score (AWM within 0.25 miles)	2.5%	--
Percent of Households with No Vehicle (AWM within 0.25 miles)	5%	--
Total	100%	100%

Table 4: Criticality Score Weights

	Criticality				
	Roadways	Airports	Bridges	Transit Stops	Light Rail Line
Link Volume	60%	--	60%	60%	75%
Airport class	--	100%	--	--	--
NBI Bypass, Detour Length	--	--	15%	--	--
Nodal density (density of centerline network nodes within 0.5 miles)	15%	--	--	15%	--
MTP/SCS dwelling and employment density (AWM within 0.25 miles)	10%	--	10%	10%	10%
Asset within SACOG Low Income High Minority community	5%	--	5%	5%	5%
CalEnviroScreen Score (AWM within 0.25 miles)	5%	--	5%	5%	5%
Percent of Households with No Vehicle (AWM within 0.25 miles)	5%	--	5%	5%	5%
Total	100%	100%	100%	100%	100%

Approach Conclusion

This indicators-based prioritization is designed to help SACOG understand which portions of its transportation system are most vulnerable to changing climate conditions. The approach is best supplemented with a more qualitative, holistic understanding of the region's transportation system. This information can be combined with other planning priorities (e.g., impacts to disadvantaged communities or effect on regional goods movement,).

The eventual results of the prioritization and the data inputs can be reused for further planning and incorporated into SACOG tools and activities, such as the project performance assessment process and more detailed studies of individual assets. The Further Considerations and Next Steps section of this document suggests additional areas for further investigation.

Analysis Documentation and Replicability

The scoring approach described in the previous section uses and processes many different datasets. This section helps document that process and serves as a reference for replicating the analysis. There are several portions of the analysis. The first is the input data development, which includes the gathering and cleaning of hazard and asset data. The second is the metric development, where this information is combined into the metrics described in the approach section. The final is the scoring, where the metrics are scaled and weighted together to produce scaled scores for each combination of hazard and asset type.

There were several files and folders used to conduct the analysis and contain the results:

- The Approach section of this report documents the raw datasets used and includes important metadata, such as original data sources, scaling methodology, and field names of scaled values.
- The exposure map geodatabase labeled "Task1MapData.gdb". This geodatabase includes most of the climate-related input data (see the appendix for maps with these projections). The geodatabase contains metadata with detailed source information for these inputs.
- The vulnerability and criticality geodatabase labeled "SACOG_VulnerabilityCriticality_Task2_20190730.gdb," which contains the following datasets and results.
 - The "asset_results" feature dataset in the geodatabase contains the asset feature classes with the results. The fields include:
 - The final tiered scores, which are provided in 10 equal interval tiers, with 10 corresponding with more vulnerable assets and 1 corresponding with less vulnerable assets. These fields are named "final_score_", followed by a hazard type abbreviation, followed by an asset type abbreviation.⁶ For example, "final_score_slr_brid" in the bridge feature class contains the final scores for sea level rise threats to bridges.
 - The scaled overall scores for each asset type-hazard combination, which range from 0 to 100, with 100 corresponding with more vulnerable assets and 0 corresponding with less vulnerable assets. These fields are named "scalescore_", followed by a hazard type abbreviation, followed by an asset type abbreviation.
 - The scaled hazard & sensitivity scores for each asset type-hazard combination, which range from 0 to 100, with 100 corresponding with more exposed and sensitive assets and 0 corresponding with less exposed and sensitive assets. These include only the exposure and sensitivity metrics for each score, but not the criticality metrics. These fields are named "scalevulnsens_score_", followed by a hazard type abbreviation, followed by an asset type abbreviation.
 - The scaled metrics scores that are weighted together into the scaled overall scores. The Approach section of this white paper documents all of these field

⁶ In these fields and others in this geodatabase, hazard abbreviations are {Sea Level Rise: "SLR", Storm Surge: "surge", Wildfire: "fire", Extreme Temperature: "temp", Riverine Flooding: "riv", Criticality: "crit"}. The asset abbreviations are {Roadways: "road", Bridges: "brid", Airports: "air", Light Rail: "lrail"}.

names and definitions.

- Unscaled metrics values. The Metric Weights Template file (see below) contains a list of all the unscaled metric field names and their corresponding scaled metric field names.
 - Other fields that were included in the original asset files, such as asset name, location, and description. There are also a few other intermediary fields created during the metric development.
- The "intermediary_feature_classes" feature dataset contains many of the feature classes that fed into metrics. The separate exposure map geodatabase includes other feature classes used in metric development. The riverine flooding and wildfire metrics draw on the projections in the exposure map geodatabase but were assembled outside of this script using a process similar to the one developed for the Caltrans Climate Action Report project. The condition metrics (e.g., NBI condition ratings) draw on data directly available in the original feature classes.
- Summary sheets and scores spreadsheets are in the "SACOG_VulnerabilityCriticality_Task2_20190730_tables" folder. This includes .csv versions of the results by asset type in the vulnerability and criticality geodatabase. It also includes .csv files with results broken out by asset type-hazard combination.
 - The Metric Development Python script for ArcGIS, titled "sacog_indicator_processing_20190715.py". Most of the metric development occurred with this Python script, which relies heavily on ArcPy, the Python package for running ArcGIS geoprocesses. The script can be viewed in Notepad++ or another source code editor. It is commented with instructions on how to rerun the metric development geoprocesses.
 - Scoring Development Jupyter Notebook for Python, titled "SACOG_asset_scaling_weighting_scoring.ipynb". This Jupyter Notebook runs blocks of Python code.⁷ This notebook was used for the metric scaling, weighting, and final scoring and classification. While ArcGIS offers rich geoprocessing functionality, traditional Python packages such as pandas and numpy are better suited for systematic tabular data manipulation. This notebook is commented and can be rerun in the future. It reads .xls (or other tabular) files exported from ArcGIS. It also reads the Metric Weights Template (see below) for the weighting process.
 - Metric Weights Template, titled "sacog_metric_weights_20190723.csv". This is an input file into the Scoring development Jupyter Notebook. It is a table with rows corresponding to metric names, columns corresponding to asset type-hazard combinations, and values corresponding to the weights used to combine the scaled metrics together for each asset type-hazard score. The weights in that table are the same as those that appear in the Approach section of this white paper. The weights in the Metric Weights Template can be modified if the user wants to rerun the scoring with a different weighting. However, the formatting of the Template should not be modified, as the Notebook may not be able to process the weights properly.
 - Auxiliary data folder, titled "auxiliary_data.". This folder contains the FEMA floodplains developed using historical data and the California Geological Survey's Deep-Seated

⁷ Jupyter Notebook is free and open source and can be downloaded here: <https://jupyter.org/>.

Landslide Susceptibility layer. These were not used in the scoring process.

Together, these can be used to rerun the analysis in the future. This report serves as a high-level reference and many of these files, particularly the Python scripts, contain further documentation on how different pieces of the analysis can be rerun. This should be done with a working geodatabase as described in the Metric Development script.

Policy Guidance

Evaluation of Relevant State and Federal Policies

There are several policies SACOG will consider as it moves forward with selecting pilot projects for more detailed analysis and developing climate adaptation strategies. These policies are in place to ensure that California state agencies and/or regional entities incorporate climate change projections into project planning and investments, and to offer guidance on how those decisions are made. Limited policies exist at the federal level at this time, so these requirements are primarily driven by the State of California. This section provides a summary of key policies that drive adaptation planning and may influence SACOG practices.

Federal Policy

FAST Act

The Fixing America's Surface Transportation (FAST) Act, signed into law in 2015, authorizes funds for highway and transit programs. The Federal Highway Administration (FHWA) notes in their *Vulnerability Assessment and Adaptation Framework* (3rd edition) that "[the FAST act] requires transportation agencies to take resilience into consideration during transportation planning processes. Following passage of the FAST Act, FHWA and the Federal Transit Administration (FTA) updated the metropolitan and statewide transportation planning regulations to reflect these new requirements (23 CFR 450.200 and 23 CFR 450.300) processes" (Federal Highway Administration 2017).

These updates to the planning regulations also added a requirement for Metropolitan Planning Organizations (MPOs) to work with natural disaster and risk mitigation experts when developing their MTPs and transportation improvement programs. They also require that the MPOs consider investments that will reduce transportation infrastructure vulnerability to natural disasters (Section 450.324(f)(7)) (Federal Highway Administration 2017).

SACOG can use the information developed in the Vulnerability and Criticality Assessment to meet these requirements.

State Policy

Executive Order B-30-15

Executive Order (EO) B-30-15 is the keystone climate adaptation policy for the State of California. The EO requires that state agencies consider climate change in all investment-decisions and these considerations need to include (Office of Governor Edmund G. Brown Jr. 2015):

1. Full life cycle cost accounting,
2. Prioritization of adaptation actions that also mitigate greenhouse gas emissions,
3. Prioritization of actions that benefit the state's most vulnerable populations,
4. Prioritization of natural infrastructure solutions,
5. And, the use of flexible approaches where possible.

SACOG can use these requirements of the EO to develop internal adaptation policies that closely align with the state's goals. These considerations can also be used in conjunction with the

criticality indicators outlined above to narrow down pilot project options, and eventually adaptation responses. These requirements and criticality indicators can also potentially be useful in selecting projects for SACOG's flexible funding rounds. For example, SACOG could decide to prioritize further assessment and adaptation for assets that lie in SACOG Low Income High Minority Areas, which meets the EO B-30-15 requirement (#3 above) to prioritize actions that benefit vulnerable populations. This policy, and its associated guidance document: *Planning and Investing for a Resilient California*, may be used to guide SACOG actions so that they align with the state's goals (Governor's Office of Planning and Research 2018). See the Governor's Office of Planning and Research section below for more on this guidance document.

Assembly Bill 2800

Another relevant state policy for SACOG to be aware of in future decision-making is Assembly Bill (AB) 2800. AB 2800 (approved in 2016) requires state agencies to take climate change impacts into account during all infrastructure planning, design, construction, investments, operations and maintenance. The bill also required the formation of a Climate-Safe Infrastructure Working Group made up of engineers and architects with relevant experience in infrastructure and climate change. SACOG can reference the group's final guidance document, *Paving it Forward: The Path Toward Climate-Safe Infrastructure in California*, to guide resilient infrastructure planning and design (Climate-Safe Infrastructure Working Group 2018). See the Climate-Safe Infrastructure Working Group section below for more on this guidance document.

Senate Bill 379

Signed in 2015, Senate Bill (SB) 379 requires that upon the next revision of a Local Hazard Mitigation Plan (LHMP) on or after January 1st, 2017 (or if a local jurisdiction has not yet adopted a plan on or before January 1st, 2022), the safety element of that jurisdiction's General Plan will be reviewed and updated to address climate change adaptation and resiliency strategies applicable to the city or county (California Legislature 2015). Natural infrastructure solutions will be identified for adaptation projects, where possible (California Legislature 2015).

SACOG may identify potential risks through this vulnerability and criticality assessment, and future studies, which could be incorporated into its member's General Plans. SACOG pilot projects and detailed asset-level assessments may also identify adaptation opportunities, which could be detailed in the region's General Plans. This requirement may provide an opening for collaboration between SACOG and its members on future project implementation.

General Plan Guidelines: 2017 Update

Following SB 379, the Governor's Office of Planning and Research updated the state's General Plan Guidelines, which now requires that a new climate change section be added within each General Plan safety chapter, and its inclusion is encouraged in other chapters as well. The safety chapter must address community vulnerabilities, create a set of goals, policies, and objectives for reducing greenhouse gas emissions, and identify a set of feasible implementation measures for greenhouse gas reduction and adaptation strategies. An entire chapter on climate change was added to the guidelines, which also provides guidance on CEQA streamlining and greenhouse gas reduction plans. See Chapter 8 of the Office of Planning and Research's General Plan Guidelines: 2017 Update for more information (Governor's Office of Planning and Research 2017).

The General Plan Guidelines update creates an opportunity for SACOG to collaborate with its members on climate change vulnerability, safety issues, and adaptation strategies. SACOG can share the work completed in this assessment to provide its members with a starting point for

their General Plan updates.

Senate Bill 246

SB 246 created the Office of Planning and Research Integrated Climate Adaptation and Resiliency Program (ICARP), which is responsible for:

1. Coordinating local and regional efforts for climate adaptation and resilience.
2. Assisting the Office of Emergency Services and other relevant state agencies with updating the Adaptation Planning Guide, which provides local support for communities trying to address climate change (California Emergency Management Agency 2012). The plan is especially helpful for local governments who need to meet SB 379 requirements in their General Plans (see above).
3. Conducting regular meetings with an advisory council for technical support, and with regional and local experts working in climate adaptation.
4. Maintaining and updating the [Adaptation Clearinghouse](#), which provides resources, tools, case studies, and climate stories on climate adaptation and resiliency efforts across California (California Legislature 2015).

Through the passage of SB 246, ICARP has become a helpful resource for local and regional adaptation efforts. SACOG and its members can leverage ICARP guidance and tools, such as the Adaptation Planning Guide and Adaptation Clearinghouse, to inform future assessments and adaptation planning. SACOG can also coordinate with ICARP directly to provide advice and expertise, per item #3 above.

Senate Bill 1

SB 1, or the Road Repair and Accountability Act of 2017, was passed by the Legislature to invest \$5.4 billion annually to maintain and rehabilitate roads, freeways, and bridges over the coming decade (Caltrans n.d.). The funds also go to statewide programs such as workforce training programs, bike and pedestrian projects, and transportation-related research at state universities. The funding source is administered by Caltrans and local investments are allocated, in part, through Local Planning Grants: The Sustainable Communities and Adaptation Planning Grants.

- **Sustainable Communities Grants (\$18 to 19 million annually):** Supports regional transportation planning projects that enhance bicycle and pedestrian safety, multimodal transportation, and overall transportation system efficiency. Assists regions with developing and updating Regional Transportation Plans and Sustainable Community Strategies (Caltrans 2018).
- **Adaptation Planning Grants (\$6 to 7 million annually):** Supported regional efforts to prepare the transportation system for the impacts of climate change and extreme weather (Adaptation Clearinghouse 2018).⁸

All applications for Local Planning Grant funding are encouraged to address the needs of disadvantaged and vulnerable communities in their local projects, to provide fair and equitable use of funds.

⁸ The last adaptation planning grants were awarded in 2019.

SACOG and its members have benefited from grant funding through the Sustainable Communities and Adaptation Planning Grant programs, which has provided necessary funding for local projects.

Comparison of Approach with Existing Guidance

The Vulnerability and Criticality Assessment approach outlined above was designed to meet needs specific to SACOG. There is no "one size fits all" approach to assessing the impacts of climate change to the transportation system, and varying agencies, organizations, and regional entities choose different methodologies to assess this risk. That said, there are many useful guidance documents that exist to help drive this process. This section provides a short summary of some of the guidance documents that are relevant to SACOG and how their approaches compare with the approach explained above.

Federal Guidance

Federal Highway Administration

The framework outlined in FHWA's *Vulnerability Assessment and Adaptation Framework* (3rd edition) is generally consistent with the work outlined in this technical approach. FHWA developed this framework to help state Departments of Transportation (DOT), MPOs, and other transportation agencies assess the impacts of extreme weather and climate change to the infrastructure they manage (Federal Highway Administration 2017). At a high-level, the framework outlines the following steps:

1. **Define study scope:** Consider the study objectives and end goals when deciding upon the scope. Select relevant assets, climate stressors, and stakeholders. Where data is available, conduct a criticality assessment to better understand the current status of the region's most important assets.
2. **Gather asset data:** Identify the range of asset data available and work within the bounds of what is accessible. Consider opportunities to collect new data where information does not currently exist.
3. **Gather climate data:** Collect projections through coordination with partners. Use best available, existing resources or develop new data where information is unavailable.
4. **Assess vulnerability:** Vulnerability is a function of the transportation system's exposure to climate stressors, sensitivity to those impacts, and adaptive capacity, or ability to change in response to those impacts. Assess through one of three approaches:
 - a. **Stakeholder Input Approach:** Rely on institutional knowledge to assess vulnerabilities to the system. Hold workshops to discuss asset exposure and weigh the most critical assets and significant risks.
 - b. **Indicator-Based Desk Review Approach:** Score and rank vulnerable transportation assets based upon existing data. Convert rankings to a single score for each asset and climate stressor considered. Can be combined with stakeholder input approach.
 - c. **Engineering Informed Assessments:** Asset-specific analyses that rely on design information to assess impacts and evaluate adaptation options.
5. **Identify, analyze, and prioritize adaptation options:** Study a range of affected assets and begin to consider applicable adaptation options. Consider monetary impacts as well as

those that cannot be quantified (e.g. community benefits). Use economic analyses to evaluate options.

6. **Incorporate assessment results in decisions:** Incorporate results into transportation planning and future projects. Monitor adaptation strategies in place and consider future modifications as necessary.

The SACOG Vulnerability and Criticality Assessment closely follows FHWA's framework. Specifically, the assessment accomplishes steps 1 – 3 above and uses elements of 4a and 4b, as recommended in the FHWA framework. Future SACOG efforts will involve conducting engineering assessments of pilot projects, which will be prioritized based on the findings of this analysis, accomplishing step 4c above. SACOG also intends to evaluate potential adaptation options for these pilot projects, per step 5 above. To date, the assessment SACOG conducted aligns closely with federal guidance and SACOG can use the FHWA framework to guide steps 5 and 6 moving forward.

State Guidance

Caltrans

The indicator approach outlined above parallels the work being done by Caltrans around the state, and eventually in District 3, as part of Caltrans' Climate Action Reports. By using similar data sources and processes, the vulnerability and criticality analysis is inherently synchronized with the work done by Caltrans.

This approach also compliments existing Caltrans guidance on climate change planning for Councils of Government (COGs), such as the *Addressing Climate Change Adaptation in Regional Transportation Plans* report, which was developed as a guide for California MPOs and Regional Transportation Planning Authorities (RTPAs). This guidance outlines two approaches for MPOs and RTPAs to assess climate change impacts to their transportation networks: a basic and advanced approach.

The report provides a high-level framework for assessing climate change risks, then provides more detail on how to integrate adaptation planning into regional transportation plans, for more advanced MPOs. The high-level evaluation approach suggests the MPO "(1) assess potential climate effects in the MPO's region; (2) consider the impacts of climate change on the MPO's five key transportation assets; and (3) develop a short list of adaptation strategies" (Caltrans 2013). The more advanced approach for adaptation planning is provided in Part III of the report, and involves assembling an asset inventory, determining criticality, and assessing vulnerability to key assets. After this assessment process, the MPO would prioritize the most critical and vulnerable assets for adaptation (Caltrans 2013).

The work completed in SACOG's Vulnerability and Criticality Assessment closely aligns with the advanced approach suggested by Caltrans. The SACOG assessment developed an asset inventory, identified criticality scores for each asset, and prioritized the most vulnerable assets through vulnerability scores, which aligns with the advanced approach summarized in Part III of the *Addressing Climate Change Adaptation in Regional Transportation Plans* report.

California Natural Resources Agency

The California Natural Resources Agency leads the development of the Safeguarding California Plan. They coordinate with agency leads from each state sector to understand how

other agencies are assessing and addressing climate change risks. The sectors covered in the plan include:

- Water
- Energy
- Transportation
- Public health
- Agriculture
- Emergency services
- Forestry
- Biodiversity and habitat
- Ocean and coastal resources

The [Safeguarding California Plan: 2018 Update](#) is the most recent update of the document and provides the collective plan for adaptation for each state sector. The adaptation vision outlined in the plan is focused on the following long-term outcomes: 1) all communities are able to respond to changing conditions in a way that minimizes risks to public health, safety, and economic disruption and protects the most vulnerable, 2) natural systems adjust and maintain functionality in the face of climate change, 3) infrastructure and built systems withstand changing conditions and shocks, while continuing to provide essential services, and 4) government managers take climate change adaptation into account in all aspects of their work.

Governor's Office of Planning and Research

EO B-30-15 led to the development of a Technical Advisory Group led by the Governor's Office of Planning and Research, who drafted a guidance document to help state agencies meet the requirements set by the EO. This guidance document, *Planning and Investing for a Resilient California: A Guidebook for State Agencies*, outlined a general process for state agencies to follow to assess and address climate change risks. Generally, this guidebook recommends that state agencies identify how climate change could affect a project or plan, conduct an analysis of climate risks, make a climate-informed decision, and track and monitor progress. The guidebook also provides suggestions related to developing an assessment methodology (in Step 2 of the report) and recommends that climate risk analyses (Governor's Office of Planning and Research 2018):

- Use a large variety of GCMs
- Use multiple emission scenarios if considering impacts after 2050 (use only RCP 8.5 if considering impacts before mid-century)
- Use up-to-date or "best available" information
- Use downscaled data
- Assess sea level rise, relevant
- Consider a worst-case scenario

The SACOG Vulnerability and Criticality Assessment uses data from 10 different downscaled GCMs and a variety of emissions scenarios, regardless of time frame. The assessment applies best available data from Cal-Adapt, state research institutions, and/or other regional datasets –

all of which were developed and released in the last few years. In addition, the analysis considers a worst-case scenario for each climate stressor by evaluating: the highest sea level rise scenarios available, outputs of the most extreme GCMs compounded with high emission scenarios, and by assessing near- and long-term impacts (with longer-term impacts likely being more severe). As such, the SACOG Vulnerability and Criticality Assessment closely follows the state's guidance for agencies.

Climate-Safe Infrastructure Working Group

Paying it Forward outlines ten recommendations for legislators, engineers, architects, scientists, consultants, and other stakeholders to develop climate-ready infrastructure for California:

1. The State Legislature should establish "The Climate-Safe Path for All" as official state policy, which accounts for the full life-cycle cost of infrastructure, uses a multi-sectoral approach, and prioritizes infrastructure investments in the state's most disadvantaged populations.
2. The State Legislature should provide a permanent funding source for the state's Climate Change Assessment process, the [Climate Change Research Program](#), and other tools and assistance agencies need to assess and respond to climate change.
3. The state budget should provide funding to state infrastructure agencies so their engineers and architects can research solutions to climate change.
4. The state budget should improve staff capacity and increase project funding to better address uncertainties inherent in planning for future climate change and the costs associated with those changes.
5. Engage all affected stakeholders in infrastructure planning and decision-making.
6. State agencies should update their infrastructure standards, codes, and guidelines that are dependent upon climate and/or weather data to create more future-oriented designs.
7. The state should help policy-makers and the public understand the additional upfront costs of planning for climate change adaptation and why it is necessary.
8. The Strategic Growth Council should work with the Government Operations Agency, Labor and Workforce Development Agency, and other relevant agencies to create a plan for training the infrastructure delivery workforce on the impacts and science of climate change.
9. The state should establish a standing Climate-Safe Infrastructure Working Group.
10. The state budget should provide full funding to agencies to respond to climate change in infrastructure delivery.

Most of these recommendations apply to the State Legislature or state agencies, and do not directly apply to SACOG. SACOG may be affected by future changes to legislation, policy, or infrastructure standards, codes, and guidelines, that are developed in response to the Climate-Safe Infrastructure Working Group's suggestions.

Moving Forward

The SACOG Vulnerability and Criticality Assessment is consistent with the major federal and state policy goals and guidance released to date, including those that provide specific recommendations for climate change assessment methodologies. Moving forward, SACOG may revisit these policies and documents to ensure that facility-level assessments and adaptation planning continue to align with state and federal guidance.

Vulnerability and Criticality Assessment Results

This section presents detailed results for each combination of asset type and hazard. The accompanying vulnerability and criticality geodatabase and tables contain the full indicator scoring and the metrics that constitute the scores. The Key Vulnerabilities subsection at the start of this report summarizes and contextualizes the detailed results. That information is not repeated in this section. See the appendix for a complete set of vulnerability and criticality tables by asset type, along with a set of maps showing future projections for the climate stressors evaluated in this analysis.

Summarized by Asset Type and Hazard

Navigate to the asset types and hazards of interest to view mapped results and summaries of the top scoring assets across the SACOG region. Navigate to the appendix to see summary tables of the final vulnerability and criticality scores for each asset type.

Criticality: Roadways:

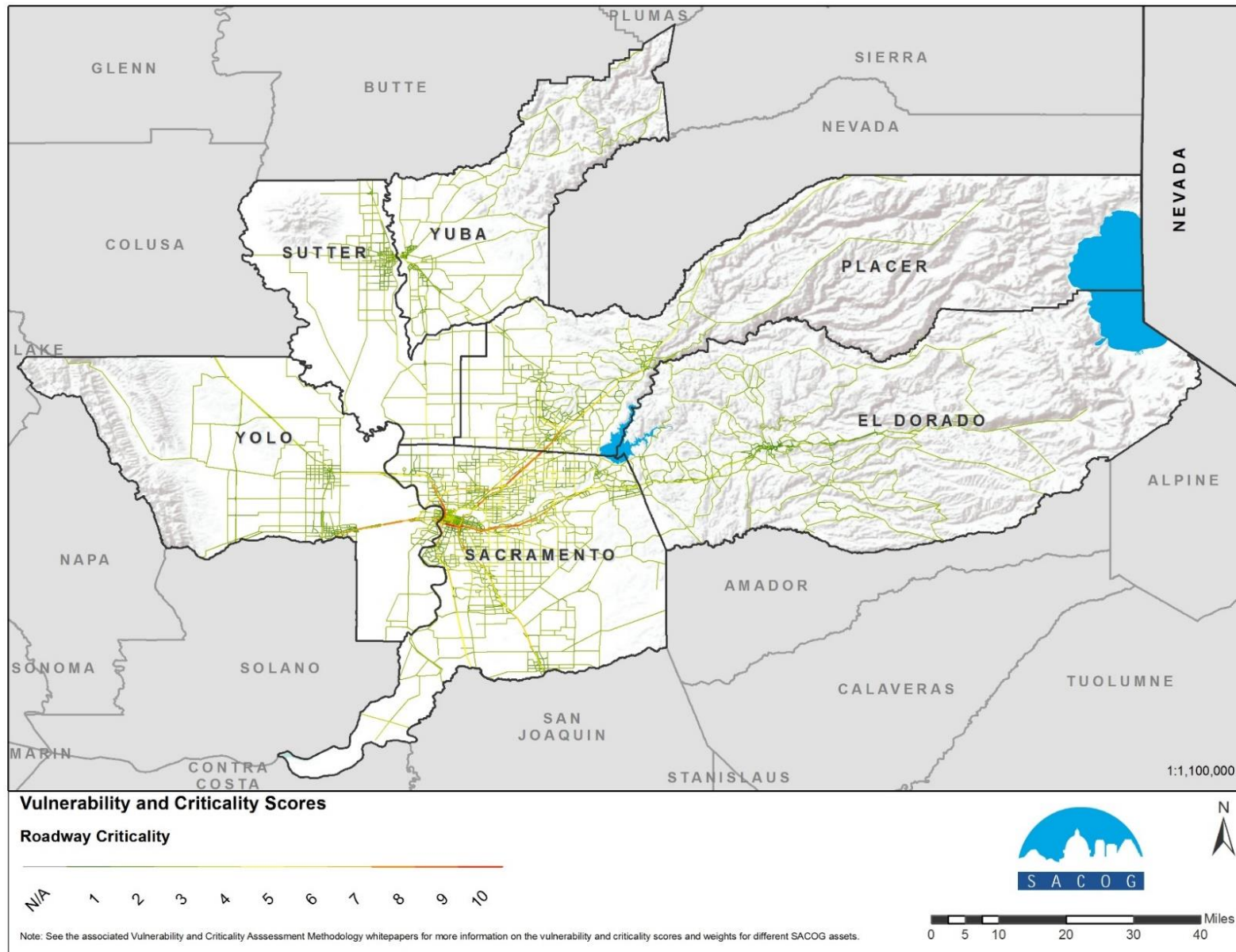


Figure 1: Roadway Criticality Scores

The roadway criticality results are driven heavily by traffic volume and occur in the Greater Sacramento area. According to the scoring, the most critical segments of roadway in the SACOG region are the portions of US-50 just south of downtown Sacramento before the I-80 splits off to the north. This is the most heavily travelled portion of roadway and passes through a high-density urban area. The portions of the I-5 near Sacramento, of the US-50 between Sacramento and Rancho Cordova, and of the I-80 between Sacramento and the Sacramento-Placer county line are also highly critical.

Criticality: Transit

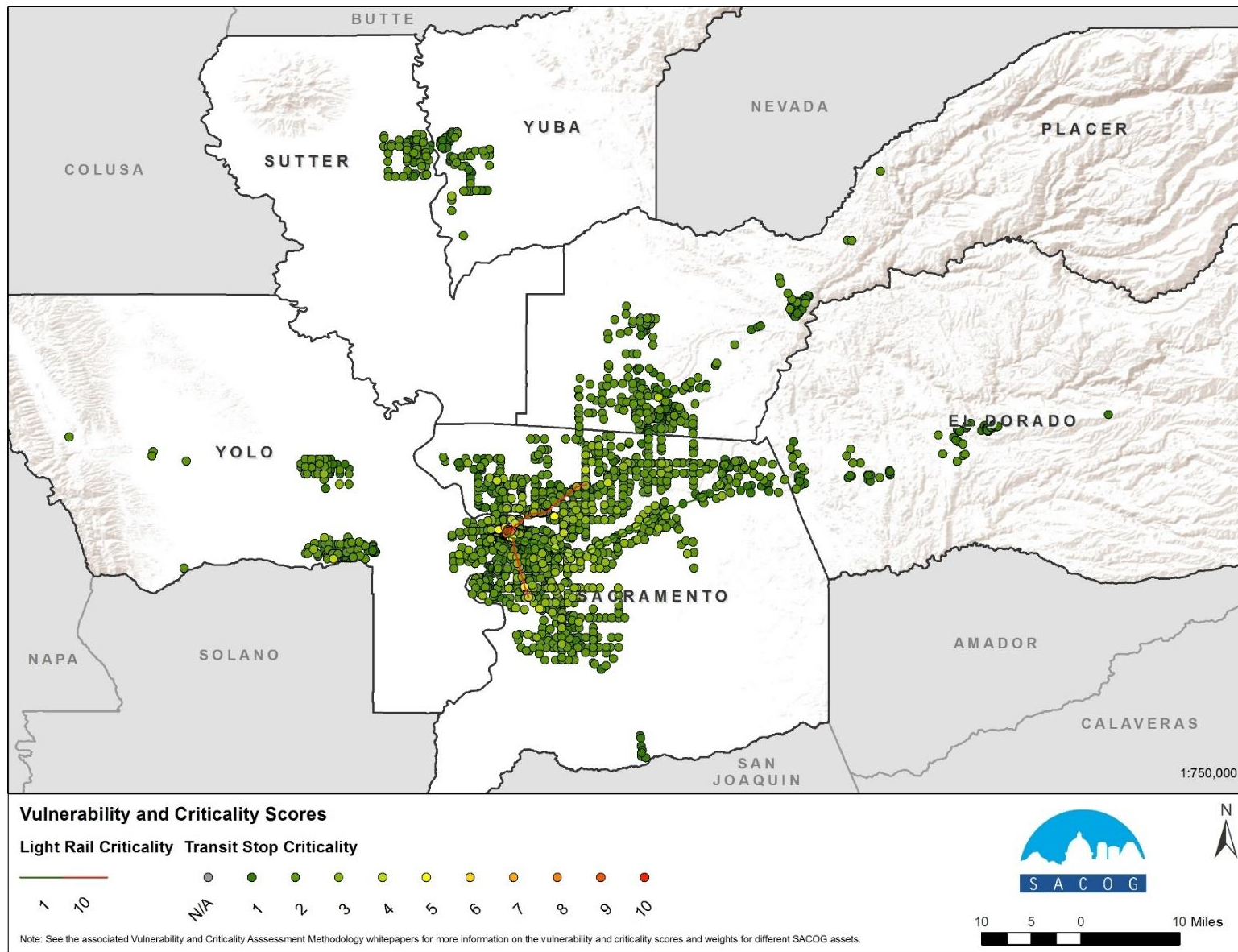


Figure 2: Transit Criticality Scores

The most critical transit stops have substantial ridership and are in dense areas with vulnerable populations. The 8th and K/St Rose Lima Park Light Rail stop (which is depicted as a single stop in the asset feature class) received the highest criticality score, due to its high number of boardings and alightings, high population and employment density, high CalEnviroScreen score, and location in a SACOG-designated Low Income/High Minority area. The next 5 highest scoring transit stops are in that vicinity and are driven primarily by the same factors. Of the highest scoring 6 stops, 4 are light rail and two are bus stations.

There are only three light rail segments, so the utility of the scoring is limited. The Blue Line ranked the most critical given its higher ridership count.

Criticality: Bridges

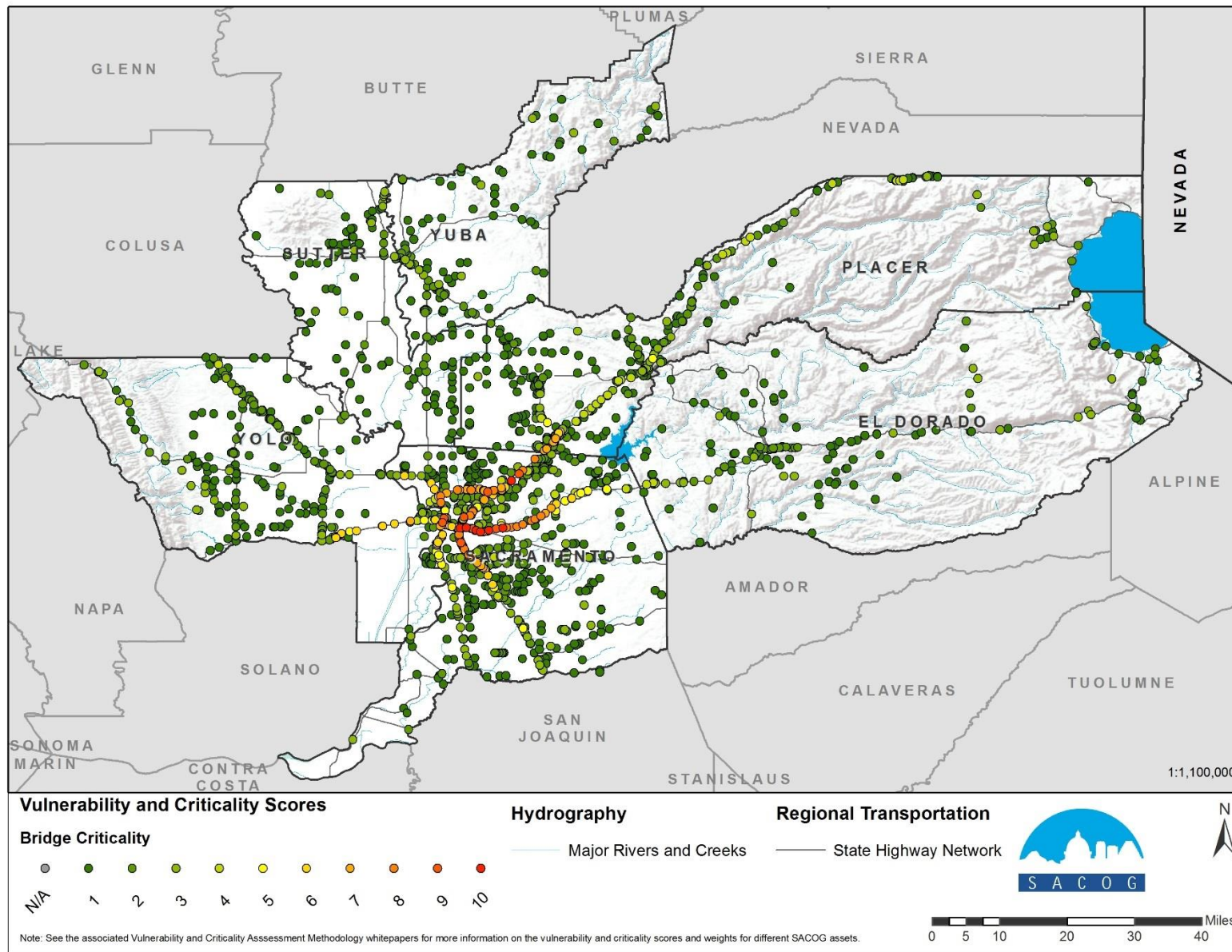


Figure 3: Bridge Criticality Scores

The criticality scores for bridges follow a similar pattern as the criticality scores for roadways. The scores are driven heavily by travel volume. The highest scores are for a handful of bridges along the US-50 between SR-99 and Watt Avenue, and one at I-80 at Madison Avenue in North Highlands. The next highest scoring bridges are also in the greater Sacramento area, and all are located on major roadways: I-80, I-5, US-50, SR-51, and SR-99.

Criticality: Airports

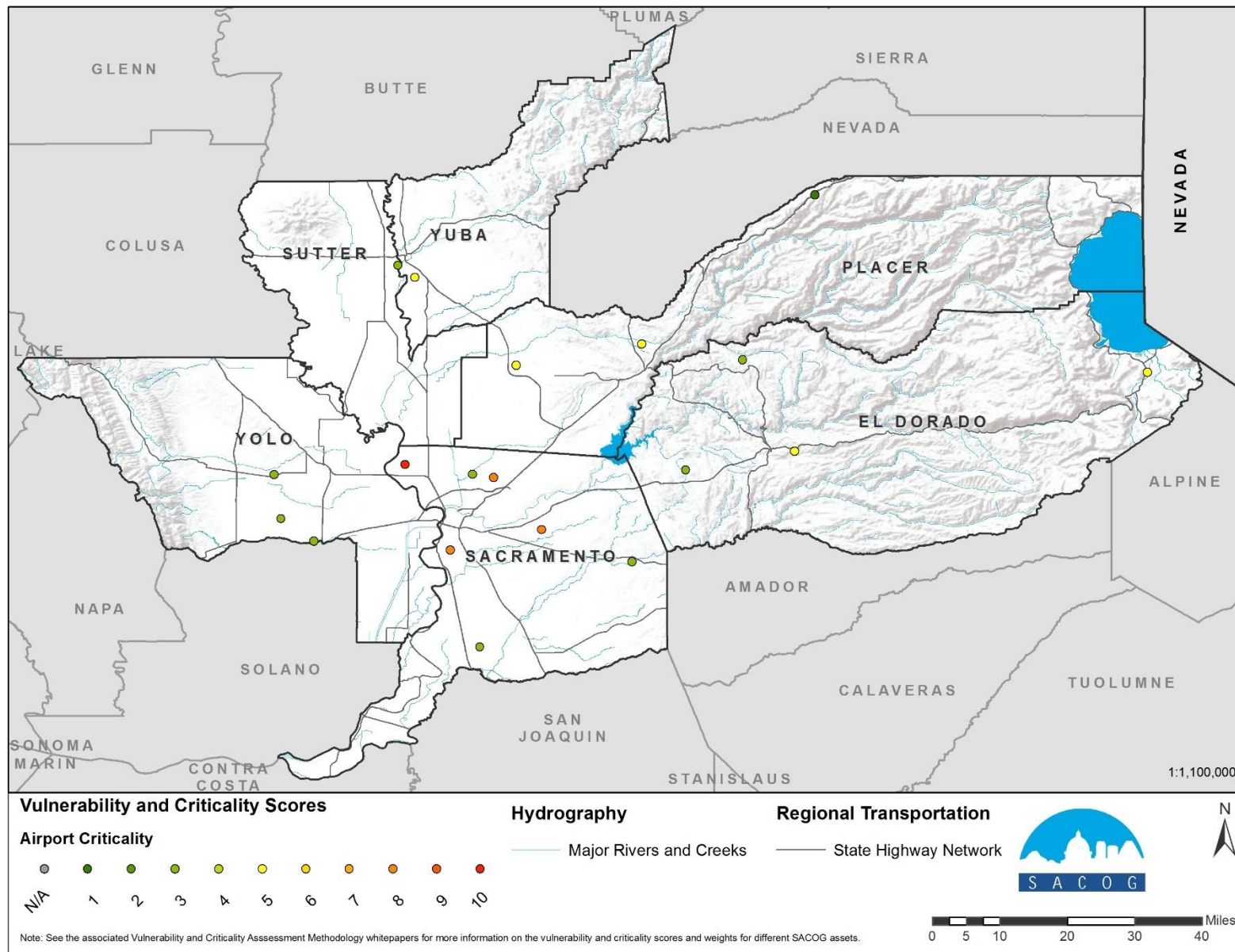


Figure 4: Airport Criticality Scores

The airport criticality scores simply correspond to the class codes assigned to them. Unsurprisingly, Sacramento International Airport is the most critical airport in the SACOG region. McClellan Airfield, Sacramento Executive Airport, and Sacramento Mather Airport are also relatively critical compared to most in the region.

Sea Level Rise: Roadways

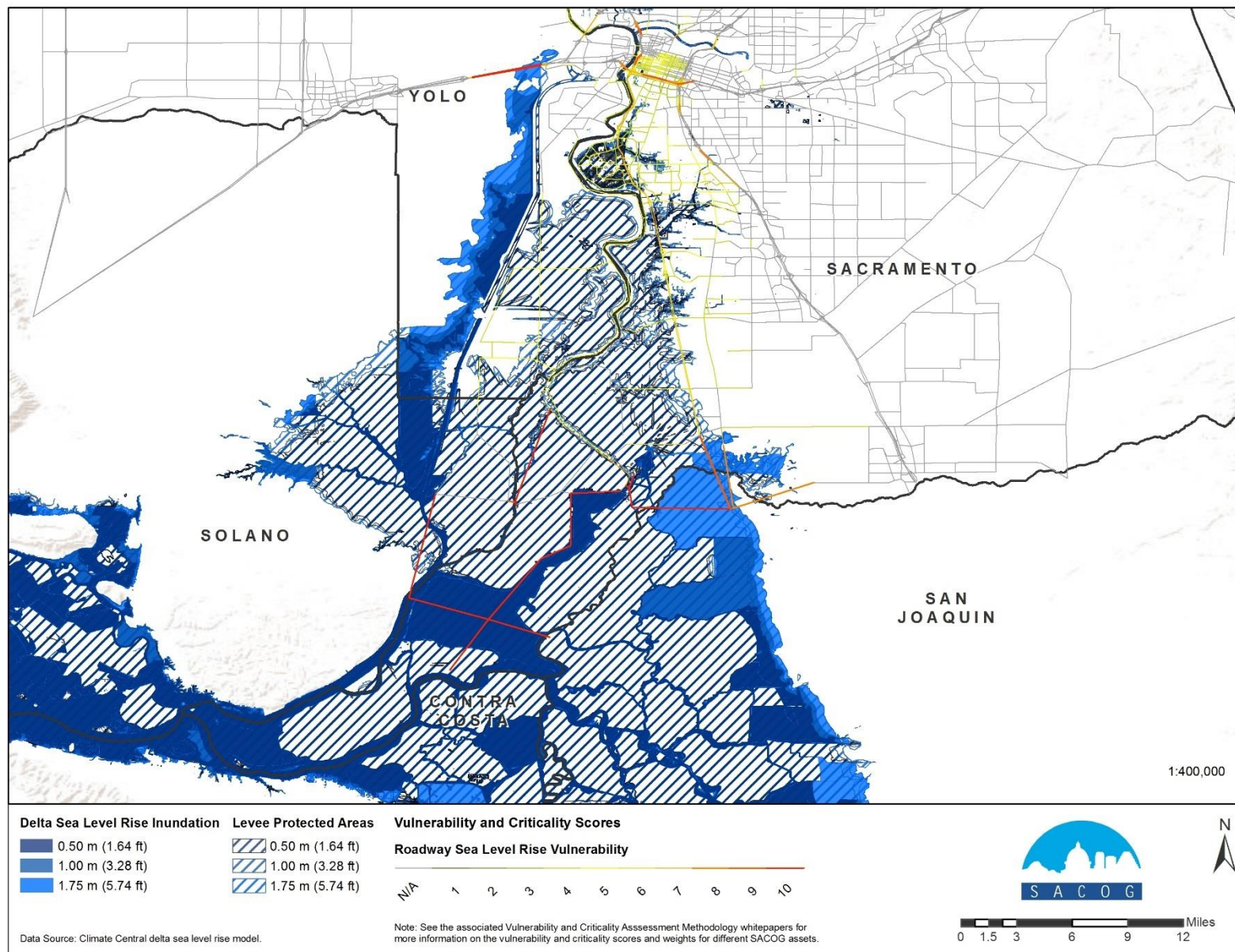


Figure 5: Roadway Sea Level Rise Vulnerability Scores

Several roads in the southwestern corner of Sacramento County, near where the Sacramento and San Joaquin Rivers converge, received the highest scores for sea level rise. These include the SR-160, SR-12, Grand Island Road, and Walnut Grove-Thornton Road. All have high projected exposure. While travel volumes on these roads are not particularly high, network redundancy is relatively sparse in this area (as indicated by the low raw nodal density values and corresponding high scaled nodal density scores). A stretch of the I-80 between Davis and West Sacramento also received one of the highest scores; while less exposed than the roads farther south in the region, it's a more heavily traveled route. Other roads with moderate exposure but high criticality received relatively high sea level rise scores, including portions of the US-50 and I-5 near downtown Sacramento and the stretch of I-5 near the Cosumnes River by the Sacramento-San Joaquin county line.

Sea Level Rise: Transit

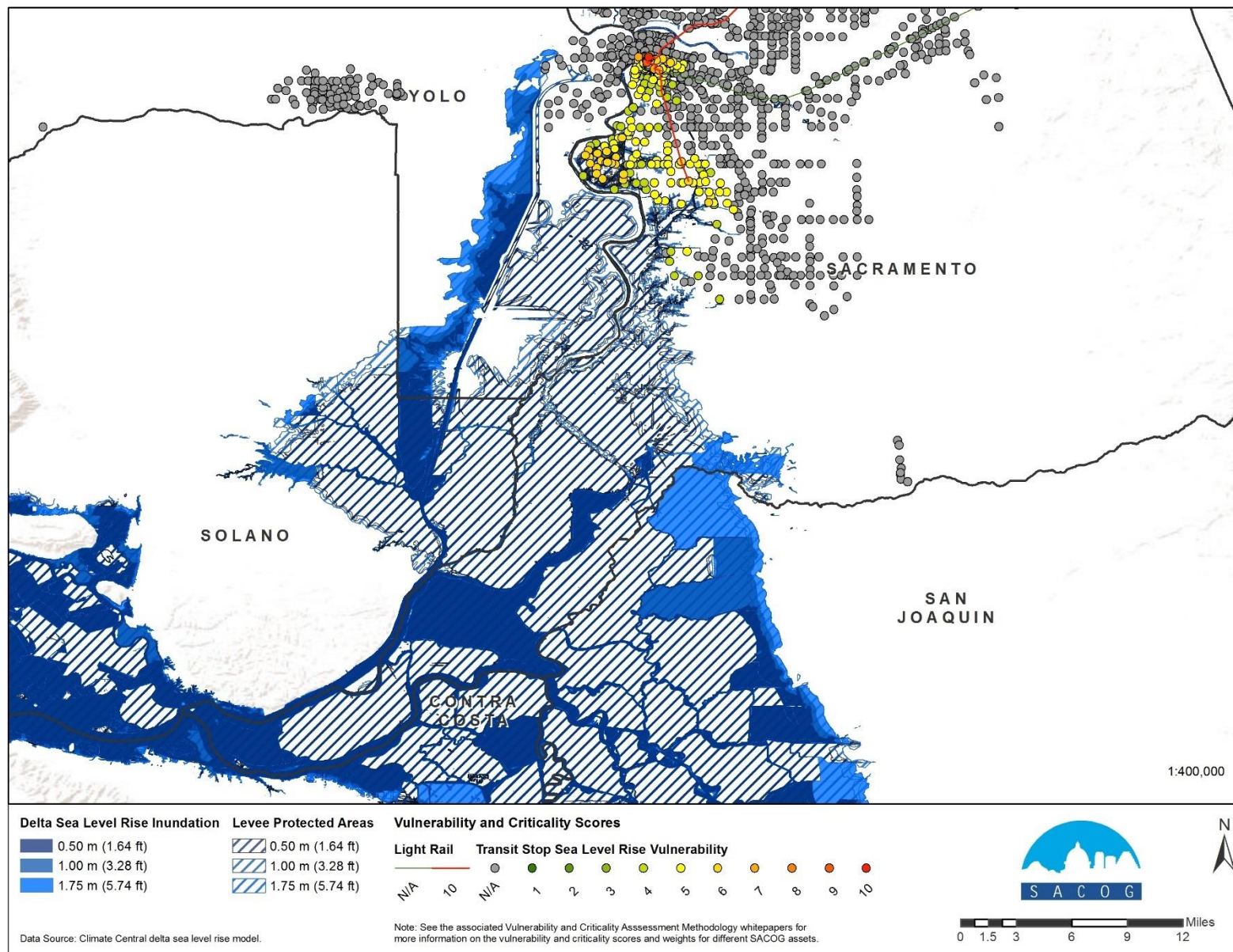


Figure 6: Transit Sea Level Rise Vulnerability Scores

There are about 270 transit stops that have some exposure to potential sea level rise. According to the inundation mapping, these stops are only exposed under the 5-meter sea level rise scenario, which is an extreme scenario with very low likelihood of occurring over the next century. Therefore, the most of differences in the final sea level rise scores among these assets are driven by their criticality; the final scores are very similar to the final criticality scores.

There are some stops that are exposed to lower increments of sea level rise when analyzing the disconnected sea level rise projections. These include the westernmost bus stop on Capitol Mall near the Sacramento River and many of the bus stops west of the I-5 in the Pocket neighborhood.

For the three light rail lines, all are exposed to the extreme 5-meter sea level rise scenario. However, portions of the Blue Line are exposed to lower increments of disconnected sea level rise. Therefore, the Blue Line receives the highest score for sea level rise.

Sea Level Rise: Bridges

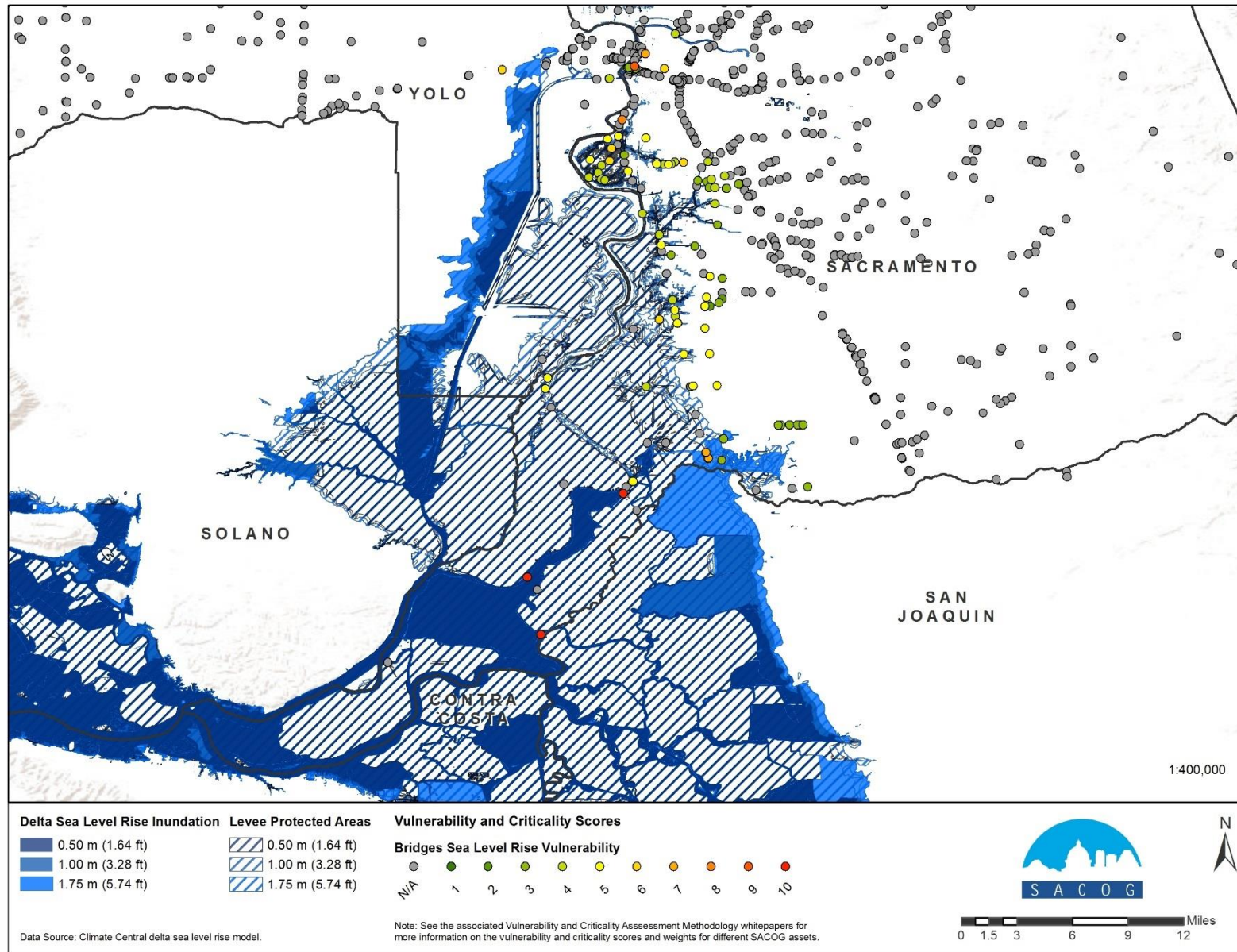


Figure 7: Bridge Sea Level Rise Vulnerability Scores

The scoring flagged several bridges in the southwestern corner of Sacramento County as the highest sea level rise risks. These include the Isleton Bridge across the Sacramento River on SR-160; the Isleton Road bridge across the Georgiana Slough near Walnut Grove; and the SR-12 bridge across the Mokelumne River. These facilities received high exposure scores and are relatively low traffic facilities. There are several bridges on the I-5 between Sacramento and the Sacramento-San Joaquin county line that received relatively high sea level rise scores, though exposure is lower at these locations.

Sea Level Rise: Airports

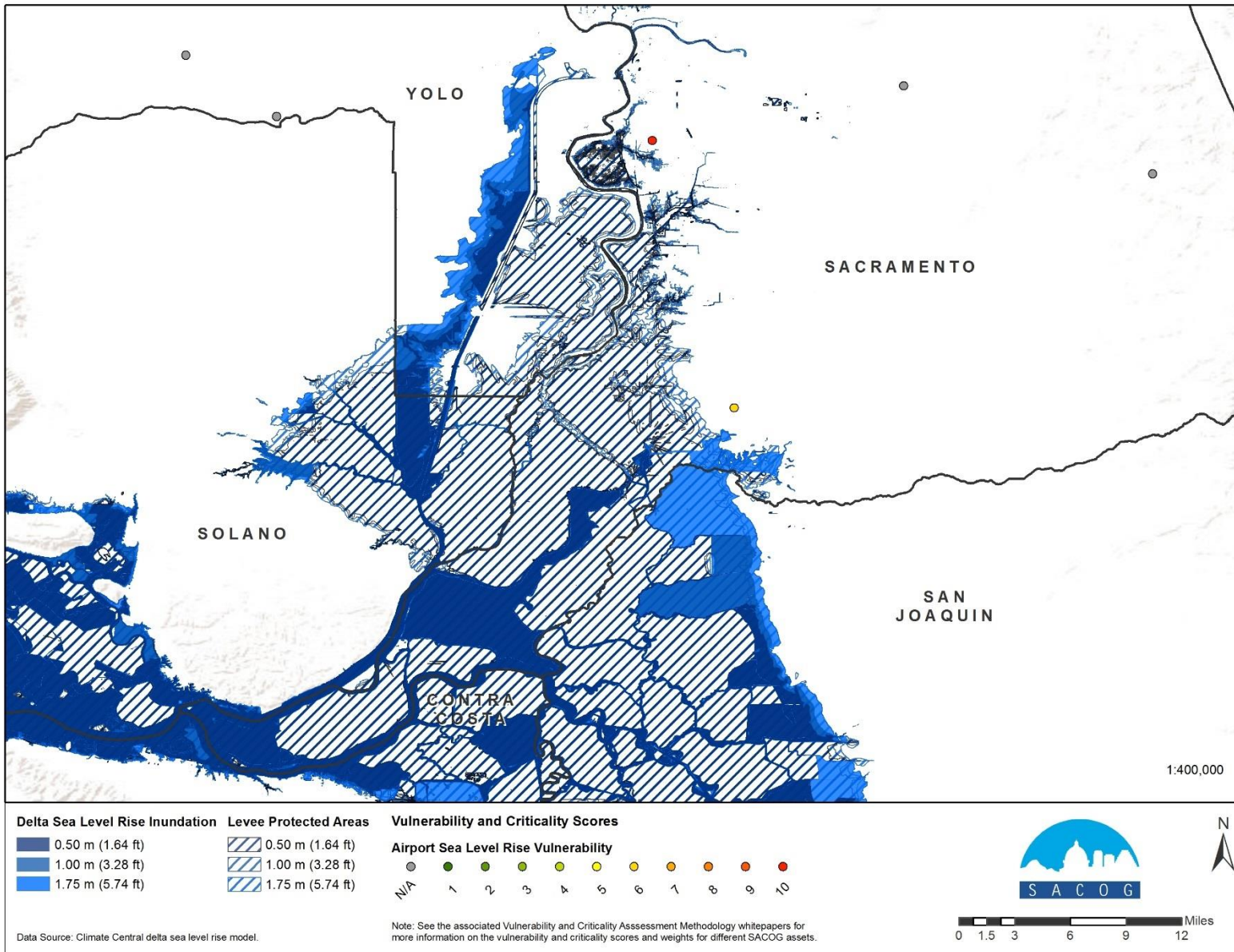


Figure 8: Airport Sea Level Rise Vulnerability Scores

Sacramento Executive Airport and Franklin Field Airport are both exposed to the 5-meter sea level rise scenario, which has a very low likelihood of being realized over the next 100 years. But scores are assigned on relative basis, and Sacramento Executive Airport receives the highest score of the airports, given its exposure and relatively high criticality.

Storm Surge: Roadways

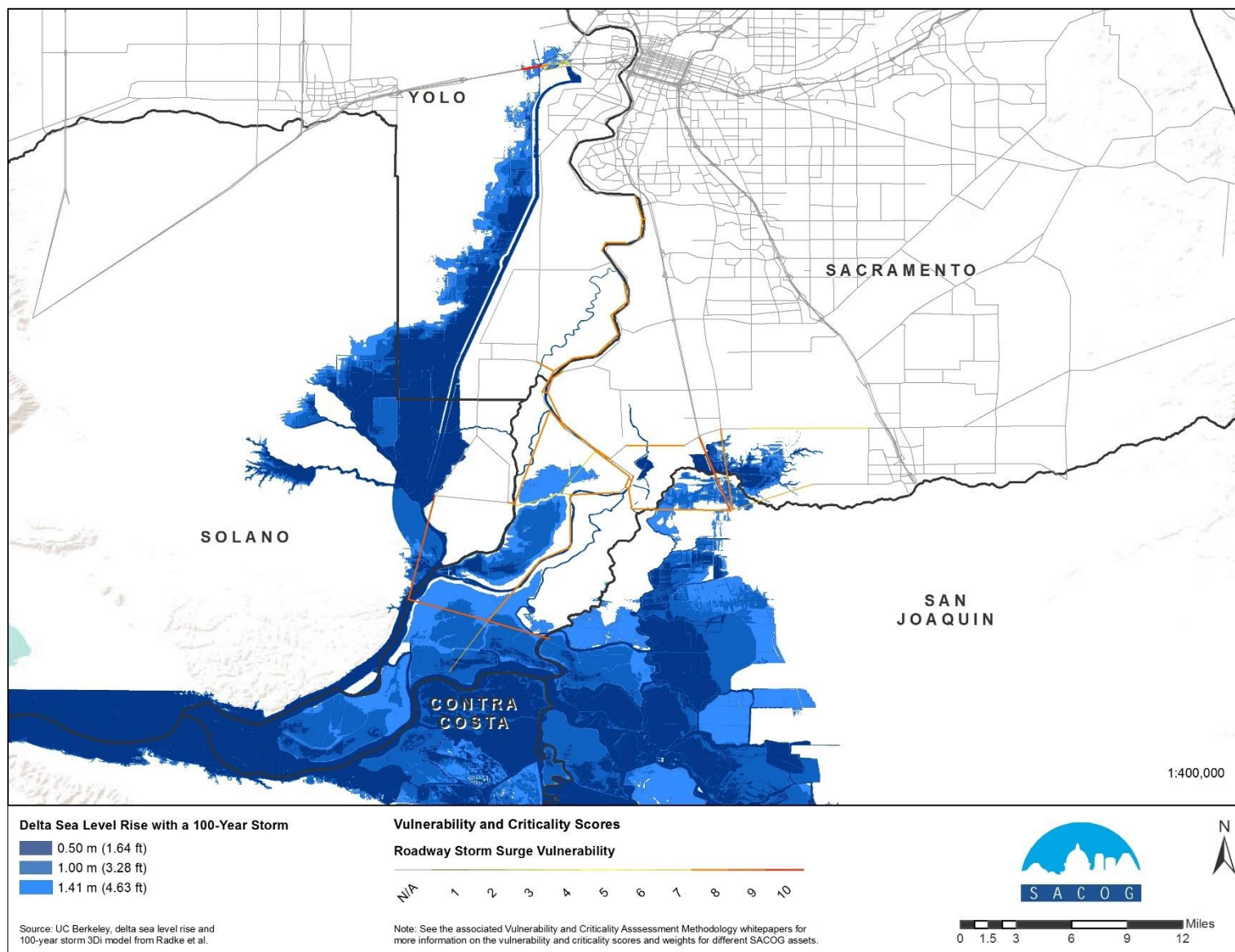


Figure 9: Roadway Storm Surge Vulnerability Scores

A small portion of the I-80 just west of West Sacramento received the highest surge score for roadways, driven by high exposure, relatively high volume, and relatively low redundancy. However, upon manual investigation, it appears the high exposure on this stretch of road may be driven by the surge model inundation layers not capturing the elevation of the roadway. SR-12 in the southwestern corner of the region and the portion of I-5 near the Cosumnes River at the southern edge of the region also received very high surge scores. Other roads in the southwestern corner, including SR-160, are also highly exposed to future storm surge.

Storm Surge: Transit

None of the transit stops or light rail lines were exposed to storm surge, according to the inundation overlay analysis.

Storm Surge: Bridges

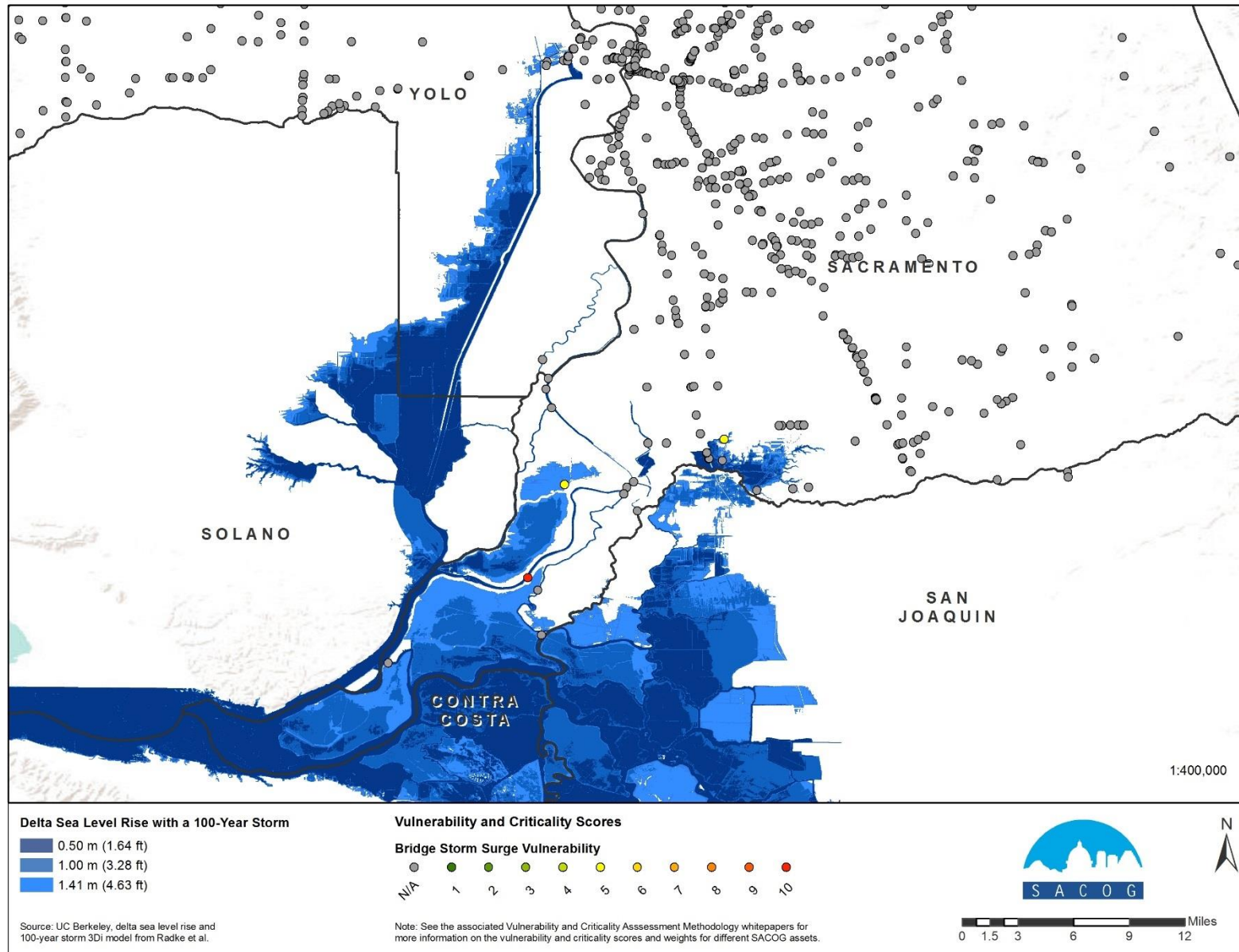


Figure 10: Bridge Storm Surge Vulnerability Scores

There were three bridges in the SACOG region that are exposed to future storm surge per the analysis. Only one was considered highly exposed: the Isleton Bridge across the Sacramento River on SR-160.

Storm Surge: Airports

None of the airports were exposed to storm surge, per the inundation overlay analysis.

Wildfire: Roadways

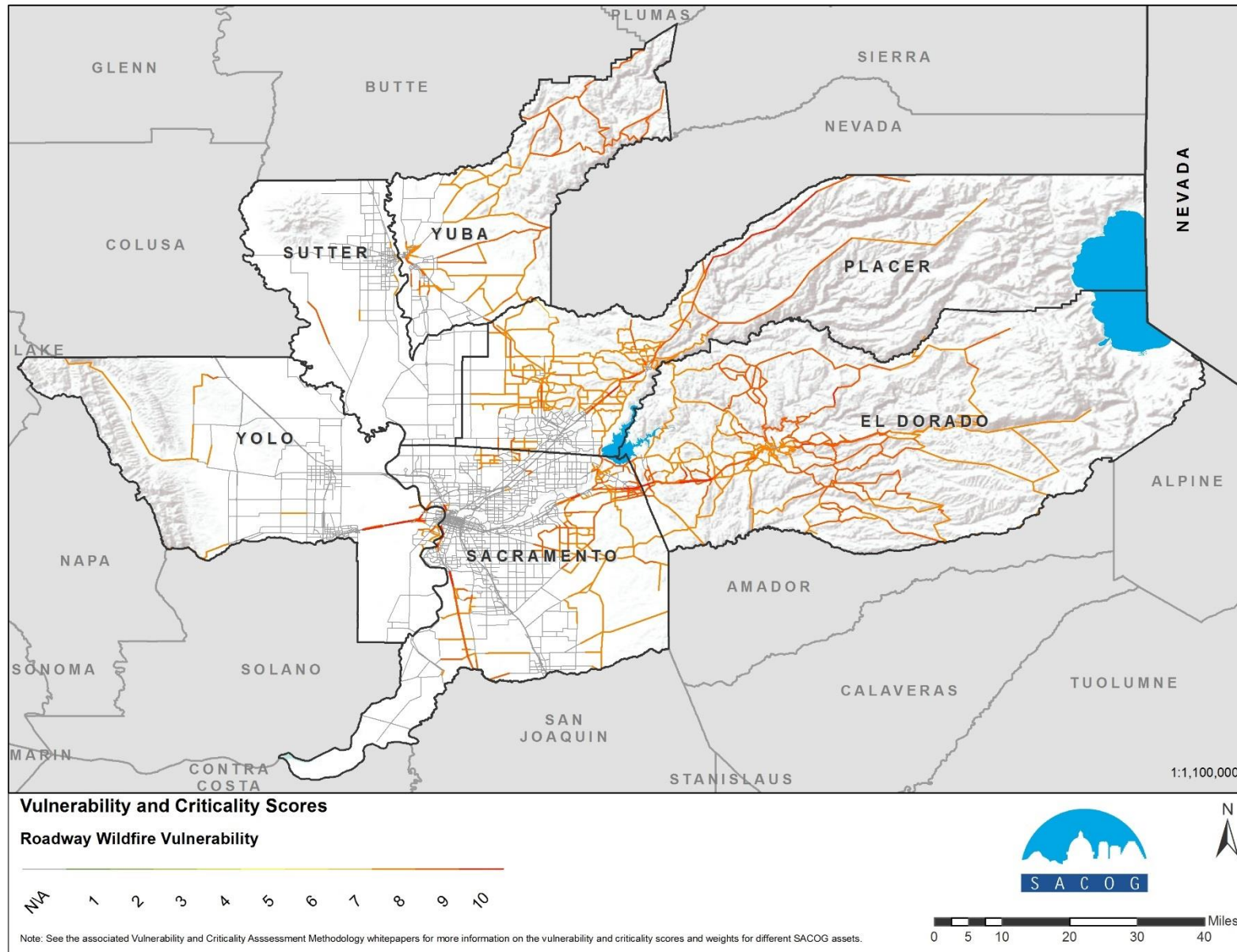


Figure 11: Roadway Wildfire Vulnerability Scores

Generally, as expected, roadways in the eastern, higher elevation portion of the SACOG region received higher wildfire risk scores than those in the valley. The roadway network in this area is relatively rural with low redundancy.

Many segments received the highest category score (10 on the 1-10 "final" scale, or 90-100 on the 0-100 scale). The longest stretch of highest scoring roadway is the I-80 between Colfax and the Emigrant Gap. Several other portions of the I-80 between Rocklin and Colfax also received the highest score, as did several segments of US-50 between Gold River and Pollock Pines.

There were some roads closer to Sacramento that received scores of 10 as well, including short segments of the I-5 and I-80. While urban and agricultural lands are masked out of the wildfire projections used in this analysis, there are pockets of unmasked exposed areas that remain. These small pockets, combined with the high criticality of these roadways, drives the high wildfire scores.

There are numerous rural mountain roads in the SACOG region that receive very high wildfire scores, underscoring the geographic magnitude of the threat and the sparsity of the network in these regions. Long stretches of roadway received high scores on almost all the rural roads analyzed east of SR-49 on the western face of the Sierras in El Dorado and Placer Counties. Note that the SACSIM model network used to analyze exposure did not extend to the Lake Tahoe region. Also, long stretches of the rural roads in eastern Yuba County received very high scores.

Many other smaller segments in the foothills closer to the Central Valley basin received very high scores as well.

Wildfire: Transit

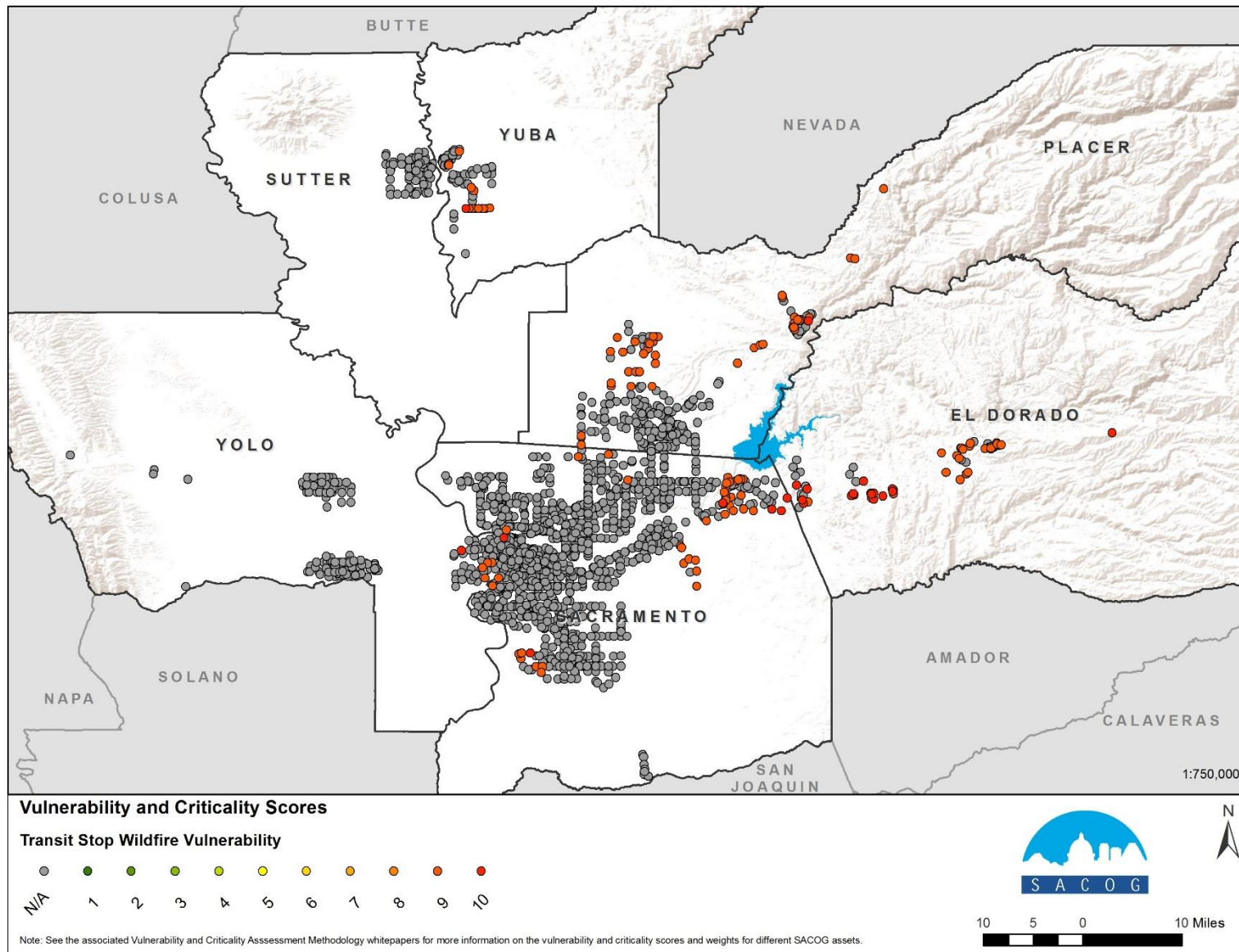


Figure 12: Transit Wildfire Vulnerability Scores

Approximately 150 of the transit stops in the SACOG region are exposed to wildfire, according to the analysis. Of these, the wildfire projections used for the analysis show that all are highly exposed. Therefore, all of these receive very high scores for wildfire.

Many of these stops are located along the US-50 corridor from Folsom to Pollock Pines; these include El Dorado Transit and SacRT-operated Folsom State Line stops. Many are Placer County Transit stops located in areas such as Auburn, Lincoln, and Meadow Vista. There are several Yuba-Sutter Transit stops, concentrated primarily in Olivehurst, that receive high scores. Most of the transit stops in these areas have low number of boardings and alightings, though some are areas designated by SACOG as Low Income-High Minority and with fairly high CalEnviroScreen scores, such as portions of the greater Placerville area and Olivehurst area. There are a few other groups of high scoring stops in southeastern Rancho Cordova (SacRT), southern West Sacramento (Yolobus), western Elk Grove (e-tran), and in other smaller patches of wildfire exposure areas in the greater Sacramento region.

Extreme Temperature: Transit

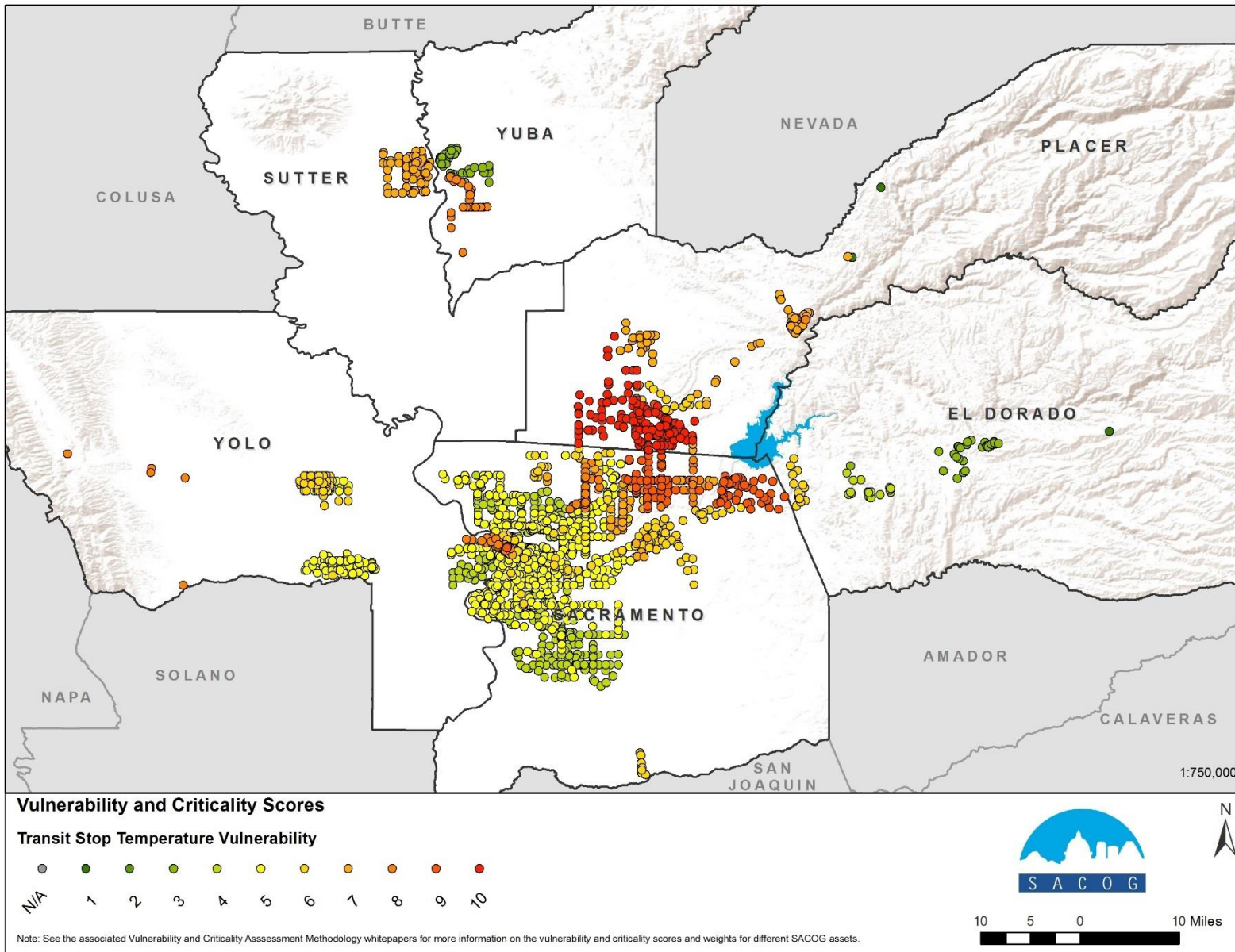


Figure 13: Transit Temperature Vulnerability Scores

Substantial increases in extreme heat are expected throughout the region, with many of the lower lying (i.e., non-mountainous) areas expected to see the highest numbers of heat health events as warming occurs. Given lack of variation in exposure between these places, the scoring exercise has limited utility. While a few of the region's transit stops in higher elevation, cooler areas do not present concerns, extreme heat will be a threat at the vast majority of transit stops in the region. Criticality-related factors, such as volume and location within disadvantaged communities, become more important factors when prioritizing which stops to focus on.

Extreme Temperature: Airports

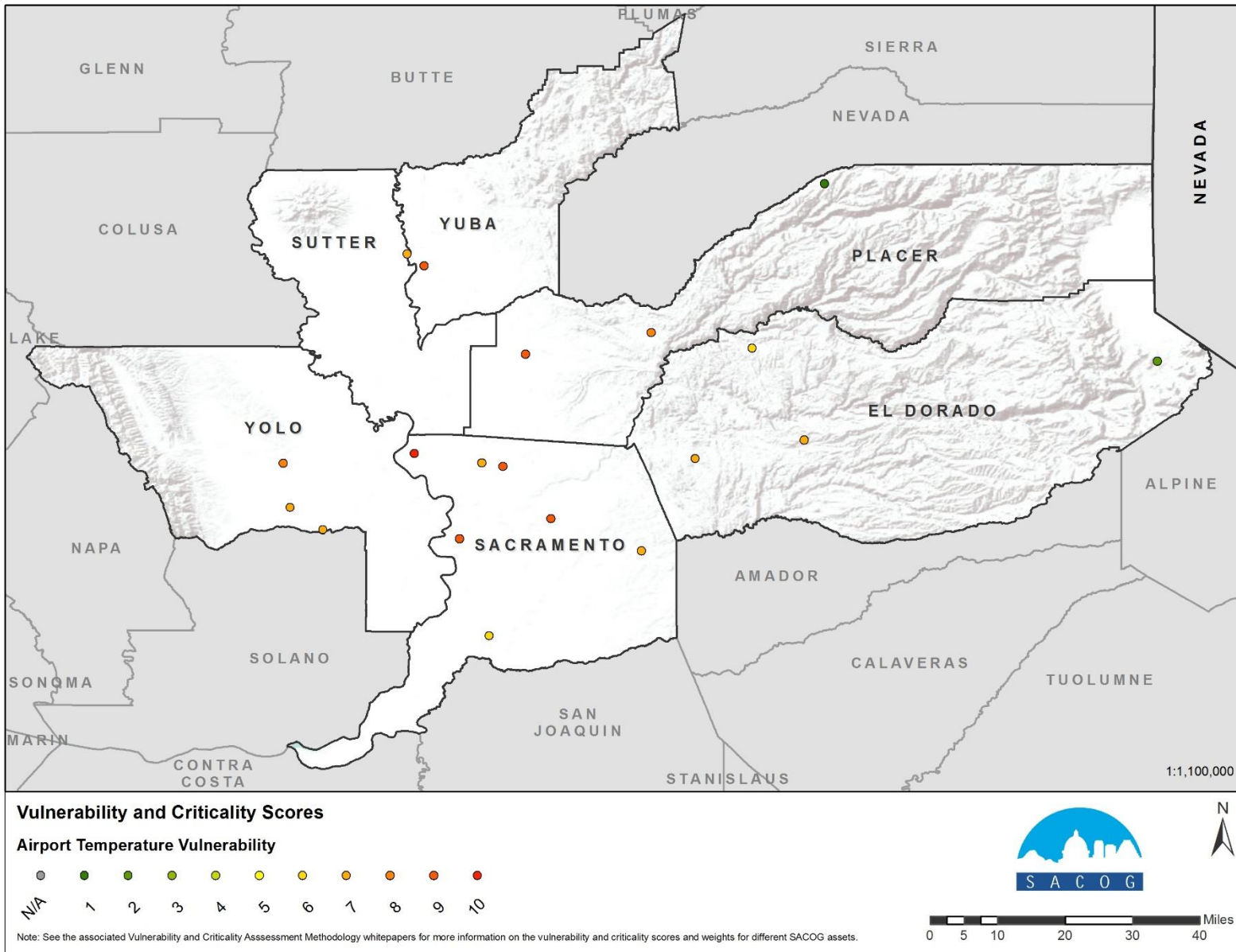


Figure 14: Airport Temperature Vulnerability Scores

Large increases in extreme heat are expected throughout the region. Thus, almost all the airports in the region, aside from a couple high in Sierra Nevada, are exposed to heat that could affect airport pavements and aircraft operations. There is limited utility in using scoring to distinguish among the varying levels of exposure, aside from the high-elevation airports (Lake Tahoe Airport and Blue Canyon Airport). The scores remaining scores largely reflect relative criticality.

Riverine Flooding: Bridges

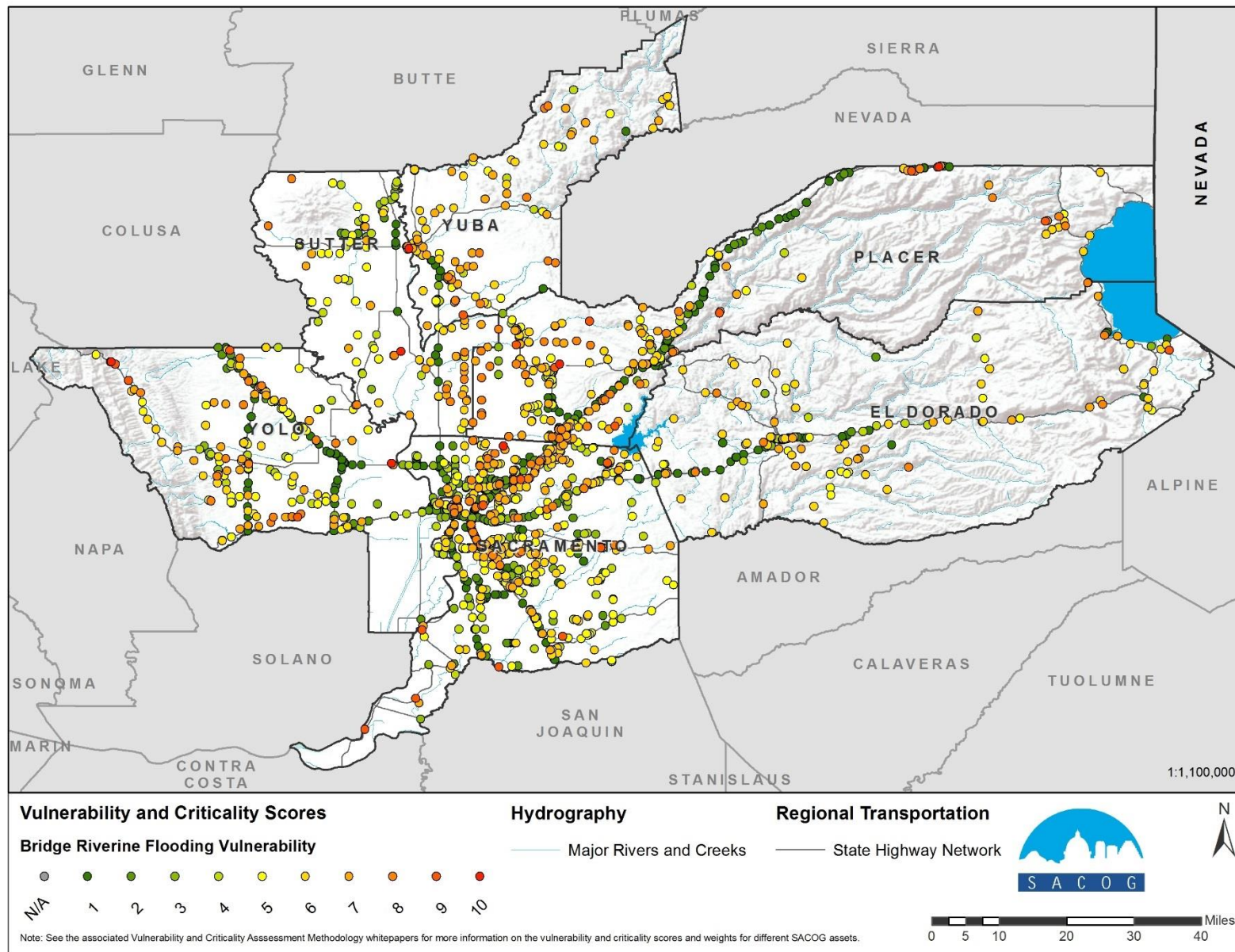


Figure 15: Bridge Riverine Flooding Vulnerability Scores

The riverine flooding bridge scores are driven primarily by several different exposure and sensitivity metrics, including future watershed heavy precipitation projections and condition ratings. There are many bridges with relatively high riverine flooding scores.

The highest scoring bridges (final scores of '10') are dispersed across the region, and despite the high overall scores, most receive relatively low criticality ratings. They include:

- SR-193/4th Street over the Auburn Ravine in Lincoln. This facility has low Scour Critical and Waterway Adequacy ratings.
- South Yuba Drive over the South Yuba River just north of I-80 near Soda Springs. This facility has a low Waterway Adequacy rating and has limited redundancy (i.e., long detour time).
- County Road 40 across the Pine Creek north of SR-16 near Rumsey. This facility has high projected future flows; low Channel Condition, Substructure Condition, and Scour Critical ratings; and limited redundancy.
- Sacramento Road over the Sutter Bypass East Channel, about a mile west of SR-99 near Nicolaus. This facility has relatively high projected flows, coupled with a relatively low Waterway Adequacy rating.
- Dowd Road over Coon Creek half a mile west of SR-65 near Lincoln Regional Airport. This facility has relatively high projected flows, coupled with a relatively low Waterway Adequacy rating.
- County Road 22 across Tule Canal west of the I-5 near the Sacramento International Airport. This bridge is expected to experience heavy future flows and has a relatively low Waterway Adequacy rating.
- Elverta Road across North Channel Dry Creek in between Antelope and Elverta. This facility has a low Waterway Adequacy rating and relatively large projected future flows.
- The Union Pacific and BNSF railroad bridge over the Feather River between Yuba City and Marysville. This facility is expected to experience heavy future flows and does not receive high condition ratings.

There are numerous other bridges that received final scores of '9' that are scattered throughout the region. They include bridges on the I-80, SR-16, SR-51, and SR-160, among others. The distinction between a '10' and '9', a '9' and '8', etc. should not be interpreted overly precisely. Many of these bridges warrant facility-level assessments of future climate risks.

Further Considerations and Next Steps

Additional Considerations

The indicators approach is a helpful exercise for a regional system-scale analysis, as it combines different types of information and suggests assets that need to be examined at a facility level. The Next Phase subsection will briefly discuss facility level assessments. This subsection mentions some of the limitations of the indicators approach and potentially helpful system-level considerations, data sources, and analyses that were not included as part of the indicators approach in this study.

The following list provides some of the key limitations of the indicator approach and additional considerations for SACOG:

- The indicator approach facilitates easier comparison within each asset type-hazard combination. But it can be challenging to compare results across different asset and hazard types in a meaningful manner. A risk-based approach that monetizes the potential costs of inaction under different climate scenarios is an effective way to make these comparisons. However, as discussed in the Approach section, it can be an intensive analysis process.
- The sea level rise and storm surge exposure analyses were done using a simple overlay of the inundation footprint and the assets. Thus, there can be 'false positives' in the results, where assets are identified as being inundated, despite being raised above where water levels would reach. This can occur due to features in either the hazard or asset datasets having imprecise geometries, or when the resolution of the elevation data used to create the hazard datasets is too low to capture the elevation of the assets. Rectifying the false positives issue would involve identifying all elevated sections of roadway in the line file and obtaining bridge deck elevations from a digital elevation model or another asset dataset. An even better solution would be to combine bridges and roadways into the same dataset and include elevation coordinates; this would ensure better compatibility across asset types. However, this is not yet a standard convention for these datasets at the national level or in other regions.

Furthermore, inundation analysis does not consider other physical impacts to infrastructure, such as erosion and scour. A more rigorous analysis would also account for these impacts, though given the amount of information needed to assess them, this is often better done at the facility-level rather than the system scale.

- Another enhancement would be to assess how future changes in the hydrologic cycle are expected to influence floodplains and flows, including changes magnitude and timing of rainfall versus snowfall as well as snowmelt.
- The analysis does not consider future fluvial⁹ and pluvial¹⁰ flooding exposure for assets aside from bridges. Doing so would require developing floodplains based on climate projections in addition to historic observations.
- The study could incorporate information about expected water management practices and dam releases from relevant managers, such as the US Army Corps of Engineers, California Department of Water Resources, and local flood control agencies.
- The lack of consistent, thorough information about levee condition and risks is another shortcoming for the region. Risks associated with levee failures can be catastrophic, and system-scale vulnerability assessments such as this one could leverage that type of information.

⁹ Associated with rivers or streams.

¹⁰ Associated with rainfall.

- Another risk to investigate would be to assess both deep-seated and shallow-seated landslides and their climactic triggers (e.g., 60-day duration precipitation, water table level, etc.), including projected future changes in these trigger events.
- Ideally, even a system-scale assessment would quantify uncertainty in climate projections and other information used to understand threats. The most practical way to do this would likely be to develop a full risk-based analysis as described above.
- One important area for more robust analysis is network redundancy. The SACSIM model could be used to approximate how closures to individual links in the transportation network affect hours of delay. Such a process would likely involve running a base case model (in assignment only mode) that other scenarios could be compared to. Then, for each link of interest, the link could be disabled, and then a disruption scenario model could be run (also in assignment only mode) to examine impacts. Impacts could be examined using a select link analysis on the base model and examining how trips that route through that link in the base scenario are affected in the disruption scenario. The result would be a change in total travel time for those trips between the base case scenario and disruption scenario.

A less rigorous but faster approach would be to use the ArcGIS Network Analyst tool to assess detour times for individual links using barriers to indicate potential disruptions.

Another type of criticality metric would be using a network dataset (e.g., the SACSIM network, ArcGIS HERE network dataset, Citilabs Sugar Access) to calculate travel time isochrones for individual links and then comparing the size of these isochrones between different links to assess relative criticality.¹¹

- The analysis did not include evaluation of other types of assets, such as communications and power related equipment.
- There is a need in the region, and across the state and country, for more systematic tracking of asset damage and disruption due to weather events and other incidents. This information is very valuable when conducting system scale and facility-level assessments.
- The indicators approach can underplay the importance of cross-agency coordination and collaboration in managing climate-related events.
- The hazards included in this analysis affect other sectors as well, and ideally, a vulnerability assessment can account for some of those effects. For instance, changes in the hydrologic cycle are anticipated to heavily affect agriculture, a key segment of the regional economy. In turn, this would influence the demand for transportation in the region.

Next Phase

This assessment examined the SACOG transportation system's vulnerabilities at a system scale. The next phase of SACOG's resiliency activities focuses on the asset scale, particularly on facility-level adaptations. Information and methods from this assessment can be leveraged in the facility-level adaptation study. Drawing on the systemwide analysis, examples of assets or asset types (and associated projects) that would be helpful to address in the facility-level study include:

- A Delta road prone to flooding, such as SR-160 or SR-12.
- A Delta bridge identified in this study, such as the Isleton Bridge across the Sacramento River on SR-160, the Isleton Road bridge across the Georgiana Slough near Walnut Grove, or the SR-12 bridge across the Mokelumne River.
- A major roadway or bridge that despite having lower levels of exposure would have high potential

¹¹ Isochrones depict links between connecting points where the travel time is equal.

consequences if flooded, such as the I-5 in the Cosumnes River floodplain or the eastern edge of the Yolo Causeway portion of I-80 over the Yolo Bypass of the Sacramento River.

- A high-streamflow bridge (such as one of the handful identified in the detailed results). This could combine flood and wildfire mitigation measures.
- Levee failure assessments and implications for a surrounding subsystem of transportation assets in a populous area, such as Sacramento. This could identify and/or assess upgrades to the transportation assets themselves or the actual levees.
- Extreme heat protection measures for transit stops, such as shading or misting systems.
- Wildfire mitigation and evacuation management along key mountain roads, such as the I-80 or US-50, or others. This could also look at how transit services could assist in evacuation efforts, particularly in communities where vehicle access is limited.
- Pavement and maintenance upgrades for one of the region's airports to mitigate extreme heat risks.
- Regional cooling center designation and management.

In general, the facility-level projects could be one of two types. One would be a project primarily focused on one or more climate-related hazards, such as a flood control, scour protection, or erosion protection measure, or an evacuation management strategy. The other would be another type of project, such as a general replacement or upgrade, that an adaptation analysis could be folded into.

The facility-level adaptation study can draw on existing local, state, and federal work and guide SACOG's members in forward-looking adaptation of the region's transportation system.

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Appendix

Criticality Score Tables

Table 5: Top Roadway Criticality Scores

OID_num	A	B	NAME	LANES	final_score_crit_road	scalescore_crit_road	scale_factor_vol	scale_node_dens	scale_popemp_dens	scale_In_LI_HM	scale_CES_awm	scale_noveh_awm
13835	5180	5186	US 50 EB:EB	4	10	100	100	2	8	100	88	21
13849	5186	5188	US 50 EB:EB	4	10	94	92	3	12	100	84	21
13858	5191	5189	US 50 WB:WB	4	10	90	88	4	12	100	77	20
13885	5205	9804	US 50 WB:WB	4	10	91	92	0	10	100	69	14
19811	9661	5193	US 50 WB:WB	4	10	93	100	4	14	0	68	19
13579	5066	5862	I 5 NB:NB	4	9	81	71	5	22	100	97	48
13585	5070	14353	I 5 NB:NB	4	9	84	73	26	8	100	94	38
13586	5071	5245	I 5 SB:SB	4	9	82	73	10	14	100	96	37
13853	5188	5190	US 50 EB:EB	4	9	86	92	4	12	0	78	20
13854	5189	5187	US 50 WB:WB	4	9	80	85	3	11	0	83	21
13860	5192	5194	US 50 EB:EB	4	9	85	91	4	13	0	69	19
13862	5193	5191	US 50 WB:WB	4	9	85	90	5	12	0	75	20
13955	5234	9714	US 50 EB:EB	4	9	81	74	19	25	100	54	5
13972	5244	5070	I 5 NB:NB	4	9	89	81	9	17	100	97	39
13977	5245	5864	I 5 SB:SB	4	9	81	72	5	18	100	96	41
14503	5510	5855	I 80 EB:EB	4	9	80	72	25	12	100	72	11
14522	5520	5879	I 80 EB:EB	4	9	81	76	34	6	100	37	3

OID_num	A	B	NAME	LANES	final_score_crit_road	scalescore_crit_road	scale_factor_vol	scale_node_dens	scale_population_dens	scale_In_LI_HM	scale_CES_awm	scale_noveh_awm
15246	5845	10065	I 80 EB:EB	5	9	82	74	24	8	100	79	9
15275	5857	5511	I 80 WB:WB	4	9	86	78	27	12	100	71	11
15289	5862	5244	I 5 NB:NB	4	9	88	80	6	21	100	96	41
15300	5868	5829	US 50 EB:EB	4	9	86	86	1	10	100	63	17
15316	5874	9439	I 5 NB:NB	4	9	81	67	3	41	100	95	58
15326	5879	5885	I 80 EB:EB	4	9	82	76	35	10	100	37	3
19367	9389	5375	BUS 80 WB:WB	4	9	84	79	11	11	100	86	14
19626	9551	9708	US 50 EB:EB	4	9	82	74	27	16	100	62	12
13564	5060	5874	I 5 NB:NB	3	8	78	74	3	44	0	86	45
13581	5067	5872	I 5 SB:SB	4	8	72	58	3	35	100	94	56
13594	5074	5080	I 5 NB:NB	4	8	75	76	21	16	0	62	5
13596	5075	5077	I 5 SB:SB	4	8	77	79	21	12	0	63	5
13598	5076	5074	I 5 NB:NB	4	8	75	76	22	12	0	64	5
13600	5077	5225	I 5 SB:SB	4	8	71	71	21	5	0	70	9
13610	5080	14356	I 5 NB:NB	4	8	76	76	27	14	0	62	5
13611	5081	5075	I 5 SB:SB	4	8	77	79	19	16	0	62	5
13812	5170	10391	50 EB:EB	3	8	76	66	9	44	100	69	7
13829	5177	4992	US 50 WB:WB	4	8	76	77	3	37	0	74	11
13851	5187	5181	US 50 WB:WB	4	8	71	65	2	8	100	88	21
13856	5190	5192	US 50 EB:EB	4	8	79	83	4	12	0	73	19
13865	5194	6217	US 50 EB:EB	4	8	76	80	4	14	0	64	18
13888	5207	5205	US 50 WB:WB	4	8	79	86	1	10	0	61	13

OID_num	A	B	NAME	LANES	final_score_crit_road	scalescore_crit_road	scale_factor_vol	scale_node_dens	scale_population_dens	scale_In_LI_HM	scale_CES_awm	scale_noveh_awm
13913	5216	9568	US 50 EB:EB	4	8	73	68	9	17	100	52	15
13914	5217	9571	US 50 WB:WB	4	8	73	69	8	14	100	50	15
13932	5224	5076	I 5 NB:NB	4	8	75	77	20	6	0	70	9
13935	5225	14354	I 5 SB:SB	4	8	73	72	21	4	0	84	23
13937	5227	9567	US 50 WB:WB	4	8	73	67	9	18	100	73	12
13957	5235	9707	US 50 WB:WB	4	8	75	72	40	15	0	52	7
14058	5284	9336	HWY 99 SB:SB	3	8	70	60	19	10	100	88	19
14196	5374	9388	BUS 80 EB:EB	4	8	75	68	11	10	100	86	14
14216	5380	5386	BUS 80 EB:EB	4	8	75	68	15	8	100	82	11
14359	5445	9049	80 WB:WB	6	8	79	68	27	6	100	93	28
14361	5446	10132	80 EB:EB	4	8	71	57	43	4	100	81	22
14489	5504	5845	I 80 EB:EB	5	8	75	77	18	6	0	80	9
14505	5511	10066	I 80 WB:WB	4	8	71	69	24	11	0	76	10
14515	5516	5865	I 80 EB:EB	4	8	73	75	29	5	0	49	6
14542	5530	10250	I 80 E:E	4	8	71	76	11	14	0	34	5
14903	5698	5695	HWY 99 SB:SB	4	8	71	76	3	9	0	57	15
15272	5855	5861	I 80 EB:EB	4	8	72	70	32	8	0	66	10
15288	5861	10051	I 80 EB:EB	4	8	70	71	24	5	0	63	9
15290	5863	5857	I 80 WB:WB	4	8	76	74	34	7	0	65	10

OID_num	A	B	NAME	LANE S	final_score_crit_road	scalescore_crit_road	scale_factor_vol	scale_number_dens	scale_population_dens	scale_in_LI_HM	scale_CES_awm	scale_novel_hawm
15294	5864	9441	I 5 SB:SB	4	8	70	58	4	23	100	97	50
15295	5865	5875	I 80 EB:EB	4	8	73	74	34	6	0	43	6
15310	5873	5517	I 80 WB:WB	4	8	71	73	26	5	0	45	5
15318	5875	10071	I 80 EB:EB	4	8	72	75	25	7	0	42	5
15321	5877	5873	I 80 WB:WB	4	8	72	73	33	6	0	43	5
15336	5883	5521	I 80 WB:WB	4	8	78	72	32	6	100	37	3
15340	5885	10101	I 80 EB:EB	4	8	74	77	25	12	0	37	2
15345	5887	5883	I 80 WB:WB	4	8	79	72	33	10	100	38	3
15955	6217	5868	US 50 EB:EB	4	8	75	80	1	15	0	59	17
19438	9431	5177	US 50 WB:WB	4	8	71	65	2	17	100	82	16
19449	9439	5066	I 5 NB:NB	4	8	72	67	4	26	0	97	56
19598	9538	9728	US 50 EB:EB	4	8	71	62	20	11	100	79	7
19606	9541	9721	US 50 WB:WB	4	8	75	68	19	6	100	79	9
19612	9544	9718	US 50 EB:EB	4	8	70	69	27	7	0	69	5
19618	9547	9713	US 50 WB:WB	4	8	72	73	20	16	0	55	5
19648	9564	9700	US 50 EB:EB	4	8	76	71	13	9	100	66	9
19652	9567	5221	US 50 WB:WB	4	8	70	71	9	16	0	74	13
19659	9571	9685	US 50 WB:WB	4	8	74	70	8	11	100	50	15
19777	9633	5867	US 50 WB:WB	4	8	79	77	0	10	100	65	17
19828	9680	5210	US 50 EB:EB	4	8	71	72	25	8	0	46	13
19833	9686	9570	US 50 EB:EB	4	8	76	73	9	12	100	52	15

OID_num	A	B	NAME	LANE S	final_score_crit_road	scalescore_crit_road	scale_factor_vol	scale_node_dens	scale_popemp_dens	scale_In_LI_HM	scale_CES_awm	scale_noveh_awm
19840	9692	5220	US 50 EB:EB	4	8	76	72	6	13	100	71	14
19849	9699	9563	US 50 WB:WB	4	8	72	67	12	10	100	64	9
19865	9707	9550	US 50 WB:WB	4	8	75	74	26	15	0	62	12
19867	9708	5234	US 50 EB:EB	4	8	76	73	41	15	0	52	7
19869	9713	5235	US 50 WB:WB	4	8	73	73	19	28	0	54	5
19870	9714	9546	US 50 EB:EB	4	8	72	74	17	17	0	55	5
19878	9718	9722	US 50 EB:EB	4	8	71	68	38	7	0	73	7
19883	9721	9717	US 50 WB:WB	4	8	70	66	38	7	0	73	7
19885	9722	9540	US 50 EB:EB	4	8	76	70	17	5	100	78	9
19891	9726	9537	US 50 WB:WB	4	8	71	63	20	11	100	80	7
20015	9804	9633	US 50 WB:WB	4	8	72	77	0	10	0	70	16
20214	10052	5863	I 80 WB:WB	4	8	74	75	26	5	0	61	9
20239	10065	5510	I 80 EB:EB	4	8	74	73	25	11	0	76	10
20256	10072	5877	I 80 WB:WB	4	8	72	73	27	7	0	42	5
20341	10130	5447	80 WB:WB	6	8	72	57	43	4	100	85	24
20348	10132	5444	80 EB:EB	4	8	76	62	34	6	100	93	28
20478	10205	10247	I 80 W:W	4	8	72	77	15	10	0	34	10
20545	10244	10204	I 80 E:E	4	8	72	68	15	10	100	34	10
20551	10247	5527	I 80 W:W	4	8	73	76	27	6	0	33	5
20555	10250	10213	I 80 E:E	4	8	70	76	13	10	0	34	3

OID_num	A	B	NAME	LANE S	final_score_crit_road	scalescore_crit_road	scale_factor_vol	scale_node_dens	scale_population_dens	scale_In_LI_HM	scale_CES_awm	scale_noveh_awm
20873	10391	5176	US 50 EB:EB	4	8	72	73	2	31	0	77	12
28746	14353	5224	I 5 NB:NB	4	8	76	76	18	5	0	85	24
28748	14354	5071	I 5 SB:SB	4	8	78	66	27	7	100	93	36
28752	14356	5064	I 5 NB:NB	4	8	72	76	11	12	0	62	5
28754	14357	5081	I 5 SB:SB	4	8	73	73	25	13	0	62	5

Table 6: Top Transit Criticality Scores

OID_num	A	Type	final_score_crit_trans	scalescore_crit_trans	scale_factor	scale_node_dens	scale_population_dens	scale_In_LI_HM	scale_CES_awnm	scale_nov_eh_awnm
8016	8016	LRT	10	100	100	4	84	100	92	50
8015	8015	LRT	9	80	75	10	78	100	90	37
4910	4910	LRT	8	76	69	5	95	100	86	33
5732	5732	BUS	8	72	66	4	72	100	94	52
5762	5762	BUS	7	68	59	6	78	100	92	47
6170	6170	LRT	7	67	58	5	76	100	93	47
8017	8017	LRT	6	59	48	3	85	100	89	43
8573	8573	LRT	6	57	49	5	49	100	98	56
2008	2008	BUS	5	45	30	7	78	100	91	41
2089	2089	BUS	5	41	24	8	83	100	90	41
2273	2273	BUS	5	40	27	6	63	100	94	40
3245	3245	BUS	5	48	42	22	21	100	79	16
4909	4909	LRT	5	43	45	10	33	0	76	29
5734	5734	BUS	5	44	29	2	83	100	91	49
5760	5760	BUS	5	49	37	4	69	100	91	45
8049	8049	LRT	5	45	22	93	20	100	77	21
8065	8065	LRT	5	42	25	76	11	100	66	10
8536	8536	LRT	5	43	27	28	46	100	99	43
8590	8590	LRT	5	45	41	9	30	100	78	18

Table 7: Top Bridge Criticality Scores

OID_num	NAME	County	RTE	BRIDGE	CITY	final_score_crit_bridge	scalescore_crit_bridge	scale_factor_vol	scale_Bdetour	scale_performance	scale_In_LI_HM	scale_CES_awm	scale_no_veh_awm
407	MADISON AVENUE OC	SAC	80	24 0127	O	10	100	100	5	12	100	76	10
446	HOWE AVENUE OC	SAC	50	24 0186	SACRAMENTO	10	94	92	0	25	100	72	12
489	ALHAMBRA BLVD OC	SAC	50	24 0229	SACRAMENTO	10	93	92	2	12	100	68	17
563	OCCIDENTAL DRIVE OC	SAC	50	24 0294	SACRAMENTO	10	91	92	3	7	100	54	6
571	65TH STREET UC	SAC	50	24 0318	SACRAMENTO	10	93	92	0	21	100	52	15
428	21ST AVENUE UC	SAC	99	24 0154	SACRAMENTO	9	80	77	2	12	100	75	14
464	WINTERS STREET UC	SAC	80	24 0205	SACRAMENTO	9	83	80	0	9	100	90	10
566	39TH STREET UC	SAC	50	24 0313	SACRAMENTO	9	84	92	2	10	0	49	13
567	48TH STREET OC	SAC	50	24 0314	SACRAMENTO	9	83	92	1	10	0	41	11
568	51ST STREET OC	SAC	50	24 0315	SACRAMENTO	9	83	92	1	9	0	41	11

OID_num	NAME	County	RTE	BRIDGE	CITY	final_score_crit_bridge	scalescore_crit_bridge	scale_factor_vol	scale_Bdetour	scale_pomp_de	scale_In_LI_HM	scale_CES_awn	scale_no_veh_awn
570	59TH STREET OC	SAC	50	24 0317	SACRAMENTO	9	84	92	2	12	0	48	14
1657	WATT AVENUE OC	SAC	50	24 0034L	0	9	86	92	10	10	0	55	8
1661	FOOTHILL FARMS POC	SAC	80	24 0103	0	9	82	80	10	6	100	63	9
1664	27TH AVENUE POC	SAC	99	24 0153	SACRAMENTO	9	82	77	10	13	100	76	15
1671	RIVERFRONT SEAL SLAB	SAC	5	24 0274M	SACRAMENTO	9	82	74	10	24	100	87	20
338	AMERICAN RIVER (BUS 80)	SAC	51	24 0003	SACRAMENTO	8	72	78	4	2	0	59	22
408	GREENBACK LANE OC	SAC	80	24 0128	0	8	74	80	4	9	0	55	7
409	ANTELOPE ROAD OC	SAC	80	24 0129	0	8	72	80	4	8	0	40	4
414	CAL EXPO UC	SAC	51	24 0133	SACRAMENTO	8	75	72	3	4	100	71	18
419	MORRISON CREEK	SAC	99	24 0143	0	8	77	72	0	16	100	91	20
421	41ST AVENUE OC	SAC	99	24 0146	0	8	70	72	3	15	0	90	13
423	FRUITRIDGE ROAD OC	SAC	99	24 0148	SACRAMENTO	8	76	72	2	10	100	84	14
425	FLORIN ROAD OC SOUTH	SAC	99	24 0150	0	8	71	64	7	9	100	83	13

OID_num	NAME	County	RTE	BRIDGE	CITY	final_score_crit_bridge	scalescore_crit_bridge	scale_factor_vol	scale_Bdetector	scale_pump_deploy	scale_In_LI_HM	scale_CESawm	scale_no_veh_awm
427	47TH AVENUE OC	SAC	99	24 0152	O	8	78	72	6	15	100	91	17
429	5TH AVENUE OC	SAC	99	24 0156	SACRAMENTO	8	72	77	2	12	0	54	14
430	2ND AVENUE UC	SAC	99	24 0157	SACRAMENTO	8	79	77	2	12	100	62	16
432	BROADWAY UC	SAC	99	24 0158	SACRAMENTO	8	79	77	1	12	100	62	16
433	12TH AVENUE OC	SAC	99	24 0161	SACRAMENTO	8	79	77	2	12	100	62	13
435	FLORIN ROAD OC NORTH	SAC	99	24 0167	O	8	77	72	7	10	100	83	14
440	MAYHEW OH	SAC	50	24 0173	O	8	73	70	5	12	100	52	7
462	RIO LINDA BLVD UC	SAC	80	24 0203	SACRAMENTO	8	73	68	3	13	100	75	14
473	SAN JUAN ROAD OC	SAC	80	24 0210	SACRAMENTO	8	73	70	5	10	100	57	9
474	ROUTIER ROAD OC	SAC	50	24 0213	RANCHO CORDOVA	8	74	70	3	7	100	76	8
477	NORTHGATE BLVD OC	SAC	80	24 0217	SACRAMENTO	8	73	70	1	7	100	69	12

OID_num	NAME	County	RTE	BRIDGE	CITY	final_score_crit_bridge	scalescore_crit_bridge	scale_factor_vol	scale_Bdetector	scale_potential_pumps	scale_inlet_LHM	scale_CESawm	scale_no_veh_awm
478	NATOMAS EAST CANAL BOH	SAC	80	24 0218	SACRAMENTO	8	72	68	3	5	100	81	12
496	CAPITOL MALL OC	SAC	5	24 0236	SACRAMENTO	8	76	71	1	53	0	85	41
546	LONGVIEW DRIVE OC	SAC	80	24 0283	SACRAMENTO	8	75	72	3	1	100	90	9
1655	B STREET UNDERPASS	SAC	51	24 0023	SACRAMENTO	8	78	80	10	7	0	74	28
1663	44TH AVENUE POC	SAC	99	24 0145	0	8	79	72	10	14	100	90	14
1665	8TH AVENUE POC	SAC	99	24 0162	SACRAMENTO	8	73	77	10	11	0	53	13
1666	TURNBRIDGE DRIVE POC	SAC	99	24 0169	0	8	79	72	10	13	100	92	19
1667	MATHER SPUR UP	SAC	50	24 0174	0	8	76	70	10	7	100	80	9
1677	MANLOVE POC	SAC	50	24 0375	RANCHO CORDOVA	8	73	74	10	23	0	62	12
1678	WHITE ROCK POC	SAC	50	24 0376	RANCHO CORDOVA	8	79	74	10	16	100	73	6

Table 8: Top Airport Criticality Scores

OID_num	FACILITY	CITY	final_score_crit_air	scalescore_crit_air	scale_aport_class
178	SACRAMENTO INTERNATIONAL AIRPORT	Sacramento	10	100	100
124	McCLELLAN AIRFIELD	Sacramento	8	75	75
177	SACRAMENTO EXECUTIVE AIRPORT	Sacramento	8	75	75
179	SACRAMENTO MATHER AIRPORT	Sacramento	8	75	75
9	AUBURN MUNICIPAL AIRPORT	Auburn	5	50	50
105	LAKE TAHOE AIRPORT	South Lake Tahoe	5	50	50
108	LINCOLN REGIONAL AIRPORT / KARL HARDER FIELD	Lincoln	5	50	50
158	PLACERVILLE AIRPORT	Placerville	5	50	50
239	YUBA COUNTY AIRPORT	Marysville	5	50	50
37	CAMERON AIRPARK AIRPORT	Cameron Park	3	25	25
65	FRANKLIN FIELD AIRPORT	Franklin	3	25	25
75	GEORGETOWN AIRPORT	Georgetown	3	25	25
162	RANCHO MURIETA AIRPORT	Rancho Murieta	3	25	25
169	RIO LINDA AIRPORT	Rio Linda	3	25	25
213	SUTTER COUNTY AIRPORT	Yuba City	3	25	25
224	UNIVERSITY AIRPORT	Davis	3	25	25
230	WATTS - WOODLAND AIRPORT	Woodland	3	25	25
238	YOLO COUNTY-DAVIS WOODLAND WINTERS AIRPORT	Davis/Woodland/Winters	3	25	25
18	BLUE CANYON AIRPORT	Emigrant Gap	1	0	0

Vulnerability Score Tables

Table g: Top Roadway Sea Level Rise Vulnerability Scores

OID_num	NAME	final_score_slr_road	scale_score_slr_road	scale_vulnsens_score_slr_road	scale_rec_dmg	scale_slr_increment	scale_slrmax_per	scale_slr_d_increment	scale_slr_dis_max_per	scale_fac_vol	scale_node_dens	scale_popemp_dens	scale_e_in_LI_H_M	scale_e_CE_S_a_wm	scale_noveh_awm
5343		10	98	100	0	100	1	100	1	1	96		0	61	4
10643		10	91	100	0	100	1	100	1	0	72	0	0	55	0
10646		10	91	100	0	100	1	100	1	0	72	0	0	55	0
10647		10	93	99	0	100	0	100	1	0	91	0	0	55	0
10652		10	94	100	0	100	1	100	1	4	78	0	0	55	0
10653	HWY 160	10	95	99	0	100	0	100	1	4	90	0	0	55	0
10655		10	94	100	0	100	1	100	1	4	78	0	0	55	0
10659	HWY 160	10	93	100	0	100	0	100	1	5	71	3	0	55	0
10664		10	93	99	0	100	0	100	1	0	91	0	0	55	0
10845	RIVER RD	10	94	100	0	100	1	100	1	4	78	2	0	55	0
11539		10	98	100	0	100	1	100	1	6	92	0	0	61	4
11541		10	100	100	0	100	1	100	1	9	91	0	0	60	4
11544		10	98	100	0	100	1	100	1	1	96		0	61	4
11545		10	100	100	0	100	1	100	1	10	92	0	0	61	4
11547		10	98	100	0	100	1	100	1	6	92	0	0	61	4
11548		10	100	100	0	100	1	100	1	9	91	0	0	60	4
11549		10	100	100	0	100	1	100	1	10	92	0	0	61	4
11550		10	96	100	0	100	1	100	1	3	92	0	0	58	2
11553		10	96	100	0	100	1	100	1	3	92	0	0	58	2

OID_num	NAME	final_score_slr_road	scale_score_slr_road	scalevulnsens_score_slr_road	scale_recdmg	scale_slr_increment	scale_slrmax_per	scale_slrd_increment	scale_slrdis_max_per	scale_fac_vol	scale_node_dens	scale_popemp_dens	scale_In_LI_H_M	scale_CE_S_a_wm	scale_noveh_awm
11554	HWY 160	10	96	100	0	100	1	100	1	4	96	0	0	55	0
13835	US 50 EB:EB	10	95	25	0	25	0	25	0	100	2	8	100	88	21
13849	US 50 EB:EB	10	90	25	0	25	0	25	0	92	3	12	100	84	21
14364	I 80 WB:WB	10	96	65	0	65	1	65	1	58	51	0	0	51	7
15300	US 50 EB:EB	10	97	41	0	25	1	100	1	86	1	10	100	63	17
19130		10	95	100	0	100	1	100	1	1	96	0	0	55	0
19136	HWY 160	10	93	100	0	100	0	100	1	5	71	3	0	55	0
19137	RIVER RD	10	94	100	0	100	1	100	1	4	78	2	0	55	0
19138		10	92	99	0	100	0	100	1	1	80	1	0	55	0
19139		10	95	100	0	100	1	100	1	1	96	0	0	55	0
19140		10	92	99	0	100	0	100	1	1	80	1	0	55	0
19777	US 50 WB:WB	10	91	41	0	25	1	100	1	77	0	10	100	65	17
20228		10	96	65	0	65	1	65	1	58	49	0	0	49	6
20234	I 80 WB:WB	10	90	55	0	55	1	55	1	58	68	0	0	39	1
20470	I 80 EB:EB	10	93	60	0	60	1	60	1	57	68	0	0	38	1

OID_num	NAME	final_score_slr_road	scale_score_slr_road	scalevulnsens_score_slr_road	scale_recdmg	scale_slr_increment	scale_slrmax_per	scale_slrd_increment	scale_slrdis_max_per	scale_fac_vol	scale_node_dens	scale_popemp_dens	scale_In_LI_H_M	scale_CE_S_a_wm	scale_noveh_awm
29611	HWY 160	10	95	99	0	100	0	100	1	4	90	0	0	55	0
29612	HWY 160	10	96	100	0	100	1	100	1	4	96	0	0	55	0
5410		9	90	99	0	100	0	100	1	0	68	0	0	55	0
10645		9	90	99	0	100	0	100	1	0	68	0	0	55	0
13423	I 5 SB:SB	9	84	73	0	70	1	85	1	23	66	0	0	59	4
13564	I 5 NB:N B	9	89	40	0	25	1	100	1	74	3	44	0	86	45
13853	US 50 EB:EB	9	83	25	0	25	0	25	0	92	4	12	0	78	20
13858	US 50 WB:W B	9	88	25	0	25	0	25	0	88	4	12	100	77	20
13860	US 50 EB:EB	9	82	26	0	25	1	25	1	91	4	13	0	69	19
13862	US 50 WB:W B	9	82	25	0	25	1	25	1	90	5	12	0	75	20
13935	I 5 SB:SB	9	81	35	0	25	0	75	0	72	21	4	0	84	23
15215	US 50 EB:EB	9	82	40	0	25	0	100	0	75	1	9	0	64	15
15278	I 5 NB:N B	9	82	41	0	25	1	100	1	67	1	42	0	81	23

OID_num	NAME	final_score_slr_road	scale_score_slr_road	scalevulnsens_score_slr_road	scale_recdmg	scale_slr_increment	scale_slrmax_per	scale_slrd_increment	scale_slrdis_max_per	scale_fac_vol	scale_node_dens	scale_popemp_dens	scale_In_LI_H_M	scale_CE_S_a_wm	scale_noveh_awm
15307	I 5 SB:SB	9	82	41	0	25	1	100	1	64	3	38	0	86	44
19132	I 5 NB:N B	9	84	73	0	70	1	85	1	23	66	0	0	60	4
19811	US 50 WB:W B	9	88	26	0	25	1	25	1	100	4	14	0	68	19
20015	US 50 WB:W B	9	84	40	0	25	1	100	1	77	0	10	0	70	16
28746	I 5 NB:N B	9	83	34	0	25	0	70	0	76	18	5	0	85	24
10604		8	72	69	0	65	1	85	1	2	96	0	0	51	4
10610		8	72	69	0	65	1	85	1	2	96	0	0	51	4
10612		8	72	69	0	65	1	85	1	0	96	0	0	61	6
10992		8	72	69	0	65	1	85	1	0	96	0	0	61	6
13568	I 5 SB:SB	8	76	41	0	25	1	100	1	58	1	38	0	81	23
13600	I 5 SB:SB	8	76	31	0	25	0	55	0	71	21	5	0	70	9
13825	US 50 WB:W B	8	74	26	0	25	1	25	1	65	2	5	100	87	19
13829	US 50 WB:W B	8	79	31	0	25	0	55	1	77	3	37	0	74	11

OID_num	NAME	final_score_slr_road	scale_score_slr_road	scalevulnsens_score_slr_road	scale_recdmg	scale_slr_increment	scale_slrmax_per	scale_slrd_increment	scale_slrdis_max_per	scale_fac_vol	scale_node_dens	scale_popemp_dens	scale_In_LI_H_M	scale_CE_S_a_wm	scale_noveh_awm
13851	US 50 WB:WB	8	74	25	0	25	0	25	0	65	2	8	100	88	21
13854	US 50 WB:WB	8	78	25	0	25	0	25	0	85	3	11	0	83	21
13856	US 50 EB:EB	8	77	25	0	25	0	25	0	83	4	12	0	73	19
13865	US 50 EB:EB	8	75	26	0	25	1	25	1	80	4	14	0	64	18
13932	I 5 NB:NB	8	80	32	0	25	0	60	0	77	20	6	0	70	9
14056	HWY 99 SB:SB	8	70	33	0	25	1	60	1	58	11	10	0	92	19
14058	HWY 99 SB:SB	8	75	26	0	25	1	25	1	60	19	10	100	88	19
14102	HWY 99 NB:NB	8	72	26	0	25	1	25	1	59	16	9	100	74	13
14361	80 EB:EB	8	75	25	0	25	0	25	0	57	43	4	100	81	22
14478	I 5 NB:NB	8	74	38	0	25	1	85	1	46	39	6	100	42	6
14818	I 80 EB:EB	8	72	37	0	25	0	85	0	56	23	6	0	79	10

OID_num	NAME	final_score_slr_road	scale_score_slr_road	scalevulnsens_score_slr_road	scale_recdmg	scale_slr_increment	scale_slrmax_per	scale_slrd_increment	scale_slrdis_max_per	scale_fac_vol	scale_node_dens	scale_popemp_dens	scale_ln_LI_HM	scale_CES_a_wm	scale_noveh_awm
14853	HWY 99 SB:SB	8	72	25	0	25	0	25	0	58	12	11	100	92	18
14884	HWY 99 NB:NB	8	72	38	0	25	1	85	1	58	13	9	0	65	13
14885	HWY 99 SB:SB	8	72	26	0	25	1	25	1	60	17	9	100	73	12
15206	HWY 99 SB:SB	8	71	40	0	25	0	100	0	44	1	10	100	62	17
15299	US 50 WB:WB	8	79	40	0	25	1	100	1	69	1	14	0	61	18
15955	US 50 EB:EB	8	74	25	0	25	0	25	0	80	1	15	0	59	17
19293	HWY 99 NB:NB	8	73	25	0	25	0	25	0	64	13	8	100	57	14
19429		8	71	36	0	25	1	75	1	44	1	25	100	84	19
19438	US 50 WB:WB	8	79	31	0	25	1	55	1	65	2	17	100	82	16
20873	US 50 EB:EB	8	77	32	0	25	0	60	1	73	2	31	0	77	12

Table 10: Top Transit Sea Level Rise Vulnerability Scores

OID_num	Type	final_score_slr_trans	scale_score_slr_trans	scalevulnsens_score_slr_trans	scale_re_c_dmg	scale_slr_increment	scale_slrd_increment	scale_fac_vol	scale_nonde_dens	scale_pomp_de ns	scale_In_LI_HM	scale_CES_awm	scale_noveh_awm
8016	LRT	10	100	63	0	25	25	100	4	84	100	92	50
4910	LRT	9	83	63	0	25	25	69	5	95	100	86	33
8017	LRT	8	74	63	0	25	25	48	3	85	100	89	43
2089	BUS	7	62	63	0	25	25	24	8	83	100	90	41
4514	BUS	7	62	95	0	25	90	6	95	14	100	19	7
4909	LRT	7	61	63	0	25	25	45	10	33	0	76	29
5734	BUS	7	65	63	0	25	25	29	2	83	100	91	49
5760	BUS	7	68	63	0	25	25	37	4	69	100	91	45
9240	BUS	7	66	100	0	25	100	0	5	43	100	86	44
2027	BUS	6	52	63	0	25	25	1	2	66	100	93	60
2029	BUS	6	52	63	0	25	25	4	9	81	100	90	37
2030	BUS	6	52	63	0	25	25	4	10	90	100	89	37
2068	BUS	6	57	63	0	25	25	18	11	59	100	90	35
2091	BUS	6	53	63	0	25	25	6	10	93	100	89	36
2095	BUS	6	58	63	0	25	25	18	11	76	100	88	33

OID_num	Type	final_score_slr_trans	scale_score_slr_trans	scalevulnsens_score_slr_trans	scale_re c_dmg	scale_slr_increment	scale_slrd_increment	scale_fac_vol	scale_node_dens	scale_pomp_dens	scale_In_LI_HM	scale_CES_awm	scale_noveh_awm
2145	BUS	6	55	63	0	25	25	6	2	80	100	91	57
2226	BUS	6	51	63	0	25	25	0	2	85	100	88	47
2227	BUS	6	51	63	0	25	25	0	9	93	100	90	39
2229	BUS	6	51	63	0	25	25	1	10	95	100	88	37
2230	BUS	6	52	63	0	25	25	5	11	78	100	86	34
2238	BUS	6	57	63	0	25	25	16	10	76	100	89	37
3424	BUS	6	58	63	0	25	25	17	9	80	100	90	38
3425	BUS	6	50	63	0	25	25	3	12	67	100	85	36
3426	BUS	6	51	63	0	25	25	9	14	38	100	79	35
3743	BUS	6	51	63	0	25	25	10	70	22	100	68	18
3773	BUS	6	51	63	0	25	25	8	80	13	100	83	17
3868	BUS	6	52	85	0	25	70	0	56	6	100	26	9
4513	BUS	6	55	100	0	25	100	5	34	15	0	31	10
4515	BUS	6	53	100	0	25	100	1	70	7	0	14	4

OID_num	Type	final_score_slr_trans	scale_score_slr_trans	scalevulnsens_score_slr_trans	scale_re c_dmg	scale_slr_increment	scale_slrd_increment	scale_fac_vol	scale_nonde_dens	scale_pos_pemp_dens	scale_In_LI_HM	scale_CES_awm	scale_noveh_awm
4516	BUS	6	53	100	0	25	100	1	70	9	0	16	4
4517	BUS	6	58	100	0	25	100	0	60	6	100	18	5
4518	BUS	6	51	95	0	25	90	3	39	10	0	28	5
4519	BUS	6	53	100	0	25	100	0	60	5	0	20	6
4520	BUS	6	57	95	0	25	90	0	65	4	100	26	9
4535	BUS	6	53	100	0	25	100	2	59	6	0	19	7
4739	BUS	6	50	63	0	25	25	5	13	54	100	84	36
4860	BUS	6	50	93	0	25	85	1	52	10	0	37	9
4907	BUS	6	51	63	0	25	25	6	12	70	100	81	34
4908	LRT	6	58	63	0	25	25	36	9	53	0	80	29
5733	BUS	6	56	63	0	25	25	9	2	89	100	91	53
5738	BUS	6	50	63	0	25	25	12	3	100	0	87	37
5754	BUS	6	58	63	0	25	25	19	10	77	100	86	30
5756	BUS	6	51	63	0	25	25	2	7	90	100	88	37

OID_num	Type	final_score_slr_trans	scale_score_slr_trans	scale_vulnsens_score_slr_trans	scale_re_c_dmg	scale_slr_increment	scale_slrd_increment	scale_fac_vol	scale_nonde_dens	scale_pompemp_de ns	scale_In_LI_HM	scale_CES_awm	scale_noveh_ahwm
5757	BUS	6	54	63	0	25	25	13	11	58	100	87	31
5758	BUS	6	53	63	0	25	25	6	6	84	100	89	41
5759	BUS	6	53	63	0	25	25	6	10	94	100	89	37
5761	BUS	6	53	63	0	25	25	6	8	86	100	90	40
5790	BUS	6	52	63	0	25	25	4	10	80	100	87	37
6030	BUS	6	52	75	0	25	50	1	98	0	100	76	3
6159	BUS	6	51	80	0	25	60	0	44	12	100	76	3
8049	LRT	6	59	63	0	25	25	22	93	20	100	77	21
8065	LRT	6	57	63	0	25	25	25	76	11	100	66	10
8066	LRT	6	55	63	0	25	25	22	81	6	100	69	3
8316	BUS	6	59	100	0	25	100	2	60	7	100	18	5
8320	BUS	6	55	100	0	25	100	3	83	7	0	14	3
8321	BUS	6	54	100	0	25	100	2	66	5	0	21	6
8322	BUS	6	53	100	0	25	100	0	60	7	0	23	5
8342	BUS	6	53	63	0	25	25	11	83	22	100	71	18
8543	LRT	6	57	63	0	25	25	23	13	28	100	76	34

OID_num	Type	final_score_slr_trans	scale_score_slr_trans	scalevulnsens_score_slr_trans	scale_repair_dmg	scale_slr_increment	scale_slrd_increment	scale_fault_vol	scale_node_dens	scale_pos_pemp_dens	scale_In_LI_HM	scale_CES_awm	scale_noveh_awm
8599	LRT	6	58	63	0	25	25	21	14	42	100	84	36

Table 11: Top Bridge Sea Level Rise Vulnerability Scores

OID_num	NAME	final_score_slr_brid	scale_score_slr_brid	scalevulnsens_score_slr_brid	scale_rec_dmg	scale_slr_increment	scale_slrd_increment	scale_Bwaterway_adequ	scale_facc_vol	scale_Bdetour	scale_popemp_de ns	scale_In_LL_H M	scale_CES_awm	scale_nov eh_a wm
369	SACRAMENTO RIVER (ISLETON)	10	100	100	0	100	100	45	1	13	0	0	55	0
683	MOKELUMNE RIVER	10	90	85	0	100	100	15	6	28	3	0	61	4
1164	GEORGIANA SLOUGH	10	100	100	0	100	100	45	1	13	1	0	55	0
1671	RIVERFRONT SEAL SLAB	10	94	45	0	25	25	50	74	10	24	100	87	20
1670	CASILADAWAY POC	8	74	45	0	25	25	50	55	10	8	0	50	4
524	MIDDLE SLOUGH	7	65	59	0	65	75	15	11	7	0	0	59	3
525	MIDDLE SLOUGH	7	66	60	0	65	85	15	11	7	0	0	59	3
526	LOST SLOUGH	7	67	60	0	65	85	15	11	9	0	0	59	3
527	LOST SLOUGH	7	67	60	0	65	85	15	11	9	0	0	59	3
1719	K STREET MALL-DOWNTOWN	7	66	45	0	25	25	50	3	10	100	100	93	60

OID_num	NAME	final_score_slr_brid	scale_score_slr_brid	scale_vulnsens_score_slr_brid	scale_rec_dmg	scale_slr_increment	scale_slrd_increment	scale_Bwaterway_adequ	scale_fac_vol	scale_Bdetour	scale_popemp_de ns	scale_In_LI_H M	scale_CES_awm	scale_nov eh_a wm
	WN PLAZA													
1734	FLORIN RD UP	7	62	45	0	25	25	50	12	10	30	100	73	17
223	YOLO CAUSEWAY EAST	6	57	27	0	25	25	15	54	24	0	0	39	1
517	43RD AVENUE UC	6	51	19	0	25	25	0	47	5	16	100	42	6
1254	STONE LAKE CANAL	6	54	51	0	25	90	45	3	13	0	0	55	0
1338	ANDERSON DRAIN	6	50	39	0	25	55	30	5	1	16	100	64	13
1723	EXECUTIVE DRAIN	6	54	45	0	25	25	50	0	10	6	100	55	10
1725	19TH TO 22ND ST VIADUCT	6	54	45	0	25	25	50	4	10	40	0	75	29
1727	SEYMOUR PARK POC	6	59	53	0	25	85	50	14	10	8	0	21	5
1728	SEYMOUR PARK POC	6	52	51	0	25	70	50	2	10	7	0	29	7
371	SACRAMENTO RIVER	5	47	46	0	25	55	45	1	6	0	0	55	0

OID_num	NAME	final_score_slr_brid	scale_score_slr_brid	scalevulnsens_score_slr_brid	scale_rec_dmg	scale_slr_increment	scale_slrd_increment	scale_Bwaterway_adequ	scale_fac_vol	scale_Bdetour	scale_popemp_de ns	scale_In_LI_H M	scale_CES_awm	scale_nov eh_a wm
	(PAINTER SVILLE)													
523	SOUTH LAND PARK DRIVE OC	5	41	19	0	25	25	0	41	3	11	0	42	9
576	STONE LAKE CREEK	5	41	33	0	25	70	15	11	12	0	0	59	3
583	SOUTH REACH STONE LAKE	5	47	35	0	25	85	15	22	7	0	0	59	3
584	MIDDLE REACH STONE LAKE	5	45	33	0	25	70	15	22	15	0	0	41	1
586	SOUTH REACH BEACH LAKE	5	48	27	0	25	25	15	37	12	1	0	56	1
1152	SUTTER SLOUGH	5	45	32	0	25	65	15	1	100	0	0	50	0
1209	DOUGLAS DRAIN	5	43	37	0	25	100	15	3	1	7	100	19	3
1226	DRAINAGE DITCH	5	45	42	0	25	25	45	1	4	0	0	62	6
1227	DRAINAGE DITCH	5	44	42	0	25	25	45	1	3	0	0	62	6

OID_num	NAME	final_score_slr_brid	scale_score_slr_brid	scale_vulnsens_score_slr_brid	scale_rec_dmg	scale_slr_increment	scale_slrd_increment	scale_Bwaterway_adequ	scale_fac_vol	scale_Bdetour	scale_popemp_de ns	scale_In_LI_H M	scale_CES_awm	scale_nov eh_a wm
1228	STONE LAKE DRAIN	5	45	42	0	25	25	45	1	9	0	0	62	6
1231	DRAINAGE DITCH	5	42	42	0	25	25	45	1	7	1	0	26	1
1232	STONE LAKE DRAIN	5	43	42	0	25	25	45	1	7	7	0	24	1
1233	DRAINAGE DITCH	5	43	42	0	25	25	45	3	7	6	0	24	2
1237	DELTA CROSS CHANNEL	5	43	39	0	50	50	0	4	12	2	0	55	0
1272	ANDERS ON DRAIN	5	45	31	0	25	55	15	11	1	10	100	60	9
1273	ANDERS ON DRAIN	5	45	27	0	25	25	15	15	2	17	100	66	18
1330	MAIN CANAL	5	44	44	0	25	100	30	2	2	13	0	17	4
1331	ELDER CREEK	5	42	27	0	25	25	15	9	1	18	100	67	21
1336	ANDERS ON DRAIN	5	48	39	0	25	55	30	2	1	11	100	61	10
1337	ANDERS ON DRAIN	5	45	35	0	25	25	30	2	1	16	100	64	10

OID_num	NAME	final_score_slr_brid	scale_score_slr_brid	scalevulnsens_score_slr_brid	scale_rec_dmg	scale_slr_increment	scale_slrd_increment	scale_Bwaterway_adequ	scale_fac_vol	scale_Bdetour	scale_popemp_deps	scale_In_LI_HM	scale_CES_awm	scale_nov eh_awm
1339	ANDERS ON DRAIN	5	44	35	0	25	25	30	0	1	14	100	64	15
1404	FLORIN CREEK	5	44	35	0	25	25	30	0	1	10	100	73	4
1445	DRAIN DITCH	5	44	42	0	25	25	45	0	2	0	0	61	5
1505	FRANKLIN BLVD	5	50	50	0	25	25	60	1	7	1	0	26	1
1726	SEYMOUR PARK POC	5	50	45	0	25	25	50	7	10	14	0	29	7

Table 12: Top Airport Sea Level Rise Vulnerability Scores

OID_num	FACILITY	CITY	final_score_slr_air	scalescore_slr_air	scalevulnscore_slr_air	scale_re c_dmg	scale_slr_incr ement	scale_slrd_in crement	scale_apo rt_class
177	SACRAMENTO EXECUTIVE AIRPORT	Sacramento	10	100	100	0	25	25	75
65	FRANKLIN FIELD AIRPORT	Franklin	6	55	100	0	25	25	25

Table 13: Top Roadway Storm Surge Vulnerability Scores

OID_num	NAME	final_score_surge_road	scalescore_surge_road	scalescore_vulnscore_surge_road	scale_rec_dmg	scale_surge_increment	scale_surgemax_per	scale_fac_vol	scale_node_dens	scale_popempop_dens	scale_In_LI_HM	scale_CES_awnm	scale_noveh_awnm
14364	I 80 WB:WB	10	100	99	0	100	0	58	51	0	0	51	7
20228		10	99	99	0	100	0	58	49	0	0	49	6
5343		9	80	100	0	100	1	1	96		0	61	4
11541		9	82	100	0	100	1	9	91	0	0	60	4
11544		9	80	100	0	100	1	1	96		0	61	4
11545		9	82	100	0	100	1	10	92	0	0	61	4
11548		9	82	100	0	100	1	9	91	0	0	60	4
11549		9	82	100	0	100	1	10	92	0	0	61	4
13423	I 5 SB:SB	9	85	100	0	100	0	23	66	0	0	59	4
14361	80 EB:EB	9	83	59	0	60	0	57	43	4	100	81	22
19132	I 5 NB:NB	9	85	99	0	100	0	23	66	0	0	60	4
5357	COURTLAND RD	8	74	99	0	100	0	0	79	0	0	39	1
5410		8	74	99	0	100	0	0	68	0	0	55	0
5413	COURTLAND RD	8	74	99	0	100	0	0	79	0	0	39	1
5414		8	74	99	0	100	0	0	76	0	0	49	0
5415	S RIVER RD	8	75	99	0	100	0	0	90	0	0	43	1
5417	S RIVER RD	8	75	99	0	100	0	0	90	0	0	44	1

OID_num	NAME	final_score_surge_road	scalescore_surge_road	scalevulnsens_score_surge_road	scale_rec_dmg	scale_surge_increment	scale_surgemax_per	scale_fac_vol	scale_node_dens	scale_popemp_dens	scale_In_LI_HM	scale_CES_awm	scale_noveh_awm
5418	S RIVER RD	8	75	99	0	100	0	0	91	0	0	45	1
5424	S RIVER RD	8	77	99	0	100	0	2	96	0	0	42	1
5426		8	74	99	0	100	0	2	70	1	0	48	0
5427		8	71	99	0	100	0	0	54	1	0	42	1
5428	S RIVER RD	8	75	99	0	100	0	2	80	0	0	45	1
10503	TWIN CITIES RD	8	79	99	0	100	0	4	96	0	0	55	0
10507	FRANKLIN BLVD	8	76	99	0	100	0	0	87	0	0	62	6
10612		8	78	100	0	100	1	0	96	0	0	61	6
10643		8	74	100	0	100	1	0	71	0	0	55	0
10645		8	74	99	0	100	0	0	68	0	0	55	0
10646		8	74	100	0	100	1	0	71	0	0	55	0
10647		8	76	99	0	100	0	0	91	0	0	55	0
10652		8	76	99	0	100	0	4	77	0	0	55	0
10653	HWY 160	8	78	99	0	100	0	4	90	0	0	55	0
10655		8	76	99	0	100	0	4	77	0	0	55	0
10659	HWY 160	8	76	99	0	100	0	4	71	3	0	55	0
10660	HWY 160	8	75	99	0	100	0	0	77	2	0	55	0
10663	RIVER RD	8	76	99	0	100	0	0	87	0	0	55	0
10664		8	76	99	0	100	0	0	91	0	0	55	0

OID_num	NAME	final_score_surge_road	scalescore_surge_road	scalevulnsens_score_surge_road	scale_rec_dmg	scale_surge_increment	scale_surgemax_per	scale_fac_vol	scale_node_dens	scale_popemp_dens	scale_ln_LI_HM	scale_CES_awm	scale_noveh_awm
10666	RIVER RD	8	76	99	0	100	0	0	90	0	0	55	0
10670		8	74	99	0	100	0	0	76	0	0	49	0
10672		8	74	100	0	100	0	0	72	0	0	55	0
10673		8	74	100	0	100	0	1	72	0	0	55	0
10674	RIVER RD	8	74	99	0	100	0	1	73	0	0	52	0
10675	RIVER RD	8	75	99	0	100	0	0	79	0	0	55	0
10692		8	74	99	0	100	0	2	70	1	0	48	0
10702	RIVER RD	8	75	99	0	100	0	1	81	0	0	55	0
10706	RIVER RD	8	75	99	0	100	0	1	81	0	0	55	0
10707	RIVER RD	8	77	100	0	100	1	0	91	0	0	55	0
10811	TWIN CITIES RD	8	79	99	0	100	0	4	96	0	0	55	0
10845	RIVER RD	8	77	99	0	100	0	4	78	2	0	55	0
10986	RIVER RD	8	76	99	0	100	0	0	90	0	0	55	0
10988	RIVER RD	8	74	99	0	100	0	1	73	0	0	52	0
10989	RIVER RD	8	76	99	0	100	0	1	87	1	0	49	0
10991	FRANKLIN BLVD	8	76	99	0	100	0	0	87	0	0	62	6
10992		8	78	100	0	100	1	0	96	0	0	61	6
11550		8	79	100	0	100	1	3	92	0	0	58	2
11553		8	79	100	0	100	1	3	92	0	0	58	2

OID_num	NAME	final_score_surge_road	scalescore_surge_road	scalevulnsens_score_surge_road	scale_rec_dmg	scale_surge_increment	scale_surgemax_per	scale_fac_vol	scale_node_dens	scale_popemp_dens	scale_In_LI_H_M	scale_CES_awm	scale_noveh_awm
11554	HWY 160	8	79	100	0	100	0	4	96	0	0	55	0
19130		8	77	99	0	100	0	1	96	0	0	55	0
19136	HWY 160	8	76	99	0	100	0	5	71	3	0	55	0
19137	RIVER RD	8	77	99	0	100	0	4	78	2	0	55	0
19138		8	75	99	0	100	0	1	80	1	0	55	0
19139		8	77	99	0	100	0	1	96	0	0	55	0
19140		8	75	99	0	100	0	1	80	1	0	55	0
24115	S RIVER RD	8	76	99	0	100	0	0	96	0	0	45	1
29579		8	71	99	0	100	0	0	54	1	0	42	1
29581	RIVER RD	8	75	99	0	100	0	2	80	0	0	45	1
29585	S RIVER RD	8	77	99	0	100	0	2	96	0	0	42	1
29586	S RIVER RD	8	77	99	0	100	0	2	96	0	0	44	1
29590	S RIVER RD	8	77	99	0	100	0	2	96	0	0	44	1
29595		8	75	99	0	100	0	0	90	0	0	44	1
29596	S RIVER RD	8	76	99	0	100	0	0	96	0	0	44	1
29597	S RIVER RD	8	76	99	0	100	0	0	96	0	0	45	1
29598	S RIVER RD	8	76	99	0	100	0	0	96	0	0	44	1

OID_num	NAME	final_score_surge_road	scalescore_surge_road	scalevulnsens_score_surge_road	scale_rec_dmg	scale_surge_increment	scale_surgemax_per	scale_fac_vol	scale_node_dens	scale_popemp_den	scale_In_LI_HM	scale_CES_awm	scale_noveh_awm
29599	S RIVER RD	8	75	99	0	100	0	0	90	0	0	43	1
29600	S RIVER RD	8	77	100	0	100	1	0	96	0	0	44	1
29601	S RIVER RD	8	75	99	0	100	0	0	91	0	0	45	1
29602	S RIVER RD	8	77	100	0	100	1	0	96	0	0	44	1
29606	RIVER RD	8	76	99	0	100	0	1	87	1	0	49	0
29607	RIVER RD	8	75	99	0	100	0	0	79	0	0	55	0
29608	RIVER RD	8	77	100	0	100	1	0	91	0	0	55	0
29609	HWY 160	8	75	99	0	100	0	0	77	2	0	55	0
29610	RIVER RD	8	76	99	0	100	0	0	87	0	0	55	0
29611	HWY 160	8	78	99	0	100	0	4	90	0	0	55	0
29612	HWY 160	8	79	100	0	100	0	4	96	0	0	55	0

Table 14: Top Bridge Storm Surge Vulnerability

OID_num	NAME	final_score_surge_brid	scalescore_surge_brid	scalesvulnsens_score_surge_brid	scale_rec_dmg	scale_surge_increment	scale_Bsubst_ruct_cond	scale_Bscour_crit	scale_Bwaterway_adequ	scale_fa_c_vol	scale_Bdetour	scale_popemp_dens	scale_In_LI_HM	scale_CES_awm	scale_noveh_awm
369	SACRAMENTO RIVER (ISLETON)	10	100	100	0	100	30	50	45	1	13	0	0	55	0
1230	MOKELUMNE RIVER OVERFLOW	5	47	45	0	40	70	50	15	0	8	0	0	62	6
1525	BEAVER SLOUGH	5	43	42	0	40	0	60	15	0	5	0	0	55	0

Table 15: Top Roadway Wildfire Vulnerability Scores

OID_n um	NAME	LAN ES	final_s core_fi re_ro ad	scales core_fi re_ro ad	scalevuln sens_sco re_fire_ro ad	scale_r ec_dmg	scale_t ime_el ev_bur n	scale_c at_burn	scale_f ac_vol	scale _nod e_de ns	scale_ pope mp_d ens	scal e_In_ LI_H M	scale_C ES_awm	scale_ nove h_aw m
10937	I80 W:W	2	10	93	100	0	100	100	15	91	0	0	16	1
10938	I80 E:E	2	10	93	100	0	100	100	15	96	0	0	17	1
11022	US HWY 50	2	10	95	100	0	100	100	33	46	4	0	13	5
12709	US HWY 50	2	10	92	100	0	100	100	23	47	3	0	13	6
13282		3	10	90	88	0	100	75	44	78	1	0	7	2
13453	I 5 NB:NB	3	10	91	88	0	100	75	43	55	2	0	65	1
13458	I 5 SB:SB	3	10	90	88	0	100	75	43	53	2	0	62	1
13500	I 5 NB:NB	4	10	90	88	0	100	75	52	20	6	0	42	6
13512	I 5 SB:SB	4	10	91	88	0	100	75	53	27	4	0	45	5
13529	I 5 SB:SB	4	10	94	88	0	100	75	57	44	4	0	52	6
13600	I 5 SB:SB	4	10	98	88	0	100	75	71	21	5	0	70	9
13772	50 EB:EB	4	10	97	88	0	100	75	52	21	12	100	93	28
13773	50 WB:WB	4	10	94	88	0	100	75	40	36	5	100	93	28
13932	I 5 NB:NB	4	10	99	88	0	100	75	77	20	6	0	70	9
13935	I 5 SB:SB	4	10	99	88	0	100	75	72	21	4	0	84	23
13996	US 50 WB:WB	3	10	90	88	0	100	75	49	29	7	0	53	4
14012	I 5 NB:NB	4	10	93	88	0	100	75	56	5	6	0	91	21

OID_num	NAME	LAN ES	final_score_fire_road	scales_core_fire_road	scalevulnsens_score_fire_road	scale_rec_dmg	scale_time_ev_burn	scale_cat_burn	scale_fac_vol	scale_node_dens	scale_pop_dens	scale_In_LI_H M	scale_C ES_awm	scale_nove_h_awm
14013	I 5 SB:SB	4	10	96	88	0	100	75	58	45	4	0	76	16
14024	US 50 EB:EB	2	10	93	100	0	100	100	30	27	10	0	15	2
14026	US 50 WB:WB	2	10	91	100	0	100	100	27	29	9	0	12	1
14039	I 5 NB:NB	4	10	95	88	0	100	75	56	44	4	0	77	17
14246	I 5 NB:NB	4	10	91	88	0	100	75	52	27	4	0	46	5
14248	I 5 SB:SB	4	10	91	88	0	100	75	54	19	6	0	41	6
14348	I 80 WB:WB	3	10	93	88	0	100	75	57	46	0	0	26	2
14356	50 EB:EB	4	10	94	88	0	100	75	39	35	5	100	93	28
14361	80 EB:EB	4	10	99	88	0	100	75	57	43	4	100	81	22
14364	I 80 WB:WB	3	10	95	88	0	100	75	58	51	0	0	51	7
14391	80 WB:WB	3	10	90	88	0	100	75	40	36	4	0	92	22
14600		3	10	90	88	0	100	75	51	40	6	0	12	2
14623		3	10	91	88	0	100	75	44	34	1	100	8	2
15421	US 50 WB:WB	2	10	95	100	0	100	100	36	36	5	0	13	2
15429	US 50 EB:EB	2	10	93	100	0	100	100	31	30	9	0	13	2
15615	I 5 NB:NB	4	10	93	88	0	100	75	55	46	4	0	52	6
18978	US 50 EB:EB	2	10	93	100	0	100	100	31	36	4	0	14	2
19085	US HWY 50	2	10	94	100	0	100	100	29	48	3	0	12	4

OID_n um	NAME	LAN ES	final_s core_fi re_road	scales core_fi re_road	scalevuln sens_sco re_fire_road	scale_r ec_dmg	scale_t ime_el ev_burn	scale_c at_burn	scale_f ac_vol	scale _nod e_de ns	scale_ pope mp_d ens	scal e_In_ LI_H M	scale_C ES_awm	scale _nove h_aw m
19087	US HWY 50	2	10	93	100	0	100	100	29	42	8	0	10	5
19089	US HWY 50	2	10	93	100	0	100	100	29	43	2	0	12	4
19091	US HWY 50	2	10	94	100	0	100	100	29	50	3	0	10	5
19126	US 50 EB:EB	2	10	95	100	0	100	100	35	38	3	0	14	2
19234	50 WB:WB	4	10	93	88	0	100	75	51	21	12	0	93	28
19444	I 5 SB:SB	4	10	93	88	0	100	75	58	5	5	0	89	21
19540	US 50 WB:WB	2	10	94	100	0	100	100	36	23	9	0	12	1
19542	US 50 EB:EB	2	10	93	100	0	100	100	30	30	10	0	13	2
19936	US 50 WB:WB	3	10	91	88	0	100	75	48	38	8	0	51	3
19937	US 50 EB:EB	3	10	91	88	0	100	75	50	29	7	0	53	4
19980	US 50 WB:WB	2	10	94	100	0	100	100	36	32	8	0	12	2
19981	US 50 EB:EB	2	10	92	100	0	100	100	31	22	6	0	13	2
19982	US 50 WB:WB	2	10	95	100	0	100	100	38	28	9	0	14	2
19985	US 50 EB:EB	2	10	93	100	0	100	100	29	39	7	0	15	2
19990	US 50 WB:WB	2	10	92	100	0	100	100	27	38	4	0	13	2
19991	US 50 EB:EB	2	10	94	100	0	100	100	35	29	4	0	11	3

OID_n um	NAME	LAN ES	final_s core_fi re_road	scales core_fi re_road	scalevuln sens_sco re_fire_ro ad	scale_r ec_dmg	scale_t ime_el ev_bur n	scale_c at_burn	scale_f ac_vol	scale _nod e_de ns	scale_ pope mp_d ens	scal e_In_ LI_H M	scale_C ES_awm	scale _nove h_aw m
20007	US HWY 50	2	10	92	100	0	100	100	31	17	4	0	10	2
20030	US 50 EB:EB	3	10	91	88	0	100	75	49	38	8	0	52	3
20199	US HWY 50	2	10	91	100	0	100	100	30	17	4	0	9	3
20228		3	10	94	88	0	100	75	58	49	0	0	49	6
20234	I 80 WB:WB	3	10	95	88	0	100	75	58	68	0	0	39	1
20288	I80 E:E	3	10	92	88	0	100	75	46	87	1	0	14	5
20289	I80 W:W	3	10	90	88	0	100	75	46	70	1	0	8	2
20341	80 WB:WB	6	10	100	88	0	100	75	57	43	4	100	85	24
20470	I 80 EB:EB	3	10	95	88	0	100	75	57	68	0	0	38	1
20471	I 80 EB:EB	3	10	92	88	0	100	75	56	46	0	0	28	2
20473	I 80 WB:WB	3	10	94	88	0	100	75	57	58	0	0	26	2
20899	US HWY 50	2	10	92	100	0	100	100	29	34	9	0	9	3
20906	US HWY 50	2	10	91	100	0	100	100	24	31	10	0	9	3
20968	LATRO BE RD	3	10	90	100	0	100	100	20	38	9	0	15	2
21100	CAMBRI DGE RD	1	10	91	100	0	100	100	8	96	4	0	9	4
21125	US HWY 50	2	10	91	100	0	100	100	23	45	6	0	11	5

OID_n um	NAME	LAN ES	final_s core_fi re_road	scales core_fi re_road	scalevuln sens_sco re_fire_road	scale_r ec_dmg	scale_t ime_el ev_burn	scale_c at_burn	scale_f ac_vol	scale _nod e_de ns	scale_ pope mp_d ens	scal e_In_ LI_H M	scale_C ES_awm	scale _nove h_aw m
21130	US HWY 50	2	10	92	100	0	100	100	23	50	3	0	14	5
21132	US HWY 50	2	10	95	100	0	100	100	33	46	4	0	13	6
21134	US HWY 50	2	10	93	100	0	100	100	26	45	9	0	12	5
21144	US HWY 50	2	10	93	100	0	100	100	26	45	8	0	12	5
21146	US HWY 50	2	10	93	100	0	100	100	29	42	8	0	12	5
21183	US HWY 50	2	10	93	100	0	100	100	29	43	3	0	11	4
21185	US HWY 50	2	10	90	100	0	100	100	22	37	4	0	12	4
21196	US HWY 50	2	10	90	100	0	100	100	21	38	5	0	11	4
21518		1	10	90	100	0	100	100	0	96		0	13	4
21519		1	10	90	100	0	100	100	0	96		0	13	4
21822	US HWY 50	2	10	91	100	0	100	100	11	89	0	0	15	2
22319		1	10	90	100	0	100	100	0	96		0	13	4
22341		1	10	90	100	0	100	100	0	96		0	13	4
22384	CAMBRI DGE RD	1	10	91	100	0	100	100	8	96	4	0	9	4
22394	US HWY 50	2	10	91	100	0	100	100	22	45	6	0	12	5

OID_n um	NAME	LAN ES	final_s core_fi re_road	scales core_fi re_road	scalevuln sens_sco re_fire_ro ad	scale_r ec_dmg	scale_t ime_el ev_burn	scale_c at_burn	scale_f ac_vol	scale _nod e_de ns	scale_ pope mp_d ens	scal e_In_ LI_H M	scale_C ES_awm	scale _nove h_aw m
22746	US HWY 50	2	10	91	100	0	100	100	25	37	9	0	10	3
22756	US HWY 50	2	10	90	100	0	100	100	21	37	5	0	11	4
23236	I80 E:E	3	10	90	88	0	100	75	46	70	1	0	8	2
23801	I80 W:W	3	10	92	88	0	100	75	46	87	1	0	14	5
23976	MARYS VILLE RD	1	10	92	100	0	100	100	1	96	0	100	11	2
23977	MARYS VILLE RD	1	10	91	100	0	100	100	1	87	0	100	11	2
23978	MARYS VILLE RD	1	10	92	100	0	100	100	0	96	0	100	11	2
23979	MARYS VILLE RD	1	10	92	100	0	100	100	0	96	0	100	11	2
23980	MARYS VILLE RD	1	10	92	100	0	100	100	0	96	0	100	11	2
23981		1	10	92	100	0	100	100	0	91	0	100	11	2
23982	HWY 49	1	10	92	100	0	100	100	0	96	0	100	11	2
23983	HWY 49	1	10	92	100	0	100	100	0	96	0	100	11	2
27113	MARYS VILLE RD	1	10	92	100	0	100	100	1	96	0	100	11	2
27126		1	10	91	100	0	100	100	0	89	0	100	11	2
27127		1	10	92	100	0	100	100	0	96	0	100	11	2
27173	LA PORTE RD	1	10	92	100	0	100	100	0	96	0	100	11	2

OID_n um	NAME	LAN ES	final_s core_fi re_road	scales core_fi re_road	scalevuln sens_sco re_fire_road	scale_r ec_dmg	scale_t ime_el ev_burn	scale_c at_burn	scale_f ac_vol	scale _nod e_de ns	scale_ pope mp_d ens	scal e_In_ LI_H M	scale_C ES_awm	scale _nove h_aw m
27177	MARYS VILLE RD	1	10	91	100	0	100	100	1	87	0	100	11	2
27178		1	10	91	100	0	100	100	0	89	0	100	11	2
27179	MARYS VILLE RD	1	10	92	100	0	100	100	1	89	0	100	11	2
27181	MARYS VILLE RD	1	10	92	100	0	100	100	0	96	0	100	11	2
27182	MARYS VILLE RD	1	10	92	100	0	100	100	1	89	0	100	11	2
27183		1	10	92	100	0	100	100	0	96	0	100	11	2
27184		1	10	92	100	0	100	100	0	96	0	100	11	2
27186		1	10	92	100	0	100	100	0	96	0	100	11	2
27190	HWY 49	1	10	92	100	0	100	100	0	96	0	100	11	2
27192	HWY 49	1	10	92	100	0	100	100	0	96	0	100	11	2
27193	HWY 49	1	10	92	100	0	100	100	0	96	0	100	11	2
27194	HWY 49	1	10	92	100	0	100	100	0	96	0	100	11	2
27195	HWY 49	1	10	91	100	0	100	100	0	89	0	100	11	2
27196		1	10	92	100	0	100	100	0	91	0	100	11	2
27197	HWY 49	1	10	91	100	0	100	100	0	89	0	100	11	2
27198	HWY 49	1	10	92	100	0	100	100	0	91	0	100	11	2
27208	HWY 49	1	10	92	100	0	100	100	0	96	0	100	11	2
27209	HWY 49	1	10	92	100	0	100	100	0	91	0	100	11	2
27210	HWY 49	1	10	92	100	0	100	100	0	96	0	100	11	2
27211	LA PORTE RD	1	10	92	100	0	100	100	0	96	0	100	11	2
27212	LA PORTE RD	1	10	92	100	0	100	100	0	96	0	100	11	2

OID_n um	NAME	LAN ES	final_s core_fi re_road	scales core_fi re_road	scalevuln sens_sco re_fire_road	scale_r ec_dmg	scale_t ime_el ev_burn	scale_c at_burn	scale_f ac_vol	scale _nod e_de ns	scale_ pope mp_d ens	scal e_In_ LI_H M	scale_C ES_awm	scale _nove h_aw m
27213	LA PORTE RD	1	10	92	100	0	100	100	0	96	0	100	11	2
27214	LA PORTE RD	1	10	92	100	0	100	100	0	96	0	100	11	2
27215	LA PORTE RD	1	10	92	100	0	100	100	0	96	0	100	11	2
27216	LA PORTE RD	1	10	92	100	0	100	100	0	96	0	100	11	2
27217	LA PORTE RD	1	10	92	100	0	100	100	0	96	0	100	11	2
27218	LA PORTE RD	1	10	92	100	0	100	100	0	96	0	100	11	2
27219	LA PORTE RD	1	10	92	100	0	100	100	0	96	0	100	11	2
27220	LA PORTE RD	1	10	92	100	0	100	100	0	96	0	100	11	2
27221	LA PORTE RD	1	10	92	100	0	100	100	0	96	0	100	11	2
27224		1	10	92	100	0	100	100	0	96	0	100	11	2
27225		1	10	92	100	0	100	100	0	96	0	100	11	2
27226	LA PORTE RD	1	10	91	100	0	100	100	0	91	0	100	11	2
27228	LA PORTE RD	1	10	91	100	0	100	100	0	91	0	100	11	2
27532	US 50 WB:WB	2	10	91	100	0	100	100	27	29	4	0	10	3

OID_n um	NAME	LAN ES	final_s core_fi re_roa d	scales core_fi re_roa d	scalevuln sens_sco re_fire_ro ad	scale_r ec_dmg	scale_t ime_el ev_bur n	scale_c at_burn	scale_f ac_vol	scale _nod e_de ns	scale_ pope mp_d ens	scal e_In_ LI_H M	scale_C ES_awm	scale _nove h_aw m
27534	US HWY 50	2	10	95	100	0	100	100	36	32	9	0	10	3
27886	I80 E:E	2	10	93	100	0	100	100	15	91	0	0	16	1
27889	I80 W:W	2	10	93	100	0	100	100	15	96	0	0	17	1
27890	I80 E:E	2	10	93	100	0	100	100	15	96	0	0	17	1
27891	I80 W:W	2	10	93	100	0	100	100	15	96	0	0	17	1
27892	I80 E:E	2	10	93	100	0	100	100	15	96	0	0	17	1
27893	I80 W:W	2	10	93	100	0	100	100	15	96	0	0	17	1
27894	I80 E:E	2	10	93	100	0	100	100	15	96	0	0	17	1
27895	I80 W:W	2	10	93	100	0	100	100	15	96	0	0	17	1
27896	I80 E:E	2	10	93	100	0	100	100	15	96	0	0	17	1
27898	I80 W:W	2	10	93	100	0	100	100	15	96	0	0	17	1
28628	US 50 WB:WB	2	10	96	100	0	100	100	37	39	7	0	15	2
28746	I 5 NB:NB	4	10	100	88	0	100	75	76	18	5	0	85	24
28933	I 80 EB:EB	3	10	93	88	0	100	75	56	58	0	0	27	2
30260		3	10	92	88	0	100	75	44	45	1	100	8	2
30262		3	10	91	88	0	100	75	45	78	1	0	7	2

Table 16: Top Transit Wildfire Vulnerability Scores

OID_n um	A	Type	final_s core_fi re_tran s	scales core_fi re_tran s	scalevulns ens_score_ fire_trans	scal e_re c_d mg	scale_tim e_elev_b urn	scale_ca t_burn	scale_fa c_vol	scale_no de_dens	scale_ popem p_den s	scale_I n_LI_H M	scale_CE S_awm	scale_ nove h_aw m
2500	2500	BUS	10	97	88	0	100	75	3	37	2	100	93	28
3400	3400	BUS	10	96	88	0	100	75	1	35	4	100	91	32
3658	3658	BUS	10	97	100	0	100	100	0	30	13	0	20	3
4135	4135	BUS	10	92	88	0	100	75	0	93	2	100	10	3
4160	4160	BUS	10	90	88	0	100	75	0	94	4	0	40	14
4391	4391	BUS	10	92	88	0	100	75	0	59	6	100	34	1
6102	6102	LRT	10	93	88	0	100	75	14	92	8	0	19	2
6236	6236	BUS	10	91	88	0	100	75	4	98	9	0	44	2
9486	9486	BUS	10	99	100	0	100	100	1	80	4	0	6	1
10405	1040 5	BUS	10	97	100	0	100	100	0	37	11	0	12	2
10424	1042 4	BUS	10	98	100	0	100	100	1	45	3	0	17	2
10474	1047 4	BUS	10	99	100	0	100	100	0	92	2	0	9	5
10475	1047 5	BUS	10	97	100	0	100	100	0	44	9	0	7	6
10478	1047 8	BUS	10	98	100	0	100	100	1	43	10	0	9	5
10485	1048 5	BUS	10	98	100	0	100	100	0	44	10	0	10	5
10489	1048 9	BUS	10	98	100	0	100	100	0	45	7	0	17	4
10507	1050 7	BUS	10	97	100	0	100	100	0	41	5	0	9	4
10555	1055 5	BUS	10	92	88	0	100	75	0	51	5	100	22	10
10806	1080 6	BUS	10	97	100	0	100	100	0	46	1	0	13	4
10907	1090 7	BUS	10	98	100	0	100	100	0	64	3	0	17	4
11023	11023	BUS	10	99	100	0	100	100	0	98	4	0	4	3

OID_n um	A	Type	final_s core_fi re_tran s	scales core_fi re_tran s	scalevulns ens_score_ fire_trans	scal e_re c_d mg	scale_tim e_elev_b urn	scale_ca t_burn	scale_fa c_vol	scale_no de_dens	scale_ popem p_den s	scale_l n_LI_H M	scale_CE S_awm	scale_ nove h_aw m
11027	11027	BUS	10	99	100	0	100	100	0	89	4	0	2	3
11038	11038	BUS	10	97	100	0	100	100	0	44	8	0	9	5
11039	11039	BUS	10	97	100	0	100	100	0	41	4	0	6	5
11046	11046	BUS	10	90	88	0	100	75	0	29	4	100	22	10
11047	11047	BUS	10	91	88	0	100	75	0	32	3	100	22	10
11185	11185	BUS	10	94	88	0	100	75	0	96	2	100	33	10
11243	11243	BUS	10	92	88	0	100	75	1	48	6	100	22	10
11248	11248	BUS	10	94	88	0	100	75	0	95	2	100	33	9
12364	12364	BUS	10	93	88	0	100	75	0	15	13	100	82	14
12423	12423	BUS	10	93	88	0	100	75	0	17	12	100	82	14
12424	12424	BUS	10	93	88	0	100	75	0	16	13	100	82	14
12505	12505	BUS	10	96	88	0	100	75	0	93	1	100	72	9
12518	12518	BUS	10	92	88	0	100	75	0	44	6	100	58	5
12519	12519	BUS	10	94	88	0	100	75	0	83	5	100	58	5
12537	12537	BUS	10	93	88	0	100	75	3	43	4	100	58	5
12545	12545	BUS	10	93	88	0	100	75	0	38	2	100	69	7
12546	12546	BUS	10	92	88	0	100	75	0	29	3	100	69	7
12648	12648	BUS	10	94	88	0	100	75	0	83	2	100	57	5
12977	12977	BUS	10	98	100	0	100	100	0	45	10	0	8	5
12979	12979	BUS	10	98	100	0	100	100	0	47	7	0	10	6
13011	13011	BUS	10	92	88	0	100	75	0	47	0	100	60	5

OID_num	A	Type	final_score_fire_trans	scales_core_fire_trans	scalevulns_score_fire_trans	scale_re_c_dmg	scale_time_elev_burn	scale_catt_burn	scale_factor_vol	scale_node_dens	scale_population_dens	scale_in_LI_HM	scale_CESawm	scale_noveh_awm
14721	14721	BUS	10	100	100	0	100	100	0	98	3	0	16	4
15506	15506	BUS	10	100	100	0	100	100	0	88	6	0	20	3
2253	2253	BUS	9	88	88	0	100	75	0	95	1	0	15	3
2606	2606	BUS	9	88	88	0	100	75	0	65	9	0	45	1
2689	2689	BUS	9	87	88	0	100	75	0	51	6	0	34	11
2720	2720	BUS	9	87	88	0	100	75	0	63	2	0	31	1
2721	2721	BUS	9	87	88	0	100	75	0	77	2	0	31	1
2726	2726	BUS	9	89	88	0	100	75	0	29	2	100	9	1
2727	2727	BUS	9	84	88	0	100	75	0	29	1	0	9	1
2731	2731	BUS	9	88	88	0	100	75	0	92	0	0	19	4
2732	2732	BUS	9	87	88	0	100	75	1	66	4	0	21	3
2745	2745	BUS	9	87	88	0	100	75	0	84	6	0	10	2
2781	2781	BUS	9	88	88	0	100	75	2	69	2	0	22	5
2783	2783	BUS	9	86	88	0	100	75	2	63	6	0	5	0
2796	2796	BUS	9	87	88	0	100	75	0	90	1	0	3	2
2797	2797	BUS	9	85	88	0	100	75	0	47	1	0	5	2
2861	2861	BUS	9	87	88	0	100	75	0	69	4	0	25	5
2862	2862	BUS	9	87	88	0	100	75	0	49	4	0	31	9
2863	2863	BUS	9	88	88	0	100	75	0	71	4	0	31	9
2865	2865	BUS	9	88	88	0	100	75	2	36	5	0	41	15
2869	2869	BUS	9	87	88	0	100	75	1	21	5	0	41	15
3090	3090	BUS	9	86	88	0	100	75	0	60	5	0	7	4
3224	3224	BUS	9	88	88	0	100	75	0	36	12	0	71	6
3496	3496	BUS	9	88	88	0	100	75	0	84	4	0	22	8
3497	3497	BUS	9	88	88	0	100	75	0	84	7	0	17	6
3551	3551	BUS	9	89	88	0	100	75	2	96	6	0	19	2
3555	3555	BUS	9	86	88	0	100	75	0	44	5	0	23	7
3558	3558	BUS	9	87	88	0	100	75	0	68	10	0	19	6
3559	3559	BUS	9	88	88	0	100	75	1	84	8	0	15	5

OID_n um	A	Type	final_s core_fi re_tran s	scales core_fi re_tran s	scalevulns ens_score_ fire_trans	scal e_re c_d mg	scale_tim e_elev_b urn	scale_ca t_burn	scale_fa c_vol	scale_no de_dens	scale_ popem p_den s	scale_l n_LI_H M	scale_CE S_awm	scale_ nove h_aw m
3594	3594	BUS	9	90	88	0	100	75	1	87	8	0	51	4
3607	3607	BUS	9	89	88	0	100	75	1	85	7	0	49	1
3652	3652	BUS	9	85	88	0	100	75	0	21	6	0	36	2
3723	3723	BUS	9	87	88	0	100	75	1	37	4	0	50	4
3822	3822	BUS	9	87	88	0	100	75	0	48	3	0	49	4
3924	3924	BUS	9	88	88	0	100	75	0	89	6	0	25	3
4133	4133	BUS	9	88	88	0	100	75	1	75	3	0	28	11
4156	4156	BUS	9	87	88	0	100	75	0	47	3	0	30	9
4165	4165	BUS	9	88	88	0	100	75	0	52	6	0	40	14
4167	4167	BUS	9	87	88	0	100	75	0	81	1	0	8	2
4169	4169	BUS	9	86	88	0	100	75	0	78	1	0	10	2
4248	4248	BUS	9	87	88	0	100	75	0	81	7	0	19	2
4249	4249	BUS	9	88	88	0	100	75	0	61	6	0	34	11
4329	4329	BUS	9	86	88	0	100	75	1	40	5	0	23	7
4450	4450	BUS	9	88	88	0	100	75	0	78	4	0	21	6
4453	4453	BUS	9	87	88	0	100	75	0	83	4	0	19	2
4458	4458	BUS	9	87	88	0	100	75	1	56	9	0	24	7
4472	4472	BUS	9	90	88	0	100	75	1	77	7	0	53	8
4527	4527	BUS	9	86	88	0	100	75	0	48	5	0	23	7
4626	4626	BUS	9	89	88	0	100	75	2	60	7	0	51	2
4791	4791	BUS	9	87	88	0	100	75	0	95	5	0	8	0
4795	4795	BUS	9	89	88	0	100	75	0	98	13	0	31	2
4851	4851	BUS	9	85	88	0	100	75	0	43	4	0	6	0
4859	4859	BUS	9	86	88	0	100	75	0	54	5	0	14	1
5904	5904	BUS	9	88	88	0	100	75	1	92	7	0	19	2
5918	5918	BUS	9	88	88	0	100	75	3	49	6	0	42	2
5929	5929	BUS	9	88	88	0	100	75	0	86	6	0	24	2
5960	5960	BUS	9	88	88	0	100	75	1	73	8	0	22	5
6005	6005	BUS	9	90	88	0	100	75	0	98	9	0	49	1
6091	6091	BUS	9	88	88	0	100	75	0	94	2	0	20	3

OID_n um	A	Type	final_s core_fi re_tran s	scales core_fi re_tran s	scalevulns ens_score_ fire_trans	scal e_re c_d mg	scale_tim e_elev_b urn	scale_ca t_burn	scale_fa c_vol	scale_no de_dens	scale_ popem p_den s	scale_l n_LI_H M	scale_CE S_awm	scale_ nove h_aw m
6104	6104	LRT	9	89	88	0	100	75	5	70	8	0	19	2
6326	6326	BUS	9	88	88	0	100	75	1	93	11	0	19	2
6348	6348	BUS	9	87	88	0	100	75	0	50	9	0	44	2
6349	6349	BUS	9	87	88	0	100	75	1	61	6	0	26	3
6598	6598	BUS	9	88	88	0	100	75	0	88	4	0	20	3
6629	6629	BUS	9	89	88	0	100	75	1	92	0	0	49	1
6637	6637	BUS	9	89	88	0	100	75	0	98	7	0	46	1
6655	6655	BUS	9	88	88	0	100	75	0	98	5	0	25	2
8068	8068	BUS	9	88	88	0	100	75	0	84	23	0	15	3
8429	8429	BUS	9	86	88	0	100	75	0	40	6	0	24	7
8435	8435	BUS	9	86	88	0	100	75	0	59	4	0	17	1
8436	8436	BUS	9	87	88	0	100	75	0	67	3	0	21	1
8561	8561	LRT	9	88	88	0	100	75	0	54	5	0	39	14
9289	9289	BUS	9	87	88	0	100	75	0	82	3	0	12	1
9623	9623	BUS	9	87	88	0	100	75	0	70	0	0	22	5
10192	1019 2	BUS	9	89	88	0	100	75	1	77	5	0	28	11
10490	1049 0	BUS	9	85	88	0	100	75	0	41	3	0	15	4
10557	1055 7	BUS	9	87	88	0	100	75	0	95	1	0	10	1
10559	1055 9	BUS	9	85	88	0	100	75	0	42	1	0	10	1
10570	1057 0	BUS	9	90	88	0	100	75	0	91	1	0	35	15
10585	1058 5	BUS	9	85	88	0	100	75	0	37	4	0	16	5
10645	1064 5	BUS	9	86	88	0	100	75	0	45	5	0	22	10
10705	1070 5	BUS	9	86	88	0	100	75	0	26	5	0	35	8
10706	1070 6	BUS	9	85	88	0	100	75	0	19	5	0	34	6

OID_n um	A	Type	final_s core_fi re_tran s	scales core_fi re_tran s	scalevulns ens_score_ fire_trans	scal e_re c_d mg	scale_tim e_elev_b urn	scale_ca t_burn	scale_fa c_vol	scale_no de_dens	scale_ popem p_den s	scale_l n_LI_H M	scale_CE S_awm	scale_ nove h_aw m
10935	10935	BUS	9	89	88	0	100	75	0	97	5	0	32	7
11010	11010	BUS	9	85	88	0	100	75	0	20	4	0	33	5
11011	11011	BUS	9	85	88	0	100	75	0	19	5	0	34	6
11161	11161	BUS	9	86	88	0	100	75	0	20	7	0	34	9
11216	11216	BUS	9	86	88	0	100	75	0	18	14	0	36	9
11228	11228	BUS	9	86	88	0	100	75	1	19	5	0	35	7
11251	11251	BUS	9	86	88	0	100	75	0	16	13	0	36	9
12453	12453	BUS	9	89	88	0	100	75	1	43	8	0	66	11
12593	12593	BUS	9	88	88	0	100	75	0	40	6	0	58	5
12594	12594	BUS	9	87	88	0	100	75	0	33	7	0	58	5
12595	12595	BUS	9	87	88	0	100	75	0	37	7	0	58	5
12978	12978	BUS	9	85	88	0	100	75	0	41	4	0	6	5
12980	12980	BUS	9	86	88	0	100	75	0	19	5	0	34	6
13547	13547	BUS	9	89	88	0	100	75	0	98	1	0	49	1
13554	13554	BUS	9	86	88	0	100	75	0	52	8	0	17	2
13594	13594	BUS	9	88	88	0	100	75	0	98	3	0	11	1
13595	13595	BUS	9	86	88	0	100	75	0	77	4	0	4	1
14224	14224	BUS	9	85	88	0	100	75	0	47	6	0	13	1
14251	14251	BUS	9	89	88	0	100	75	0	98	11	0	31	4
14304	14304	BUS	9	88	88	0	100	75	1	94	3	0	17	4
14324	14324	BUS	9	88	88	0	100	75	2	52	3	0	55	3

OID_n um	A	Type	final_s core_fi re_tran s	scales core_fi re_tran s	scalevulns ens_score_ fire_trans	scal e_re c_d mg	scale_tim e_elev_b urn	scale_ca t_burn	scale_fa c_vol	scale_no de_dens	scale_ popem p_den s	scale_I n_LI_H M	scale_CE S_awm	scale_ nove h_aw m
14360	14360	BUS	9	88	88	0	100	75	0	81	0	0	49	1
14548	14548	BUS	9	89	88	0	100	75	1	89	3	0	40	1
14554	14554	BUS	9	90	88	0	100	75	0	98	4	0	49	1
14561	14561	BUS	9	90	88	0	100	75	0	98	4	0	49	1
14564	14564	BUS	9	85	88	0	100	75	0	44	0	0	20	3
14670	14670	BUS	9	89	88	0	100	75	0	86	0	0	49	1
14871	14871	BUS	9	88	88	0	100	75	0	98	0	0	16	4

Table 17: Top Transit Temperature Vulnerability Scores

OID_n um	A	Typ e	final_sc ore_te mp_tra ns	scalesc ore_te mp_tra ns	scalevu lsens_ score_t emp_tr ans	scale_r ec_dmg	scale_h he_p1m x	scale_hh e_mx	scale_f ac_vol	scale_n ode_de ns	scale_po pemp_de ns	scale_In _LI_HM	scale_C ES_aw m	scale_no veh_aw m
2013	2013	BUS	10	90	100	0	100	100	0	19	14	0	27	2
2014	2014	BUS	10	91	100	0	100	100	0	32	13	0	24	1
2015	2015	BUS	10	91	100	0	100	100	0	37	13	0	25	2
2016	2016	BUS	10	91	100	0	100	100	1	32	14	0	27	2
2019	2019	BUS	10	93	100	0	100	100	0	36	15	0	51	9
2020	2020	BUS	10	99	100	0	100	100	2	39	12	100	61	11
2021	2021	BUS	10	97	100	0	100	100	0	36	18	100	52	8
2022	2022	BUS	10	97	100	0	100	100	0	37	17	100	53	7
2072	2072	BUS	10	92	100	0	100	100	0	48	29	0	24	1
2076	2076	BUS	10	93	100	0	100	100	0	98	9	0	9	1
2225	2225	BUS	10	91	100	0	100	100	1	35	16	0	24	1
2240	2240	BUS	10	94	100	0	100	100	0	89	8	0	26	10
2246	2246	BUS	10	93	100	0	100	100	0	62	2	0	56	3
2248	2248	BUS	10	98	100	0	100	100	0	60	4	100	59	8
2249	2249	BUS	10	94	100	0	100	100	0	73	7	0	54	3
2250	2250	BUS	10	99	100	0	100	100	0	84	7	100	53	5
2251	2251	BUS	10	93	100	0	100	100	1	86	4	0	9	6
2253	2253	BUS	10	93	100	0	100	100	0	95	1	0	15	3
2262	2262	BUS	10	92	100	0	100	100	5	26	15	0	24	1
2263	2263	BUS	10	91	100	0	100	100	3	18	8	0	21	2
2264	2264	BUS	10	92	100	0	100	100	1	70	6	0	20	2
2265	2265	BUS	10	91	100	0	100	100	0	55	6	0	24	1
2266	2266	BUS	10	91	100	0	100	100	0	53	12	0	24	1
2267	2267	BUS	10	92	100	0	100	100	0	48	27	0	24	1
2269	2269	BUS	10	92	100	0	100	100	1	48	21	0	24	1
2270	2270	BUS	10	91	100	0	100	100	0	54	6	0	24	1
2271	2271	BUS	10	93	100	0	100	100	1	53	24	0	18	7

OID_n um	A	Typ e	final_sc ore_tem p_tra ns	scalesc ore_tem p_tra ns	scalevu lsens_ score_t emp_tr ans	scale_r ec_dmg	scale_h he_p1m x	scale_hh e_mx	scale_f ac_vol	scale_n ode_de ns	scale_po pemp_de ns	scale_In _LI_HM	scale_C ES_awa m	scale_no veh_awa m
2272	2272	BUS	10	93	100	0	100	100	0	89	4	0	12	11
2323	2323	BUS	10	100	100	0	100	100	20	71	10	0	34	2
2324	2324	BUS	10	94	100	0	100	100	2	85	10	0	30	2
2326	2326	BUS	10	93	100	0	100	100	1	66	7	0	31	2
2327	2327	BUS	10	92	100	0	100	100	0	67	5	0	23	2
2424	2424	BUS	10	92	100	0	100	100	1	67	6	0	24	1
2731	2731	BUS	10	93	100	0	100	100	0	92	0	0	19	4
2745	2745	BUS	10	92	100	0	100	100	0	84	6	0	10	2
2751	2751	BUS	10	93	100	0	100	100	0	90	9	0	18	4
2755	2755	BUS	10	94	100	0	100	100	1	90	8	0	21	4
2756	2756	BUS	10	93	100	0	100	100	0	92	2	0	20	3
2757	2757	BUS	10	92	100	0	100	100	0	85	5	0	16	3
2760	2760	BUS	10	98	100	0	100	100	1	40	11	100	57	12
2766	2766	BUS	10	91	100	0	100	100	2	24	6	0	39	0
2768	2768	BUS	10	98	100	0	100	100	0	47	7	100	62	10
2769	2769	BUS	10	98	100	0	100	100	2	37	16	100	58	9
2770	2770	BUS	10	98	100	0	100	100	0	35	14	100	57	10
2771	2771	BUS	10	98	100	0	100	100	0	37	16	100	55	9
2772	2772	BUS	10	93	100	0	100	100	3	42	11	0	46	2
2773	2773	BUS	10	98	100	0	100	100	0	92	5	100	36	3
2774	2774	BUS	10	92	100	0	100	100	0	68	4	0	28	5
2777	2777	BUS	10	90	100	0	100	100	0	37	8	0	14	3
2781	2781	BUS	10	93	100	0	100	100	2	69	2	0	22	5
2807	2807	BUS	10	97	100	0	100	100	0	39	15	100	50	5
2808	2808	BUS	10	93	100	0	100	100	0	60	4	0	46	1
2809	2809	BUS	10	92	100	0	100	100	2	17	11	0	45	8
2810	2810	BUS	10	94	100	0	100	100	4	66	11	0	26	10
2811	2811	BUS	10	96	100	0	100	100	0	17	13	100	35	10
2812	2812	BUS	10	92	100	0	100	100	4	16	12	0	27	7

OID_n um	A	Typ e	final_sc ore_te mp_tra ns	scalesc ore_te mp_tra ns	scalevu lsens_ score_t emp_tr ans	scale_r ec_dmg	scale_h he_p1m x	scale_hh e_mx	scale_f ac_vol	scale_n ode_de ns	scale_po pemp_de ns	scale_In _LI_HM	scale_C ES_awa m	scale_no veh_awa m
2813	2813	BUS	10	93	100	0	100	100	6	22	13	0	27	7
2814	2814	BUS	10	94	100	0	100	100	6	50	22	0	21	7
2815	2815	BUS	10	94	100	0	100	100	2	85	9	0	19	7
2816	2816	BUS	10	92	100	0	100	100	0	72	10	0	12	6
2820	2820	BUS	10	93	100	0	100	100	0	96	7	0	16	7
2825	2825	BUS	10	92	100	0	100	100	1	62	6	0	10	9
2855	2855	BUS	10	93	100	0	100	100	4	44	10	0	27	7
2856	2856	BUS	10	93	100	0	100	100	0	62	4	0	22	13
2867	2867	BUS	10	93	100	0	100	100	1	65	4	0	29	4
2883	2883	BUS	10	93	100	0	100	100	0	58	6	0	31	13
2888	2888	BUS	10	92	100	0	100	100	5	26	7	0	33	2
2893	2893	BUS	10	92	100	0	100	100	0	58	6	0	22	3
2895	2895	BUS	10	91	100	0	100	100	3	44	5	0	14	1
2896	2896	BUS	10	94	100	0	100	100	1	91	8	0	14	8
2897	2897	BUS	10	93	100	0	100	100	0	86	11	0	16	5
2898	2898	BUS	10	94	100	0	100	100	0	87	6	0	38	3
2899	2899	BUS	10	94	100	0	100	100	0	73	8	0	56	3
3058	3058	BUS	10	93	90	0	80	100	8	88	15	100	46	7
4010	4010	BUS	10	92	100	0	100	100	2	63	12	0	7	1
4065	4065	BUS	10	91	100	0	100	100	0	27	9	0	39	0
4098	4098	BUS	10	94	100	0	100	100	1	79	6	0	43	3
4174	4174	BUS	10	98	100	0	100	100	3	28	15	100	27	14
4175	4175	BUS	10	94	100	0	100	100	3	50	31	0	18	7
4185	4185	BUS	10	92	100	0	100	100	0	50	25	0	22	3
4260	4260	BUS	10	92	100	0	100	100	0	72	5	0	12	5
4262	4262	BUS	10	92	100	0	100	100	0	92	5	0	6	3
4270	4270	BUS	10	92	100	0	100	100	0	76	7	0	4	3
4272	4272	BUS	10	92	100	0	100	100	1	86	5	0	7	3
4278	4278	BUS	10	94	100	0	100	100	1	90	6	0	30	2

OID_n um	A	Typ e	final_sc ore_te mp_tra ns	scalesc ore_te mp_tra ns	scalevu lsens_ score_t emp_tr ans	scale_r ec_dmg	scale_h he_p1m x	scale_hh e_mx	scale_f ac_vol	scale_n ode_de ns	scale_po pemp_de ns	scale_In _LI_HM	scale_C ES_aw m	scale_no veh_aw m
4295	4295	BUS	10	92	100	0	100	100	1	39	13	0	48	3
4299	4299	BUS	10	91	100	0	100	100	0	16	9	0	45	8
4300	4300	BUS	10	92	100	0	100	100	0	52	7	0	21	13
4302	4302	BUS	10	94	100	0	100	100	0	89	12	0	13	13
4304	4304	BUS	10	92	100	0	100	100	1	49	7	0	26	10
4388	4388	BUS	10	91	100	0	100	100	0	16	11	0	45	8
4561	4561	BUS	10	94	100	0	100	100	1	79	5	0	31	6
4565	4565	BUS	10	91	100	0	100	100	0	22	2	0	45	1
4642	4642	BUS	10	92	100	0	100	100	0	49	4	0	46	1
4644	4644	BUS	10	98	100	0	100	100	0	41	11	100	61	10
4645	4645	BUS	10	92	100	0	100	100	1	49	5	0	26	10
4863	4863	BUS	10	92	100	0	100	100	0	39	15	0	49	3
5528	5528	BUS	10	90	100	0	100	100	0	23	8	0	34	2
5529	5529	BUS	10	90	100	0	100	100	0	22	5	0	37	1
5539	5539	BUS	10	90	100	0	100	100	0	20	1	0	43	1
5960	5960	BUS	10	93	100	0	100	100	1	73	8	0	22	5
5978	5978	BUS	10	92	100	0	100	100	0	83	1	0	14	3
5989	5989	BUS	10	90	100	0	100	100	1	35	7	0	15	0
6071	6071	BUS	10	91	100	0	100	100	0	57	6	0	20	1
6090	6090	BUS	10	91	100	0	100	100	0	20	5	0	46	1
6091	6091	BUS	10	93	100	0	100	100	0	94	2	0	20	3
6113	6113	BUS	10	94	100	0	100	100	0	98	5	0	22	5
6115	6115	BUS	10	93	100	0	100	100	0	98	4	0	22	5
6151	6151	BUS	10	94	100	0	100	100	2	98	5	0	20	5
6157	6157	BUS	10	92	100	0	100	100	0	78	7	0	14	6
6288	6288	BUS	10	92	100	0	100	100	0	61	5	0	22	2
6598	6598	BUS	10	93	100	0	100	100	0	88	4	0	20	3
6599	6599	BUS	10	91	100	0	100	100	2	21	13	0	24	1

OID_n um	A	Typ e	final_sc ore_tem p_tra ns	scalesc ore_tem p_tra ns	scalevu lsens_ score_t emp_tr ans	scale_r ec_dmg	scale_h he_p1m x	scale_hh e_mx	scale_f ac_vol	scale_n ode_de ns	scale_po pemp_de ns	scale_In _LI_HM	scale_C ES_awa m	scale_no veh_awa m
6601	6601	BUS	10	93	100	0	100	100	3	57	13	0	18	7
6602	6602	BUS	10	93	100	0	100	100	0	98	0	0	17	3
6616	6616	BUS	10	93	100	0	100	100	0	98	4	0	20	3
7250	7250	BUS	10	91	100	0	100	100	0	49	11	0	24	1
7251	7251	BUS	10	92	100	0	100	100	0	51	15	0	24	1
8016	8016	LRT	10	92	45.71429	0	20	71.42857	100	4	84	100	92	50
8068	8068	BUS	10	93	100	0	100	100	0	84	23	0	15	3
8158	8158	BUS	10	90	100	0	100	100	1	20	4	0	26	1
8293	8293	BUS	10	98	100	0	100	100	0	94	7	100	27	5
8294	8294	BUS	10	92	100	0	100	100	0	60	6	0	40	2
8295	8295	BUS	10	98	100	0	100	100	0	80	9	100	43	3
8298	8298	BUS	10	99	100	0	100	100	1	53	8	100	63	12
8299	8299	BUS	10	93	100	0	100	100	4	17	7	0	45	8
8302	8302	BUS	10	94	100	0	100	100	0	97	4	0	18	10
8308	8308	BUS	10	93	100	0	100	100	0	74	12	0	11	9
8565	8565	LRT	10	93	100	0	100	100	1	39	16	0	52	5
9376	9376	BUS	10	94	100	0	100	100	4	64	10	0	46	1
9623	9623	BUS	10	92	100	0	100	100	0	70	0	0	22	5
10079	10079	BUS	10	90	100	0	100	100	0	24	5	0	36	1
11255	11255	BUS	10	93	100	0	100	100	0	90	9	0	9	3
11256	11256	BUS	10	93	100	0	100	100	0	98	5	0	5	3
11269	11269	BUS	10	93	100	0	100	100	1	80	8	0	14	5
11270	11270	BUS	10	93	100	0	100	100	0	98	1	0	5	5
11391	11391	BUS	10	90	100	0	100	100	0	24	12	0	26	2
12025	12025	BUS	10	93	100	0	100	100	0	87	8	0	22	5

Old_n um	A	Type	final_sc ore_tem p_tra ns	scalesc ore_tem p_tra ns	scalevu lsens_ score_t emp_tr ans	scale_r ec_dmg	scale_h he_p1m x	scale_hh e_mx	scale_f ac_vol	scale_n ode_de ns	scale_po pemp_de ns	scale_In _LI_HM	scale_C ES_awa m	scale_no veh_awa m
13537	13537	BUS	10	93	100	0	100	100	0	93	5	0	14	4
13600	13600	BUS	10	92	100	0	100	100	0	90	4	0	8	1
13603	13603	BUS	10	92	100	0	100	100	0	88	12	0	6	2
13619	13619	BUS	10	92	100	0	100	100	0	81	5	0	18	1
13620	13620	BUS	10	93	100	0	100	100	0	64	11	0	46	1
13626	13626	BUS	10	92	100	0	100	100	1	55	6	0	31	2
14228	14228	BUS	10	93	100	0	100	100	2	72	6	0	31	2
14229	14229	BUS	10	93	100	0	100	100	0	89	7	0	30	2
14240	14240	BUS	10	93	100	0	100	100	0	94	3	0	19	2
14331	14331	BUS	10	93	100	0	100	100	0	95	2	0	22	5
14334	14334	BUS	10	93	100	0	100	100	0	98	3	0	11	3
14647	14647	BUS	10	94	100	0	100	100	1	97	2	0	22	5
14653	14653	BUS	10	93	100	0	100	100	0	96	3	0	22	5
14763	14763	BUS	10	94	100	0	100	100	2	95	8	0	22	5
14871	14871	BUS	10	93	100	0	100	100	0	98	0	0	16	4
15549	15549	BUS	10	93	100	0	100	100	0	95	2	0	21	4
15550	15550	BUS	10	94	100	0	100	100	0	94	8	0	22	5

Table 18: Top Airport Temperature Vulnerability Scores

OID_num	FACILITY	CITY	final_score_temp_air	scalescore_temp_air	scalevulnsens_score_temp_air	scale_rec_dmg	scale_mx7day_temp	scale_aport_class
178	SACRAMENTO INTERNATIONAL AIRPORT	Sacramento	10	100	85	0	85	100
108	LINCOLN REGIONAL AIRPORT / KARL HARDER FIELD	Lincoln	9	86	100	0	100	50
124	McCLELLAN AIRFIELD	Sacramento	9	89	87	0	87	75
177	SACRAMENTO EXECUTIVE AIRPORT	Sacramento	9	83	78	0	78	75
179	SACRAMENTO MATHER AIRPORT	Sacramento	9	86	83	0	83	75
239	YUBA COUNTY AIRPORT	Marysville	9	81	93	0	93	50
9	AUBURN MUNICIPAL AIRPORT	Auburn	8	72	80	0	80	50
230	WATTS - WOODLAND AIRPORT	Woodland	8	72	97	0	97	25
37	CAMERON AIRPARK AIRPORT	Cameron Park	7	64	85	0	85	25
158	PLACERVILLE AIRPORT	Placerville	7	66	71	0	71	50
162	RANCHO MURIETA AIRPORT	Rancho Murieta	7	67	90	0	90	25
169	RIO LINDA AIRPORT	Rio Linda	7	65	86	0	86	25
213	SUTTER COUNTY AIRPORT	Yuba City	7	68	92	0	92	25
224	UNIVERSITY AIRPORT	Davis	7	67	89	0	89	25
238	YOLO COUNTY-DAVIS WOODLAND WINTERS AIRPORT	Davis/Woodland/Winters	7	69	93	0	93	25
65	FRANKLIN FIELD AIRPORT	Franklin	6	58	76	0	76	25
75	GEORGETOWN AIRPORT	Georgetown	6	58	77	0	77	25
105	LAKE TAHOE AIRPORT	South Lake Tahoe	2	17	0	0	0	50
18	BLUE CANYON AIRPORT	Emigrant Gap	1	0	10	0	10	0

Table 19: Top Bridge Riverine Flooding Scores

OID_num	NAME	final_score_riv_brid	scales_core_riv_brid	scalevulnsens_score_riv_brid	scale_recdmg	scale_riv_area_t1max	scale_riv_area_max	scale_Bsubst_ruct_cond	scale_Bchannel_cond	scale_Bscore_crit	scale_Bwaterway_adequ	scale_fac_vol	scale_Bdetour	scale_popemp_dens	scale_In_LI_HM	scale_CE_Sawm	scale_nov_eh_awn
762	SUTTER BYPASS EAST CHANNEL	10	93	92	0	70	74	30	45	60	75	0	15	0	100	61	5
857	SOUTH YUBA RIVER	10	92	88	0	69	69	50	60	15	75	0	100	0	0	10	2
1010	AUBURN RAVINE	10	100	100	0	67	66	30	45	90	90	4	7	3	100	30	1
1050	TULE CANAL	10	90	93	0	83	87	30	15	15	75	1	1	0	0	73	7
1075	PINE CREEK	10	91	82	0	83	87	90	90	100	30	0	100	0	100	23	5
1383	NORTH CHANNEL DRY CREEK	10	94	98	0	72	70	10	45	50	90	2	5	2	0	25	4
1693	BIZ JOHNSON DRIVE UP	10	91	90	0	93	92	50	50	50	50	0	10	5	100	76	11
140	SOUTH YUBA RIVER (BIG BEND)	9	80	74	0	70	71	50	15	60	45	10	100	0	0	3	1
338	AMERICAN RIVER (BUS 80)	9	81	69	0	93	93	10	45	60	15	78	4	2	0	59	22
369	SACRAMENTO RIVER	9	85	88	0	99	99	30	15	50	45	1	13	0	0	55	0

OID_num	NAME	final_score_riv_brid	scales_core_riv_brid	scalevulnsens_score_riv_brid	scale_recdmg	scale_riv_area_t1max	scale_riv_area_max	scale_Bsubst_ruct_cond	scale_Bchannel_cond	scale_Bscore_cri_t	scale_Bwaterway_adequ	scale_fac_vol	scale_Bdetour	scale_popemp_dens	scale_In_LI_HM	scale_CE_Sawm	scale_nov_eh_awn
	(ISLETON)																
371	SACRAMENTO RIVER (PAINTERSVILLE)	9	85	89	0	99	99	50	15	50	45	1	6	0	0	55	0
398	THREE MILE SLOUGH	9	86	82	0	100	100	60	15	60	30	6	69	0	0	61	4
698	DRY CREEK	9	84	86	0	71	71	30	60	90	60	1	7	0	0	53	5
869	MINERS RAVINE	9	83	86	0	63	62	30	45	60	75	6	5	1	0	3	2
897	COON CREEK	9	87	91	0	71	70	30	60	50	75	0	8	0	0	22	5
903	COON CREEK	9	87	82	0	68	67	30	60	60	60	0	100	0	0	23	2
963	SQUAW CREEK	9	84	79	0	56	54	30	75	15	75	1	100	4	0	3	1
1016	AUBURN RAVINE	9	86	87	0	67	66	30	15	60	75	12	12	5	0	22	3
1024	CACHE CREEK	9	81	77	0	83	87	30	45	90	30	0	51	0	100	23	5
1047	BUCKEYE CREEK	9	82	85	0	65	65	60	75	90	60	0	4	0	0	59	7
1066	DRY SLOUGH	9	81	94	0			10	45	60	90	2	3	0	0	10	4
1183	ARCADE CREEK	9	86	89	0	66	65	30	60	60	75	5	3	5	0	55	7
1238	GRIZZLEY SLOUGH	9	89	89	0	85	85	90	45	100	45	1	8	0	100	51	4
1308	SKUNK CREEK	9	83	77	0	54	56	0	60	15	75	0	100	0	0	42	1

OID_num	NAME	final_score_riv_brid	scales_core_riv_brid	scalevulnsens_score_riv_brid	scale_recdmg	scale_riv_area_t1max	scale_riv_area_max	scale_Bsubst_ruct_cond	scale_Bchannel_cond	scale_Bscore_cri_t	scale_Bwaterway_adequ	scale_fac_vol	scale_Bdetour	scale_popemp_dens	scale_In_LI_HM	scale_CE_Sawm	scale_nov_eh_awn
1377	DEER CREEK	9	80	75	0	73	72	30	60	50	45	0	100	3	0	23	2
1474	AMERICAN RIVER LAKE NATOMA	9	82	84	0	93	93	10	15	60	45	8	1	5	0	21	7
1629	TROUT CREEK	9	80	83	0	67	70	30	0	15	75	2	2		0	14	4
1646	POPPY CREEK	9	82	85	0	83	87	50	50	50	50	0	10	0	0	23	5
1704	NORTH FORK AMERICAN RIVER	9	80	84	0	81	83	50	50	50	50	0	10	0	0	13	2
37	FEATHER RIVER BOH	8	76	72	0	93	92	30	30	90	15	17	2	3	100	73	12
70	LINDA CREEK	8	78	66	0	64	62	30	45	15	45	66	3	10	100	32	5
76	NORTH FORK AMERICAN RIVER	8	79	73	0	34	32	30	15	15	90	4	100	0	0	15	3
201	CACHE CREEK	8	78	80	0	83	87	10	15	60	45	5	1	0	0	60	5
205	SACRAMENTO RIVER (TOWER BRIDGE)	8	76	73	0	99	99	60	15	60	15	5	5	43	100	78	21
216	CACHE CREEK	8	71	73	0	83	87	30	30	60	30	1	5	0	0	60	5

OID_num	NAME	final_score_riv_brid	scalescore_riv_brid	scalevulnsens_score_riv_brid	scale_recdmg	scale_riv_area_t1max	scale_riv_area_max	scale_Bsubst_ruct_cond	scale_Bchannel_cond	scale_Bscore_cri_t	scale_Bwaterway_adequ	scale_fac_vol	scale_Bdetour	scale_popemp_dens	scale_In_LI_HM	scale_CE_Sawm	scale_nov_eh_awnm
218	SACRAMENTO RIVER (KNIGHTS LANDING)	8	71	70	0	95	94	30	45	50	15	3	36	3	0	62	6
243	RUMSEY CANYON	8	78	77	0	83	87	30	15	15	45	0	57	0	0	23	5
253	SOUTH FORK WILLOW SLOUGH	8	71	71	0	65	64	10	60	60	45	2	1	0	100	23	5
336	AMERICAN RIVER (160 SB)	8	72	71	0	93	93	30	15	90	15	11	3	8	0	92	29
341	STRAWBERRY CREEK	8	77	66	0	55	56	30	45	60	45	52	4	9	100	59	8
373	AMERICAN RIVER VIADUCT I-5 NB	8	78	69	0	93	93	30	30	60	15	37	5	7	100	87	27
405	ARCADE CREEK	8	77	69	0	66	65	10	15	60	45	58	0	9	0	81	9
419	MORRISON CREEK	8	73	58	0	68	67	10	30	15	30	72	0	16	100	91	20
424	ELDER CREEK	8	77	63	0	62	62	10	30	15	45	64	0	13	100	82	17
478	NATOMAS EAST CANAL BOH	8	72	57	0	74	73	30	15	60	15	68	3	5	100	81	12

OID_num	NAME	final_score_riv_brid	scalescore_riv_brid	scalevulnsens_score_riv_brid	scale_recdmg	scale_riv_area_t1max	scale_riv_area_max	scale_Bsubst_ruct_cond	scale_Bchannel_cond	scale_Bscour_cri_t	scale_Bwaterway_adequ	scale_fa_c_vol	scale_Bdetour	scale_popemp_dens	scale_In_LI_HM	scale_CE_Sawm	scale_nov_eh_awn
634	GREEN WOOD CREEK	8	70	72	0	70	69	30	15	60	45	1	16	0	0	22	4
692	DRY CREEK	8	76	75	0	71	70	30	60	60	45	0	40	0	0	67	4
707	BEALE AFB SLOUGH	8	72	70	0	52	54	60	45	15	60	2	14	0	100	47	4
710	WEST BEST SLOUGH	8	76	80	0	67	69	60	75	15	60	0	2	0	0	51	6
718	DRY CREEK	8	76	79	0	71	73	60	45	90	45	0	7	0	0	33	2
719	DRY CREEK	8	71	74	0	71	71	30	30	60	45	0	4	0	0	51	6
723	HUTCHINSON CREEK	8	73	72	0	64	66	60	45	60	45	1	2	1	100	61	4
725	REEDS CREEK	8	71	70	0	62	64	60	45	50	45	1	2	0	100	61	4
741	DRY CREEK	8	70	71	0	51	50	30	60	50	60	0	20	0	0	67	4
748	SOUTH HONCUT CREEK	8	72	66	0	56	57	30	45	60	45	0	100	0	0	11	2
751	SOUTH HONCUT CREEK	8	74	76	0	55	55	0	30	15	75	0	22	0	0	11	2
787	AUBURN RAVINE	8	72	74	0	69	69	60	45	50	45	1	11	0	0	52	2
791	COON CREEK	8	72	75	0	72	71	60	45	50	45	1	4	0	0	52	2
797	SUTTER BYPASS WEST	8	73	71	0	52	52	30	30	60	60	0	11	0	100	67	5

OID_num	NAME	final_score_riv_brid	scales_core_riv_brid	scalevulnsens_score_riv_brid	scale_recdmg	scale_riv_area_t1max	scale_riv_area_max	scale_Bsubst_ruct_cond	scale_Bchannel_cond	scale_Bscore_cri_t	scale_Bwaterway_adequ	scale_fac_vol	scale_Bdetour	scale_popemp_dens	scale_In_LI_HM	scale_CE_Sawm	scale_nov_eh_awnm
	CHANNEL																
801	CHEROKEE DRAIN	8	77	78	0	49	51	90	60	100	60	0	31	0	0	38	3
807	EASTSIDE CANAL	8	76	79	0	76	75	60	75	50	45	0	4	0	0	52	2
809	YANKEE SLOUGH	8	79	83	0	61	60	60	45	15	75	0	7	0	0	37	4
824	BUTTE SLOUGH	8	75	77	0	68	72	30	15	15	60	0	12	0	0	55	4
843	PLEASANT GROVE CREEK CANAL	8	70	73	0	70	69	30	30	60	45	0	5	0	0	52	2
855	SQUAW CREEK	8	71	65	0	63	61	30	45	15	45	1	100	1	0	3	1
863	SOUTH YUBA RIVER	8	71	75	0	70	70	50	45	60	45	0	5	0	0	3	1
864	SOUTH YUBA RIVER	8	70	74	0	70	70	30	45	60	45	0	5	0	0	3	1
871	MINERS RAVINE	8	72	74	0	65	64	0	60	15	60	4	5	2	0	13	2
872	SECRET RAVINE	8	75	78	0	65	63	90	75	100	45	1	8	0	0	8	4
882	NORTH FORK AMERICAN RIVER	8	78	77	0	67	65	60	30	15	60	0	61	0	0	10	2
892	DRY CREEK	8	72	75	0	71	70	60	45	50	45	3	7	2	0	20	3

OID_num	NAME	final_score_riv_brid	scales_core_riv_brid	scalevulnsen_s_score_riv_brid	scale_re_c_dmg	scale_riv_area_t1max	scale_riv_area_max	scale_Bsubst_ruct_cond	scale_Bchannel_cond	scale_Bscore_crit	scale_Bwaterway_adequ	scale_fac_vol	scale_Bdetour	scale_popemp_dens	scale_In_LI_HM	scale_CE_Sawm	scale_nov_eh_awnm
893	DRY CREEK	8	73	74	0	71	69	30	60	60	45	4	2	10	0	57	9
894	DRY CREEK	8	72	71	0	69	68	10	30	60	45	1	1	19	100	49	7
895	DOTY RAVINE	8	74	77	0	62	60	10	60	60	60	0	3	0	0	42	3
896	MARKHAM RAVINE	8	71	65	0	63	62	30	45	15	45	0	100	0	0	22	5
898	COON CREEK	8	72	75	0	55	56	30	75	50	60	0	10	0	0	22	5
900	MCKINNEY CREEK	8	71	74	0	58	57	50	30	50	60	1	1		0	8	5
901	MCKINNEY CREEK	8	72	75	0	58	56	50	45	50	60	1	1		0	6	5
902	CURRY CREEK	8	75	78	0	60	60	10	15	15	75	0	6	0	0	22	5
906	AUBURN RAVINE	8	71	73	0	67	66	60	45	60	45	1	7	0	0	22	5
907	DOTY RAVINE	8	71	74	0	63	63	50	60	90	45	0	3	0	0	42	3
910	MARKHAM RAVINE	8	71	74	0	62	61	30	60	15	60	0	7	0	0	22	5
913	CURRY CREEK	8	72	75	0	58	58	30	45	50	60	0	4	0	0	37	3
914	DOTY RAVINE	8	76	80	0	65	64	30	60	60	60	0	3	0	0	42	3
920	PLEASANT GROVE CREEK	8	70	74	0	68	67	60	60	50	45	0	4	0	0	22	5
921	SECRET RAVINE	8	73	77	0	62	60	30	60	50	60	1	3	1	0	7	4

OID_num	NAME	final_score_riv_brid	scales_core_riv_brid	scalevulnsens_score_riv_brid	scale_recdmg	scale_riv_area_t1max	scale_riv_area_max	scale_Bsubst_ruct_cond	scale_Bchannel_cond	scale_Bscore_cri_t	scale_Bwaterway_adequ	scale_fa_c_vol	scale_Bdetour	scale_popemp_dens	scale_In_LI_HM	scale_CE_Sawm	scale_nov eh_awnm
922	AUBURN RAVINE	8	78	82	0	69	69	30	60	50	60	0	5	0	0	22	5
928	SOUTH FORK DRY CREEK	8	70	73	0	57	55	30	45	50	60	1	3	1	0	29	5
932	TRUCKEE RIVER	8	74	69	0	79	79	10	30	60	30	1	100	0	0	1	1
939	WOOLEY CREEK	8	71	65	0	57	56	10	45	60	45	4	100	1	0	10	2
942	SECRET RAVINE	8	71	74	0	62	60	30	75	15	60	3	3	2	0	7	4
1040	BIRD CREEK	8	72	65	0	30	27	10	15	60	75	0	100	0	0	59	7
1042	DRY SLOUGH	8	78	77	0	34	32	10	45	60	90	2	6	0	100	35	2
1043	CHICKA HOMINY SLOUGH	8	77	77	0	33	30	10	45	60	90	2	5	0	100	35	2
1045	OAT CREEK	8	72	74	0	64	63	30	45	15	60	1	3	0	0	59	7
1065	DRY SLOUGH	8	71	74	0	40	39	30	60	60	75	2	3	0	0	16	4
1081	COTTON WOOD SLOUGH	8	72	63	0	60	59	10	45	15	45	0	100	0	100	29	3
1083	CHICKA HOMINY SLOUGH	8	74	64	0	39	38	90	75	100	45	0	100	0	100	35	2
1099	DRY SLOUGH	8	79	79	0	40	39	50	45	15	90	0	5	0	100	23	3
1101	DRY SLOUGH	8	76	80	0	45	45	10	45	15	90	0	5	0	0	10	4
1107	OAT CREEK	8	78	79	0	63	62	60	45	60	60	0	18	0	0	59	7

OID_num	NAME	final_score_riv_brid	scales_core_riv_brid	scalevulnsens_score_riv_brid	scale_recdmg	scale_riv_area_tmax	scale_riv_area_max	scale_Bsubst_ruct_cond	scale_Bchannel_cond	scale_Bscour_cri_t	scale_Bwaterway_adequ	scale_fa_c_vol	scale_Bdetour	scale_popemp_dens	scale_In_LI_HM	scale_CE_Sawm	scale_nov_eh_awnm
1109	OAT CREEK	8	77	80	0	64	63	60	45	60	60	0	1	0	0	59	7
1141	CACHE CREEK	8	73	64	0	83	87	30	15	60	15	0	100	0	100	23	5
1143	BUCKEY E CREEK	8	72	75	0	65	65	30	30	15	60	0	4	0	0	59	7
1148	ARCADE CREEK	8	73	70	0	67	66	30	15	60	45	8	4	3	100	87	11
1155	SOUTH CHANNEL DRY CREEK	8	75	74	0	72	71	10	45	60	45	2	4	0	100	51	3
1240	ELDER CREEK	8	71	68	0	61	61	50	30	50	45	9	3	4	100	79	6
1270	ARCADE CREEK	8	70	64	0	64	62	0	30	15	45	28	3	9	100	53	8
1345	SOUTH CHANNEL DRY CREEK	8	72	75	0	72	71	30	45	60	45	2	1	1	0	57	2
1350	SOUTH CHANNEL DRY CREEK	8	72	74	0	72	71	30	60	50	45	1	4	1	0	46	3
1357	ARCADE CREEK	8	70	72	0	66	65	30	60	60	45	7	2	5	0	54	6
1363	DEER CREEK	8	72	75	0	73	72	30	45	60	45	0	7	0	0	23	2
1415	NATOMAS EAST TRIBUTARY NO 1	8	79	82	0	56	58	10	30	60	75	2	3	2	0	29	3
1504	AMERICAN RIVER (FOLSO)	8	78	81	0	93	93	30	15	15	45	6	5	2	0	11	2

OID_num	NAME	final_score_riv_brid	scales_core_riv_brid	scalevulnsens_score_riv_brid	scale_recdmg	scale_riv_area_t1max	scale_riv_area_max	scale_Bsubst_ruct_cond	scale_Bchannel_cond	scale_Bsur_cri_t	scale_Bwaterway_adequ	scale_fa_c_vol	scale_Bdetour	scale_popemp_dens	scale_In_LI_HM	scale_CE_Sawm	scale_nov_eh_awnm
	M LAKE CROSSING)																
1522	ELDER CREEK	8	75	73	0	59	58	0	30	50	60	0	5	3	100	87	7
1612	SOUTH FORK AMERICAN RIVER	8	70	64	0	66	64	10	15	15	45	0	100	0	0	8	4
1613	NORTH FORK COSUMNES RIVER	8	71	73	0	75	74	10	15	50	45	0	20	0	0	16	2
1651	SOUTH FORK WILLOW CREEK	8	73	71	0	60	59	50	50	50	50	4	10	1	100	23	5
1655	B STREET UNDERPASS	8	75	60	0			50	50	50	50	80	10	7	0	74	28
1656	ELVAS UP	8	72	60	0			50	50	50	50	70	10	5	0	72	31
1657	WATT AVENUE OC	8	77	60	0			50	50	50	50	92	10	10	0	55	8
1658	WATT AVENUE OC	8	72	60	0			50	50	50	50	70	10	10	0	54	8
1661	FOOTHILL FARMS POC	8	79	60	0			50	50	50	50	80	10	6	100	63	9

OID_num	NAME	final_score_riv_brid	scales_core_riv_brid	scalevulnsens_score_riv_brid	scale_recdmg	scale_riv_area_t1max	scale_riv_area_max	scale_Bsubst_ruct_cond	scale_Bchannel_cond	scale_Bsur_cri_t	scale_Bwaterway_adequ	scale_fac_vol	scale_Bdetour	scale_popemp_dens	scale_In_LI_HM	scale_CE_Sawm	scale_nov_eh_awn
1663	44TH AVENUE POC	8	78	60	0			50	50	50	50	72	10	14	100	89	14
1664	27TH AVENUE POC	8	79	60	0			50	50	50	50	77	10	13	100	76	15
1665	8TH AVENUE POC	8	73	60	0			50	50	50	50	77	10	11	0	52	13
1666	TURNBRIDGE DRIVE POC	8	78	60	0			50	50	50	50	72	10	13	100	92	19
1667	MATHER SPUR UP	8	77	60	0			50	50	50	50	70	10	7	100	80	9
1671	RIVERFRONT SEAL SLAB	8	79	60	0			50	50	50	50	74	10	24	100	87	20
1674	FOLSOM SOUTH CANAL	8	77	70	0	59	57	50	50	50	50	48	10	10	0	52	3
1677	MANLOVE POC	8	73	60	0			50	50	50	50	74	10	23	0	62	12
1678	WHITE ROCK POC	8	78	60	0			50	50	50	50	74	10	16	100	73	6
1681	EAGLE CREEK	8	70	72	0	62	60	50	50	50	50	2	10		0	26	5
1683	DEER CREEK	8	72	70	0	58	57	50	50	50	50	25	10	5	0	13	6
1697	PG&E OH FLUME	8	73	75	0	67	66	50	50	50	50	10	10	1	0	6	3
1737	WEBER CREEK	8	74	77	0	71	70	50	50	50	50	2	10	1	0	15	5

Exposure Mapping

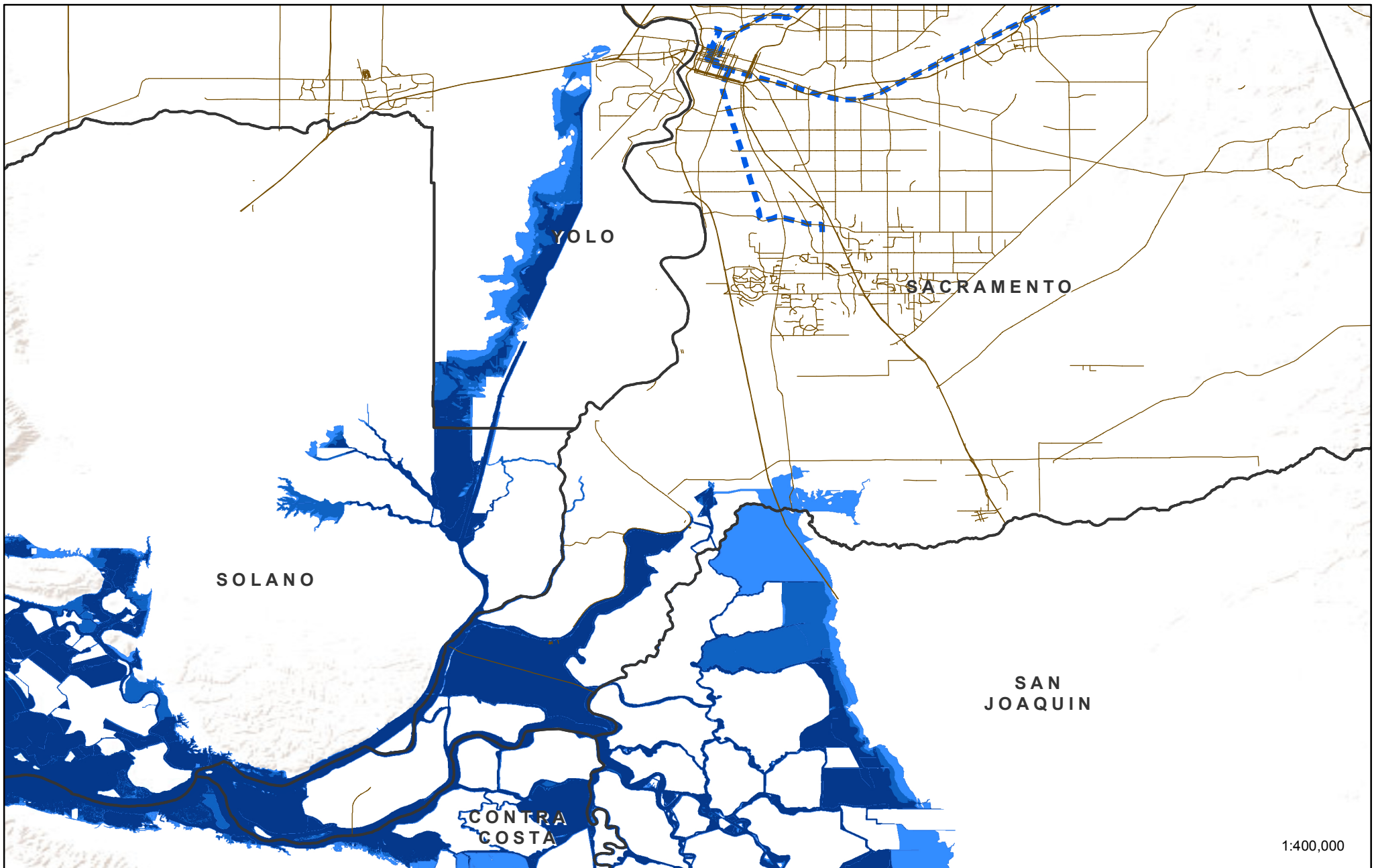
Sea Level Rise,

Delta Storm Surge,

Wildfire,

Extreme Temperature,

Precipitation.



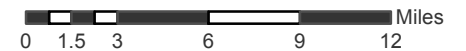
SACOG Assets

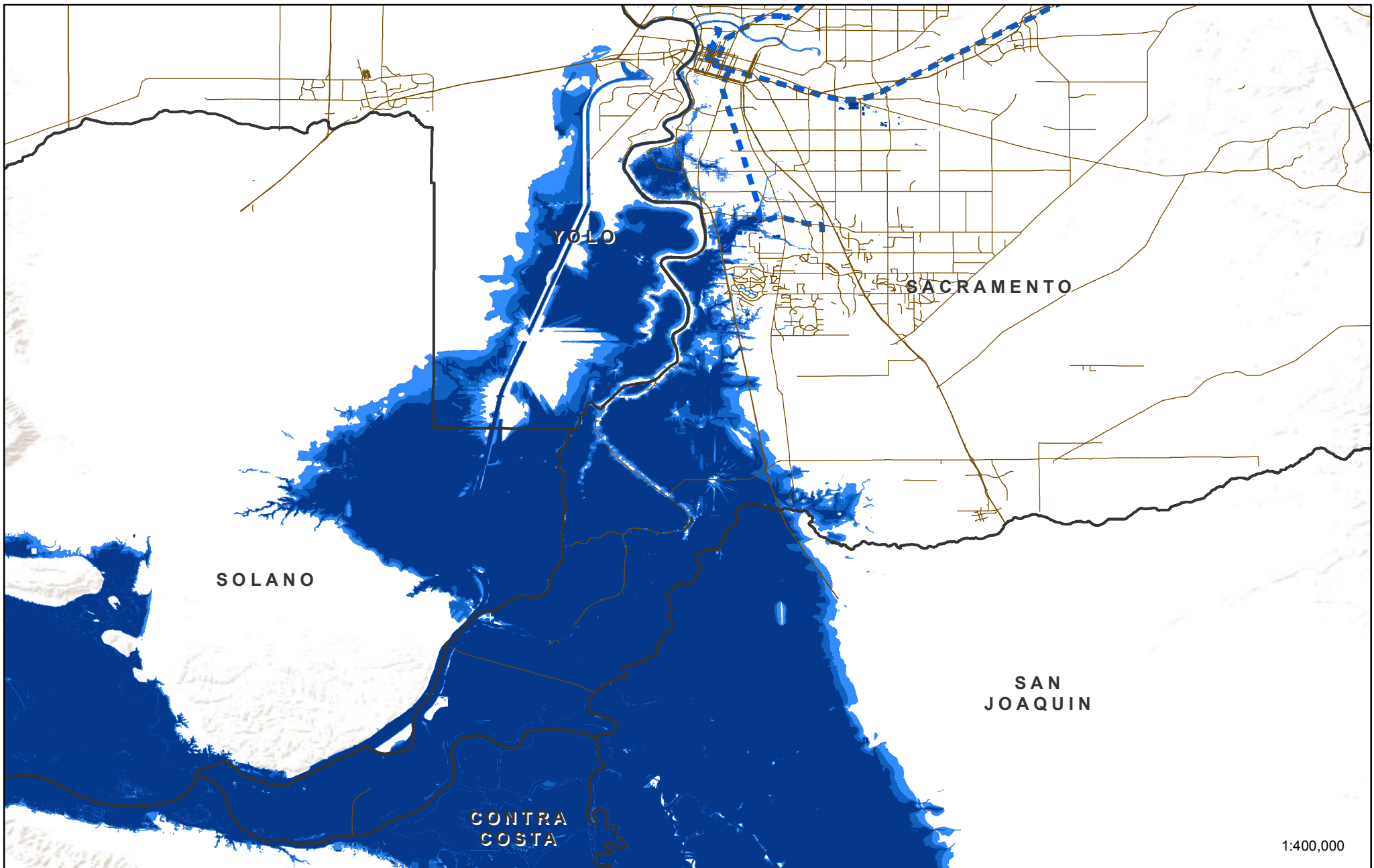
- Regional Centerline - Highways and Arterials
- - - Light Rail Lines

Delta Sea Level Rise Inundation

- 0.50 m (1.64 ft)
- 1.00 m (3.28 ft)
- 1.75 m (5.74 ft)

Source: Climate Central delta sea level rise model



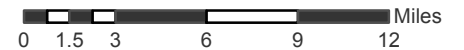


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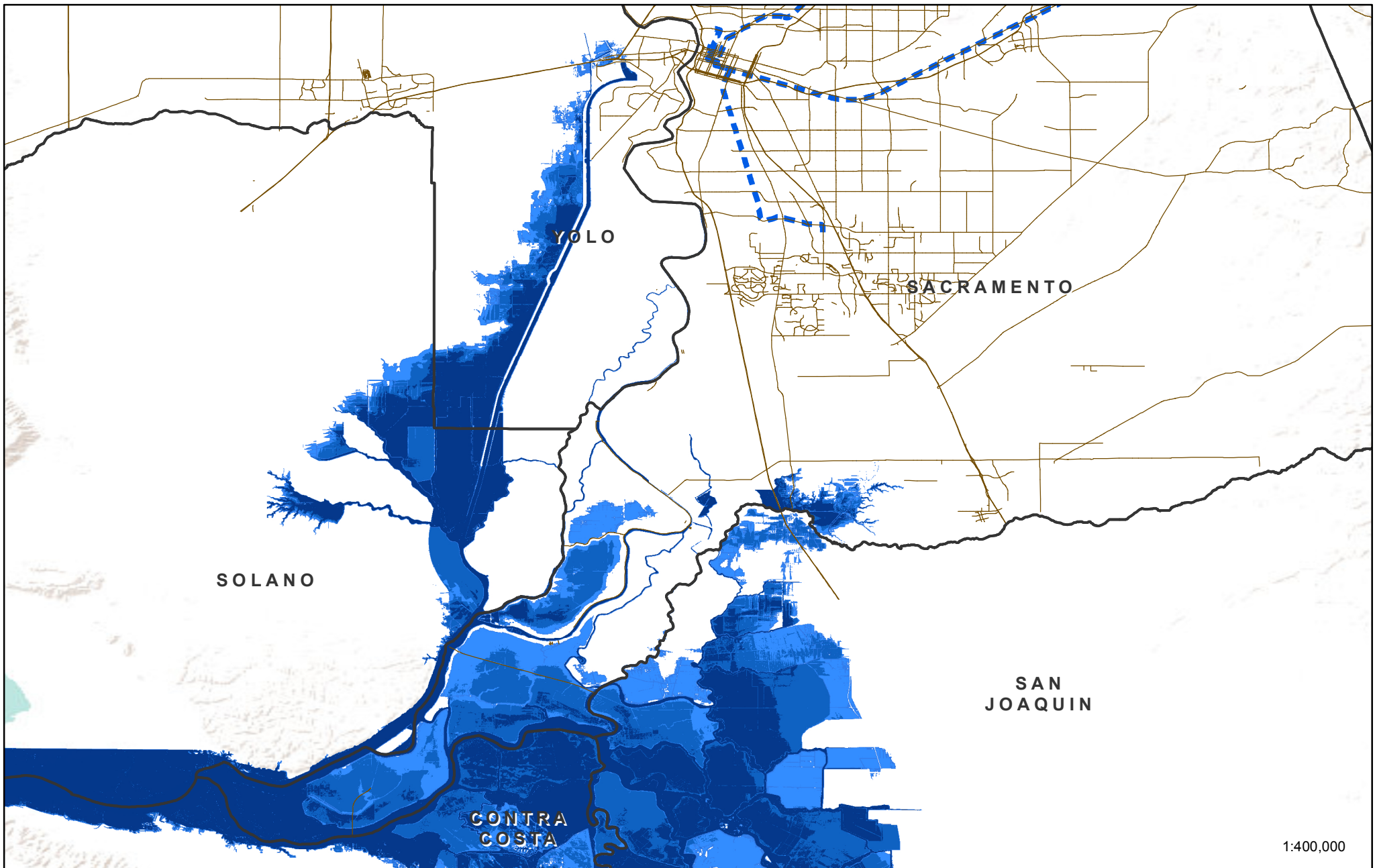
- Regional Centerline - Highways and Arterials
- - - Light Rail Lines

Delta Sea Level Rise - Levee Protected Areas Inundation

- 0.50 m (1.64 ft)
- 1.00 m (3.28 ft)
- 1.75 m (5.74 ft)



Source: Climate Central delta sea level rise model



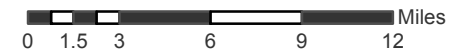
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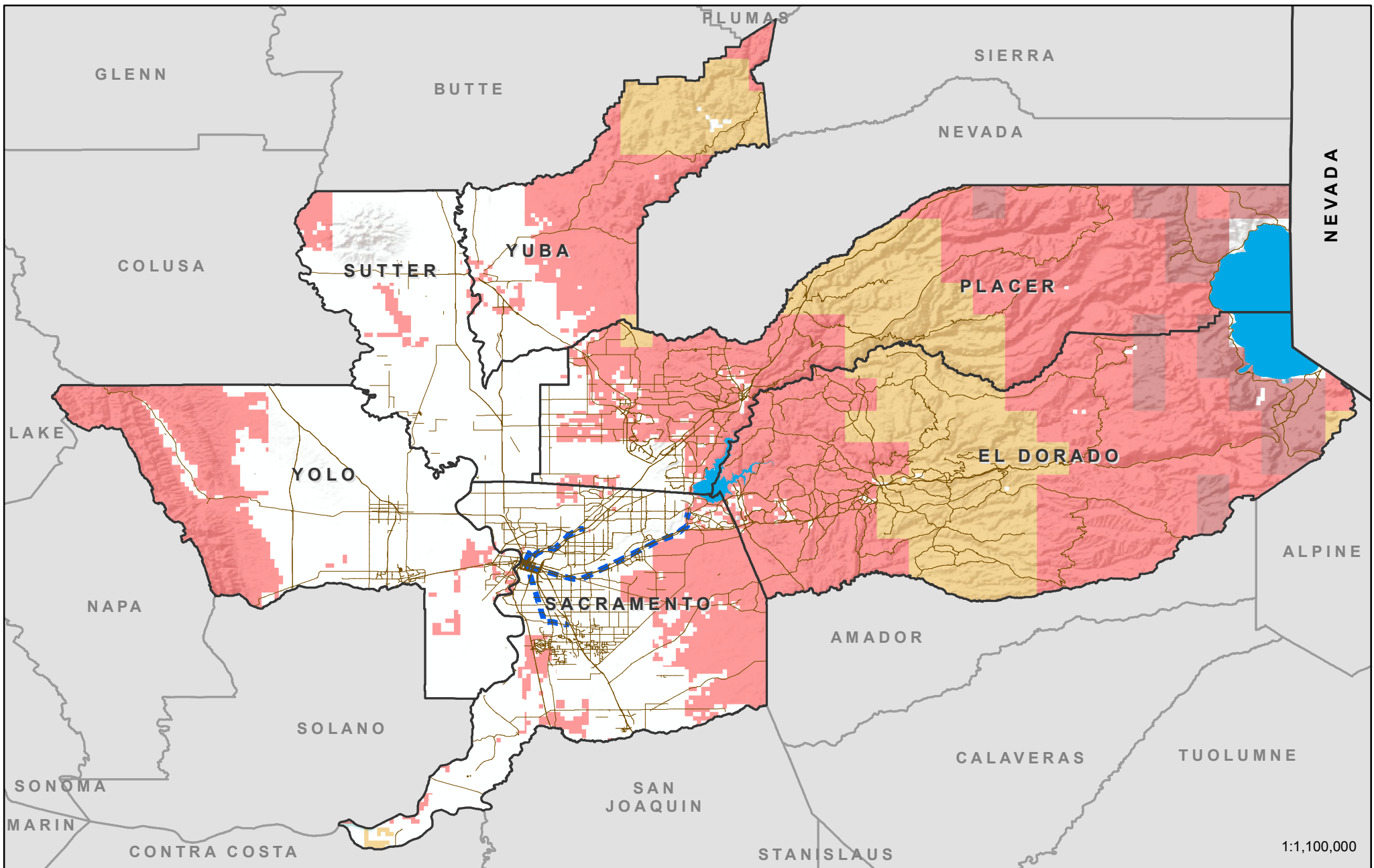
- Regional Centerline - Highways and Arterials
- - - Light Rail Lines

Delta Sea Level Rise with a 100-Year Storm Event

- 0.50 m (1.64 ft)
- 1.00 m (3.28 ft)
- 1.41 m (4.63 ft)

Source: UC Berkeley, delta sea level rise and 100-year storm 3Di model from Radke et al.





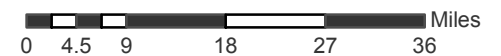
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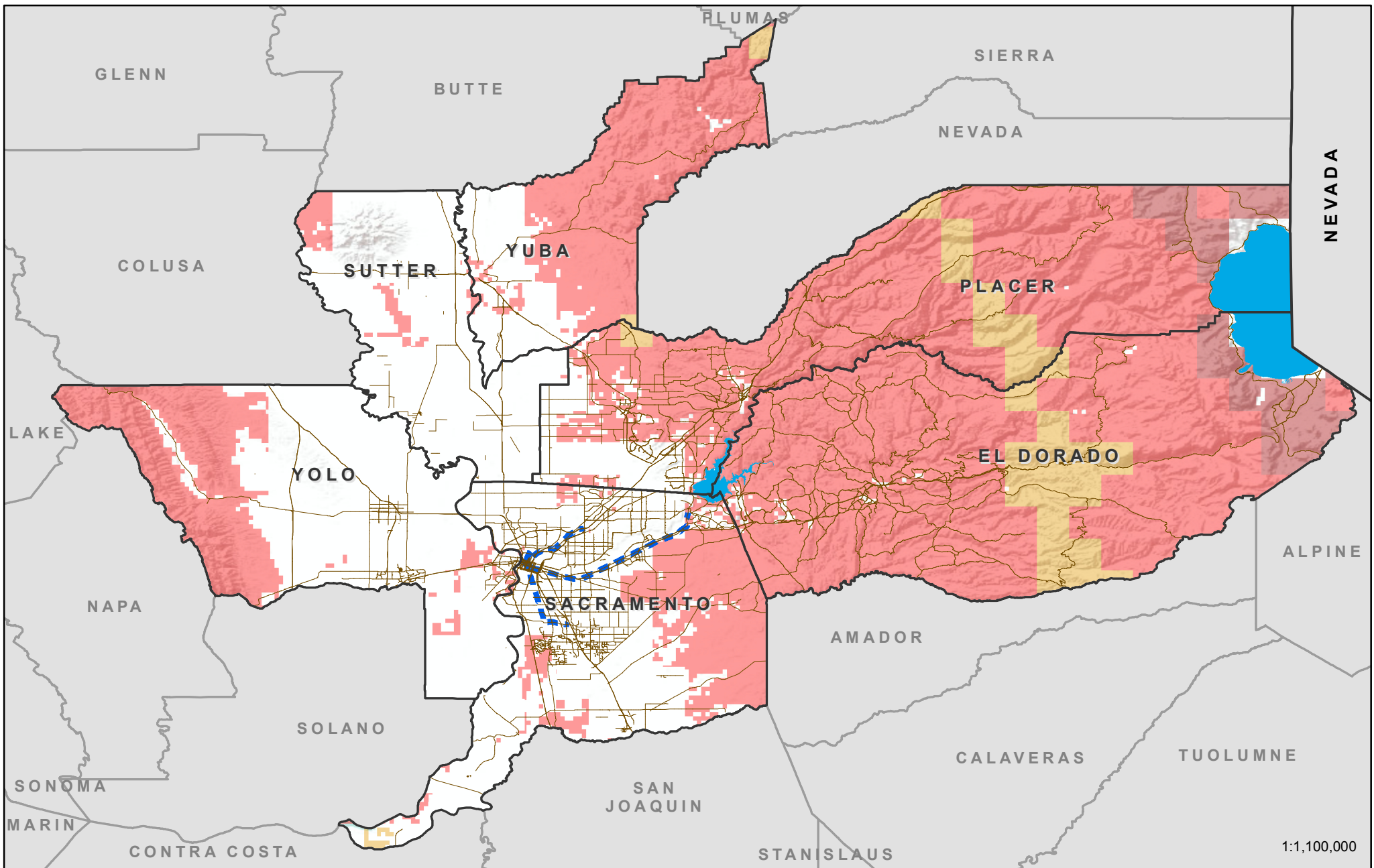
- Regional Centerline - Highways and Arterials
- - - Light Rail Lines

Level of Wildfire Concern RCP 8.5 - 2025

- Very High
- High
- Moderate

Source: Amalgamation of three fire models: 1) MC2-EPA Climate Impacts Risk Assessment, USFS, 2) MC2-Applied Climate Science Lab at the University of Idaho, 3) University of California Merced model.





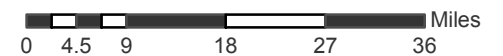
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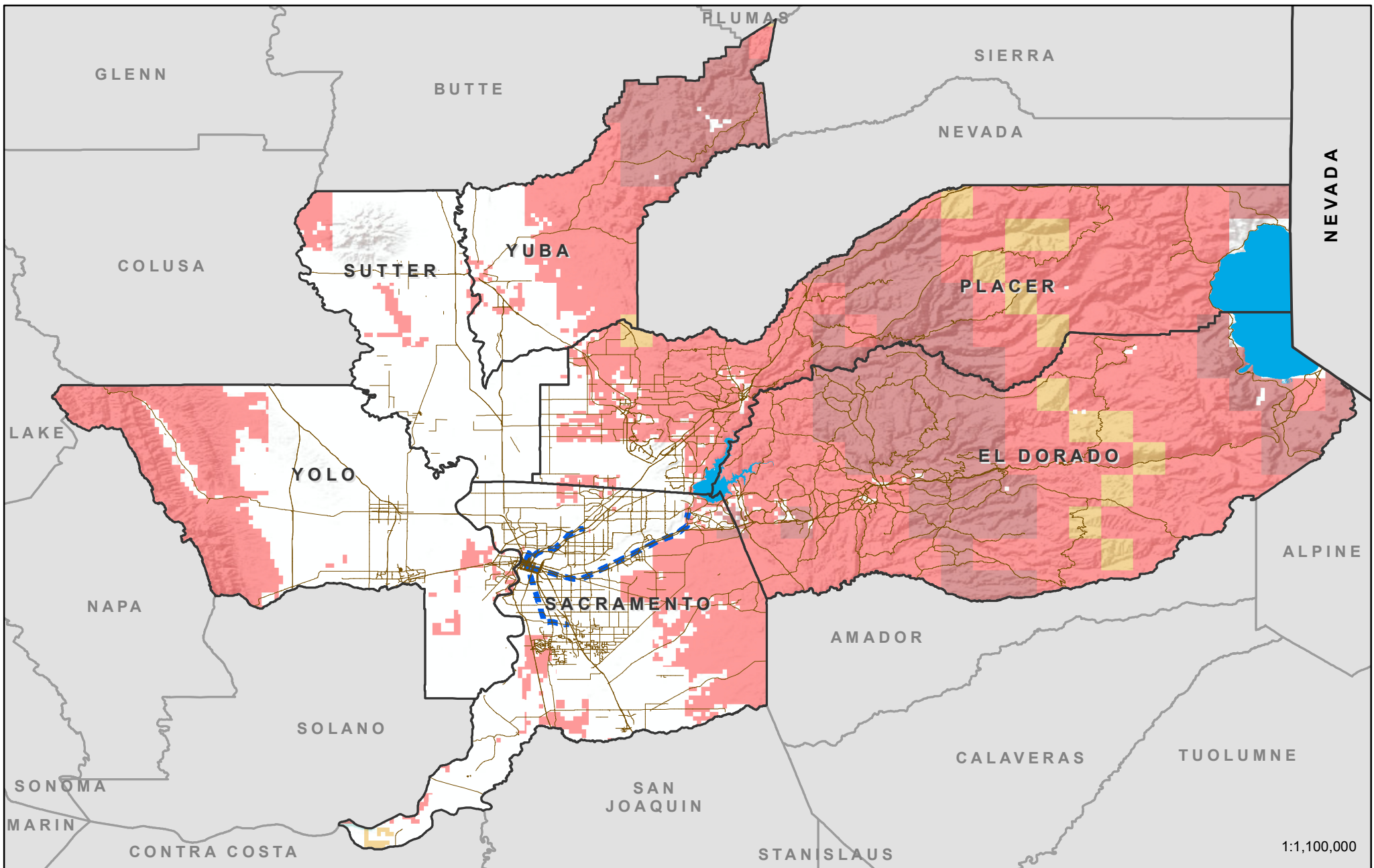
- Regional Centerline - Highways and Arterials
- - - Light Rail Lines

Level of Wildfire Concern RCP 8.5 - 2055

- Very High
- High
- Moderate

Source: Amalgamation of three fire models: 1) MC2-EPA Climate Impacts Risk Assessment, USFS, 2) MC2-Applied Climate Science Lab at the University of Idaho, 3) University of California Merced model.





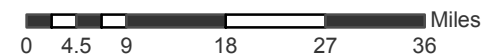
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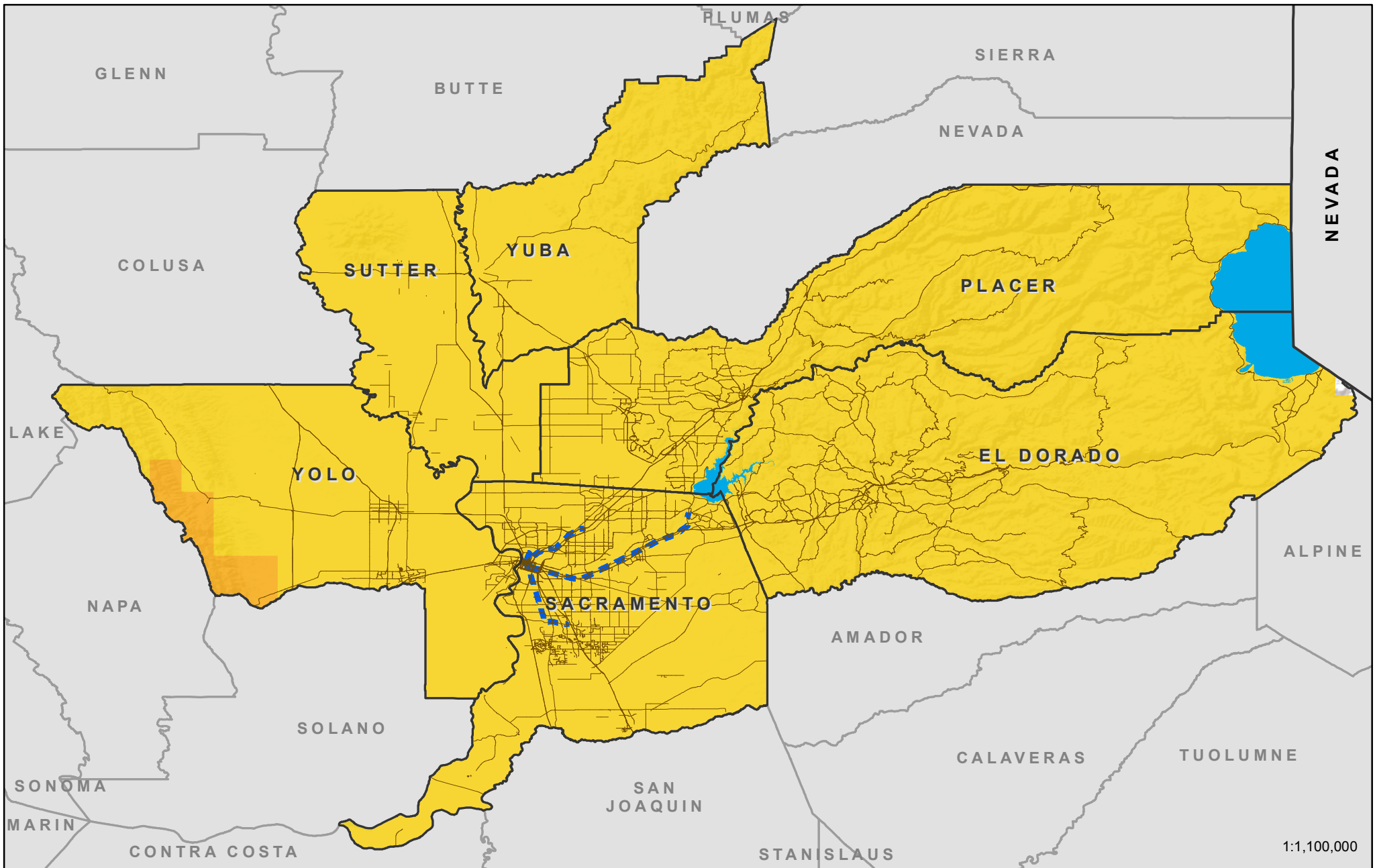
- Regional Centerline - Highways and Arterials
- - - Light Rail Lines

Level of Wildfire Concern RCP 8.5 - 2085

- Very High
- High
- Moderate

Source: Amalgamation of three fire models: 1) MC2-EPA Climate Impacts Risk Assessment, USFS, 2) MC2-Applied Climate Science Lab at the University of Idaho, 3) University of California Merced model.



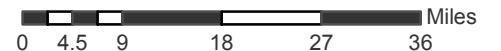
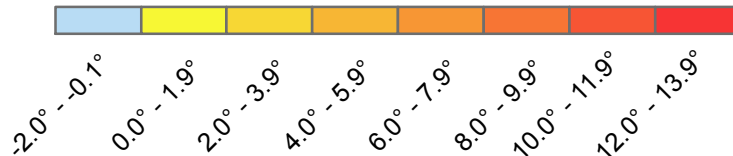


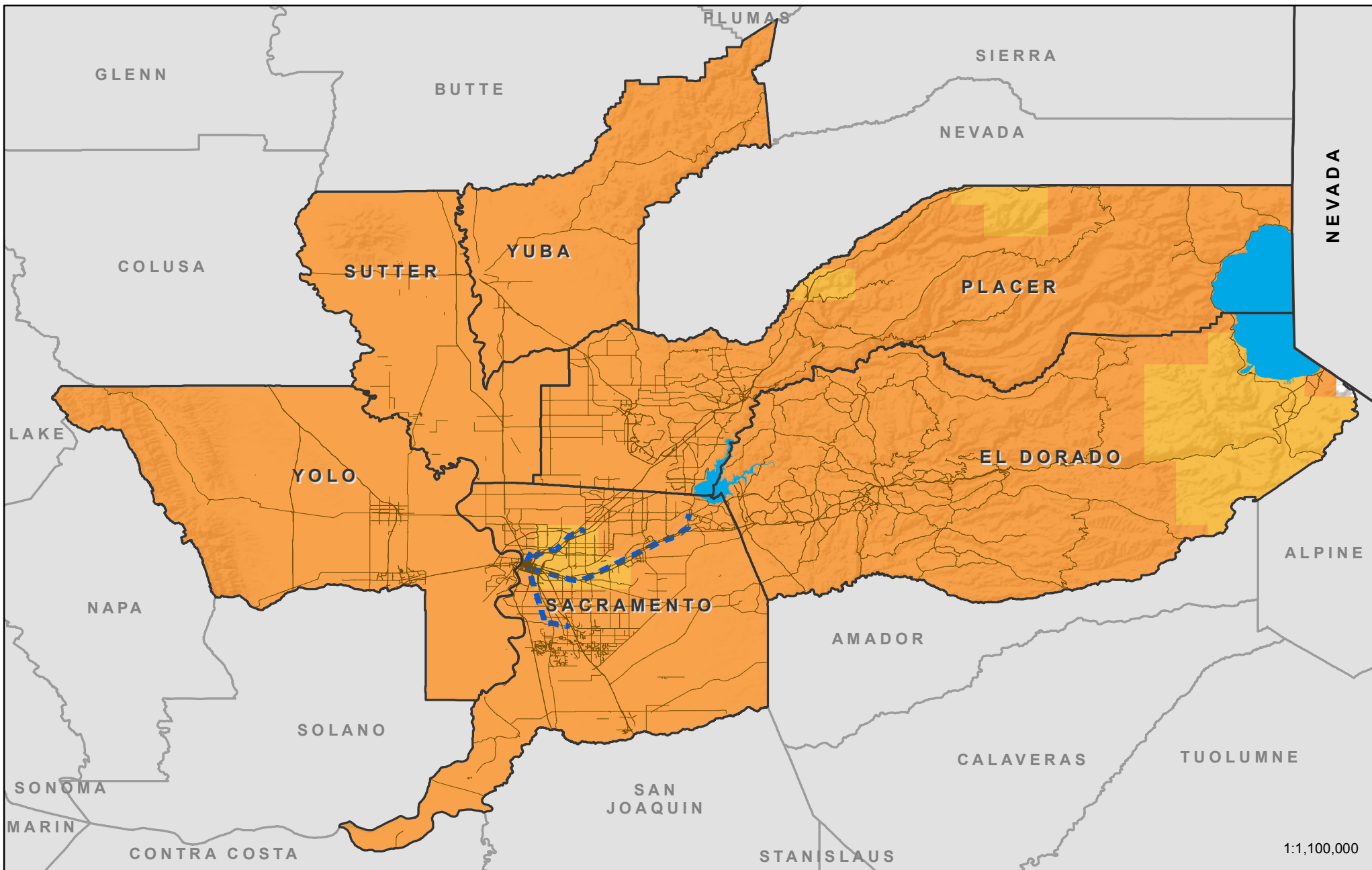
SACOG Assets

- Regional Centerline - Highways and Arterials
- - - Light Rail Lines

Source: CMCC-CMS Global Climate Model, downscaled by the Scripps Institution of Oceanography using the Localized Constructed Analogs technique. RCP 8.5 emissions scenario.

Change in 7-Day Average Maximum Temperature (°F) - 2025



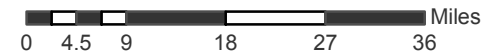
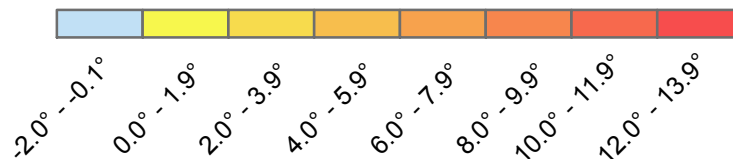


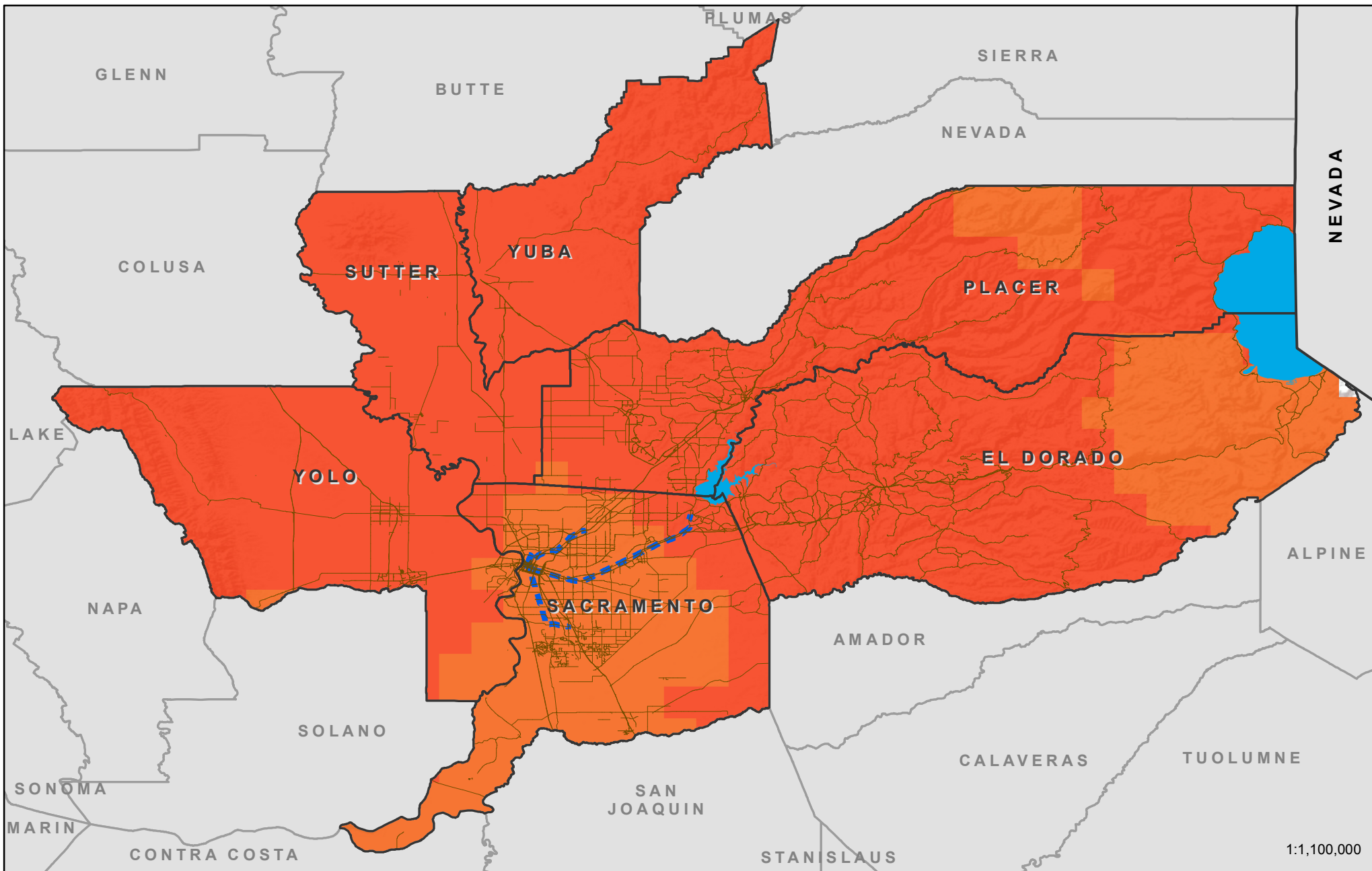
SACOG Assets

- Regional Centerline - Highways and Arterials
- Light Rail Lines

Source: CMCC-CMS Global Climate Model, downscaled by the Scripps Institution of Oceanography using the Localized Constructed Analogs technique. RCP 8.5 emissions scenario.

Change in 7-Day Average Maximum Temperature (°F) - 2055





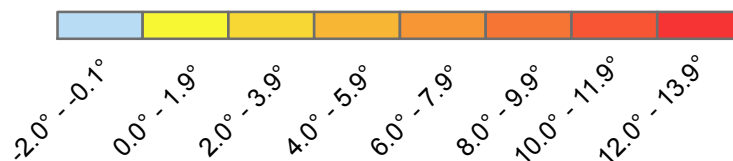
SACOG Assets

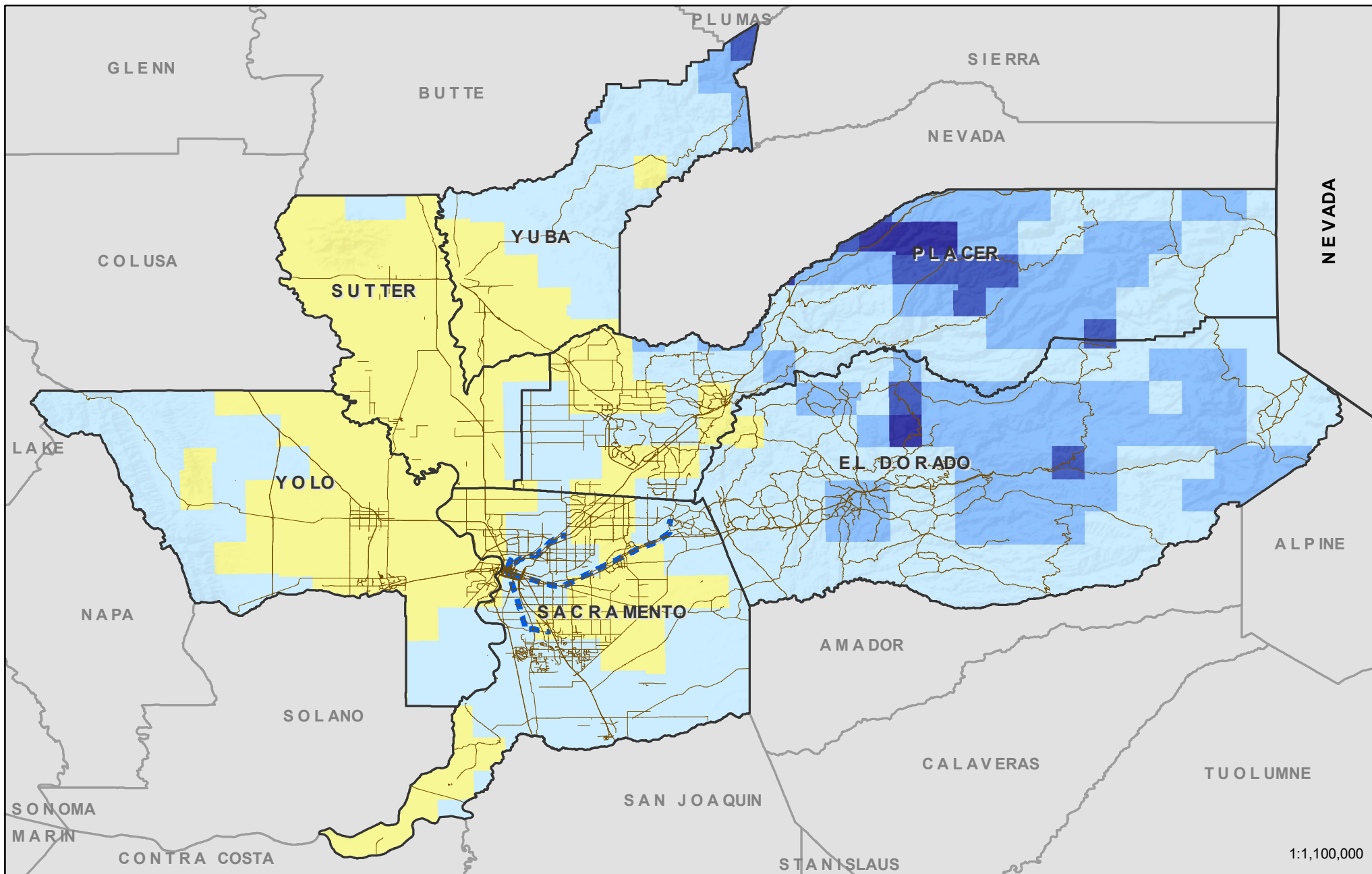
— Regional Centerline - Highways and Arterials

--- Light Rail Lines

Source: CMCC-CMS Global Climate Model, downscaled by the Scripps Institution of Oceanography using the Localized Constructed Analogs technique. RCP 8.5 emissions scenario.

Change in 7-Day Average Maximum Temperature (°F) - 2085





1:1,100,000

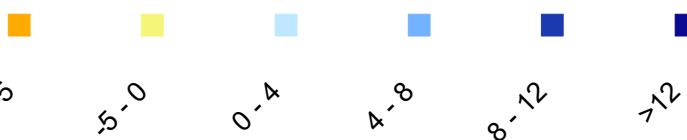
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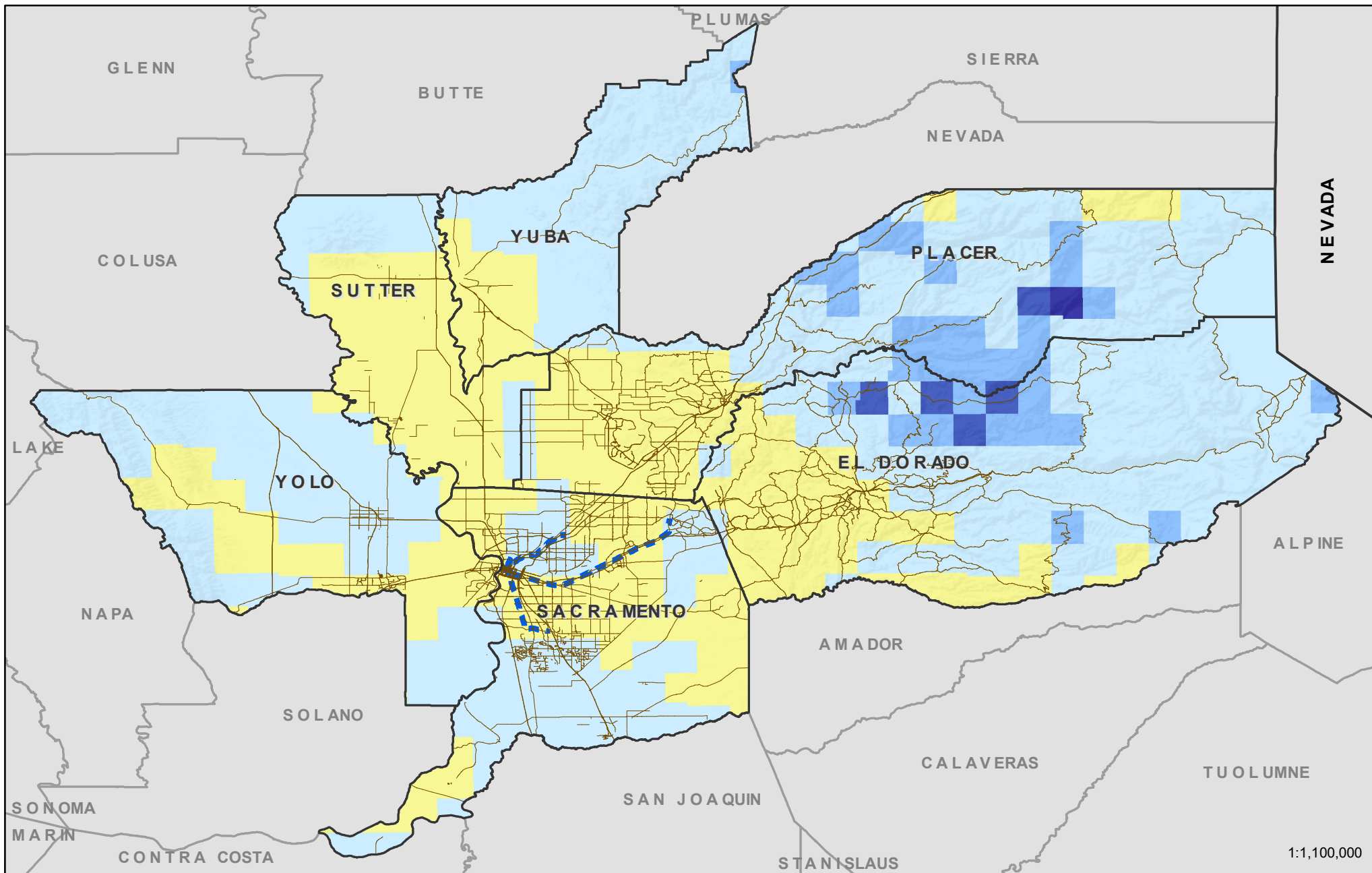
— Regional Centerline - Highways and Arterials

— Light Rail Lines

Source: MIROC5 Global Climate Model, downscaled by the Scripps Institution of Oceanography using the Localized Constructed Analogs technique. RCP 8.5 emissions scenario. Results should be used with caution; users should consider projections from multiple climate models

Inches Change in 100-Year Storm Depth - Historical to 2025





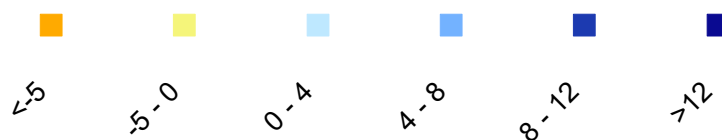
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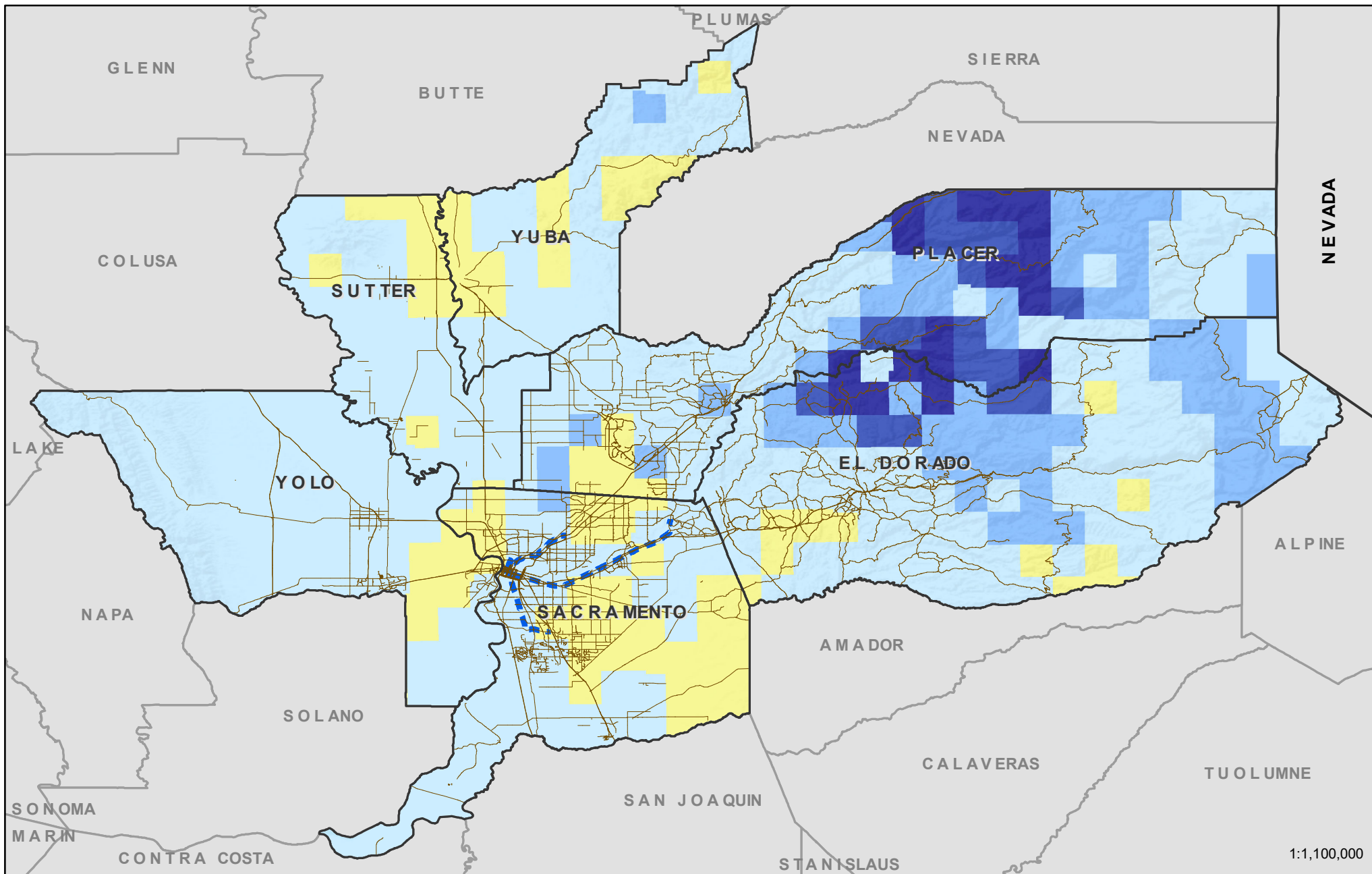
— Regional Centerline - Highways and Arterials

--- Light Rail Lines

Source: MIROC5 Global Climate Model, downscaled by the Scripps Institution of Oceanography using the Localized Constructed Analogs technique. RCP 8.5 emissions scenario. Results should be used with caution; users should consider projections from multiple climate models

Inches Change in 100-Year Storm Depth - Historical to 2055





SACOG Assets

— Regional Centerline - Highways and Arterials

- - - Light Rail Lines

Source: MIROC5 Global Climate Model, downscaled by the Scripps Institution of Oceanography using the Localized Constructed Analogs technique. RCP 8.5 emissions scenario. Results should be used with caution; users should consider projections from multiple climate models

Inches Change in 100-Year Storm Depth - Historical to 2085

