Literature Review and Existing Conditions Report

March 2025

City of Sacramento and SacRT

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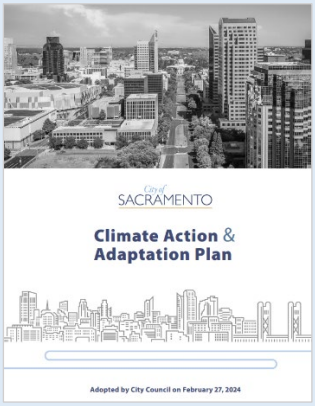
Literature Review

The purpose of this Literature Review is to present a compilation of relevant plans, strategies, and data that will support the City of Sacramento (City) and Sacramento Regional Transit (SacRT) in developing an effective and comprehensive adaptation plan. The information in this report outlines the work and analysis that has already occurred in the region and the relevant strategies and plans that exist to help inform the Sacramento Transportation Infrastructure Adaptation Plan, or "SacAdapt." The data and information in this report will serve as a reference and resource for the subsequent tasks, including the Vulnerability Assessment.

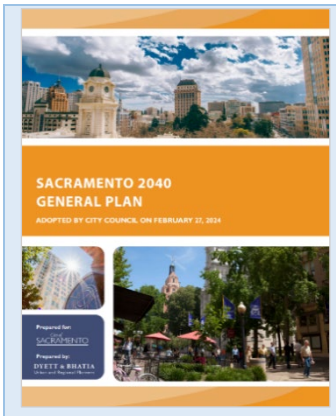
SacAdapt will analyze the current and future climate risks to Sacramento's transportation system and will identify key recommendations to adapt to these changes. These climate risks – extreme heat, flooding, and extreme storms – are not new to the Sacramento region, and there are numerous past and ongoing efforts to model and quantify these risks.

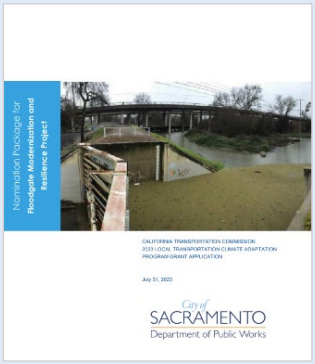
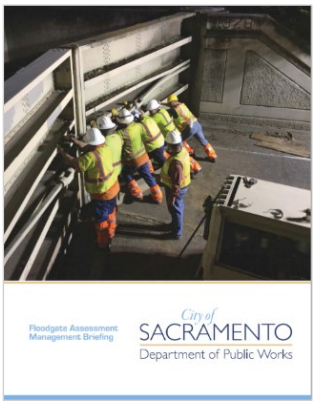
Additionally, there are many ongoing transportation planning and priority-setting efforts led by the City of Sacramento and SacRT, as well as regional agencies, that have identified key projects for providing core services, enhancing sustainability, and encouraging mode shift to active and public transportation. SacAdapt will review and build upon these efforts as well as national best practices. Table 1 indexes the most relevant previous work, segmented into the following sections: the City of Sacramento, SacRT, regional entities, State, and best practices and key examples.

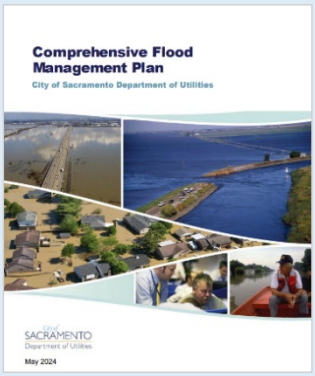
Table 1. Relevant literature index, organized by agency and level of government.

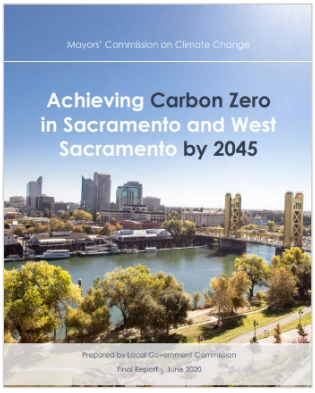
Document/Report	Summary & Relevance to Project
City of Sacramento	
2024 City of Sacramento Climate Action & Adaptation Plan 	**Summary:** The Sacramento Climate Action & Adaptation Plan (CAAP) builds off the City's 2012 Climate Action Plan, the City's Climate Emergency Declaration, and the Mayors' Commission on Climate Change. The CAAP is aligned with the 2040 General Plan's strategies for climate change mitigation, adaptation, and resilience. **Relevance to SacAdapt**: The plan's adaptation chapter and climate change vulnerability assessment appendix summarize current and future climate hazards—such as heat, precipitation, flooding, storms, drought, wildfires, air quality, and sea level rise—as well as how these hazards could affect Sacramento, its people, and its infrastructure. For instance, the CAAP lists populations that are particularly vulnerable to climate hazards and gives context to extreme heat and flooding in Sacramento. Historically, the city has averaged four extreme heat days (days over 103.9°F) per year; by mid-century, the city is projected to face 18-22 extreme heat days per year. The city has historically averaged four extreme rain events (where two-day rainfall exceeds 0.97 inches) per year; by the end of century, this is

	projected to increase to seven rain events per year. The CAAP also maps repetitive loss areas where properties have experienced relatively high degrees of flood damage. In addition to providing projections for the city itself, the CAAP reviews relevant regional climate projections, such as expected changes in peak flows on the American River upstream of Sacramento, that can help inform SacAdapt risk analysis. The CAAP outlines a broad adaptation strategy, describing existing capacity of the City to address climate risks and establishing a high-level set of adaptation priorities. Relevant goals include: • GOAL A-1: Strengthen City government capacity for integrated, holistic climate adaptive strategies and to reduce climate risks • GOAL A-2: Create built environments that reduce exposure to extreme heat and mitigate the urban heat island effect • GOAL A-3: Reduce the risk of damage to life, infrastructure, and property due to flooding • GOAL A-5: Increase community resilience to prepare for climate impacts The goals are accompanied by lists of supporting General Plan policies and implementation actions, which can inform adaptation strategies in SacAdapt. The CAAP also provides contextual information that can inform SacAdapt's recommendation prioritization. Notably, the CAAP sets a pathway to meet the City's goal of achieving carbon neutrality by 2045. Sustainable transportation represents a critical part of this pathway, with key goals including: • MEASURE TR-1: Improve Active Transportation Infrastructure to Achieve 6% Active Transportation Mode Share by 2030 and 12% by 2045 • MEASURE TR-2: Support Public Transit Improvements to Achieve 11% Public Transit Mode Share by 2030 and Maintain Through 2045 These targets are important context for SacAdapt because adaptation strategies that help enable these mode shifts (e.g., addressing extreme heat that affects both active transportation and public transit users) are likely to be prioritized.
2024 City of Sacramento General Plan 2040	Summary: The Sacramento General Plan is a blueprint to guide the city's land use and capital investment decisions for the next two decades. The General Plan includes a policy index, which lists many specific climate adaptation, resilience, and infrastructure maintenance policies.

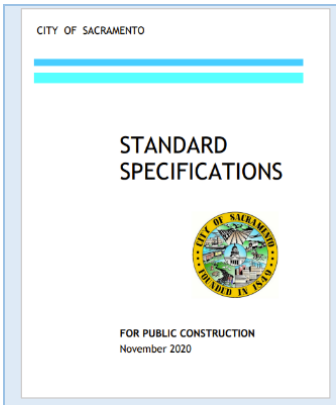
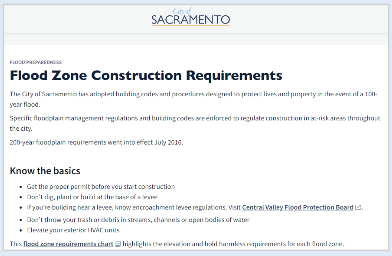
	**Relevance to SacAdapt**: The plan includes goals and policies that outline how the city aims to prioritize emergency management to prepare for the climate hazards it faces, as well as other topics relevant for climate resilience. The policies listed under the 'Climate Adaptation and Resiliency' and 'Environmental Hazards' topics in the policy index appear to be the most relevant for SacAdapt. While relatively high-level, these policies can inform adaptation strategies for SacAdapt. Specific transportation-related policies most likely to be applicable as adaptation strategies for SacAdapt include (in no particular order): • Parking Lot Shading (and related policies such as Parking Lot Shade Ordinance) • Planting (and related policies such as Street Standards for Tree Canopy) • Resiliency Hubs (and related policies like Cooling Centers) • Emergency Power (and related policies) • Bus Shelter Design • Cooling Landscape Standards (and related policies like Climate-Resilient Design and Cooling Design Techniques) • Protection from Flood Hazards (and related policies like Flood Management Planning Coordination and Flood Regulation) • Interagency Levee Management • Unobstructed Access to Levees • Fire Hazards (and related policies) • Evacuation Routes Consistency with these and other policies in the plan could be a component of the strategy prioritization for SacAdapt, either to directly implement General Plan policies or to enhance the resilience of areas the plan prioritizes for investment and future growth. For instance, an adaptation strategy benefiting a road that is a 'Candidate High-Frequency Transit Corridor' could warrant a higher priority in SacAdapt.
2020 Extreme Heat and Social Vulnerability Study NASA DEVELOP	**Summary**: As part of the development of the CAAP and 2040 General Plan, Sacramento partnered with NASA for an analysis of urban heat. The findings indicated that some North Sacramento neighborhoods can be as much as 13°F warmer than outside of city limits, and neighborhoods along south Franklin Boulevard can be as high as 15°F warmer than outside of city limits. **Relevance to SacAdapt**: Vulnerable areas or areas more heavily affected by the urban heat island effect can be cross-referenced with potential adaptation project locations for the development of SacAdapt. Urban heat islands can be mitigated through a variety of

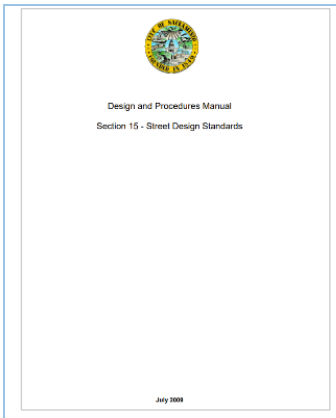
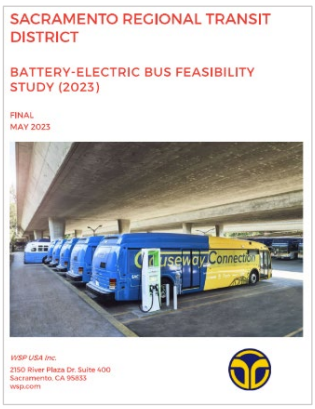
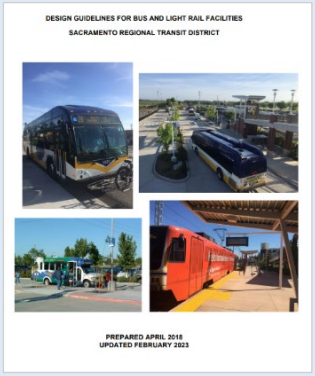
	solutions, such as increased tree cover, green/cool roofs, increased vegetation, and reduction in impervious surfaces.
2023 City of Sacramento Department of Public Works Floodgate Modernization and Resilience Project Scope 	**Summary**: The City of Sacramento Floodgate Modernization and Resilience Project will provide necessary repairs and modernization to ten critical floodgates located where road, rail, and active transportation facilities intersect the city's secondary levee berm. Sacramento's floodgates directly protect critical transportation infrastructure and climate-vulnerable communities in the event of a main levee breach. The floodgates are an essential part of the city's transportation infrastructure that balance the need to travel with flood protection. The U.S. Army Corps of Engineers (USACE) cites Sacramento as among the most at-risk regions in the United States for catastrophic flooding, and the proposed project will directly protect over 300,000 people and 240 critical facilities located in potential flood inundation zones. **Relevance to SacAdapt**: This document provides helpful hazard data within SacAdapt service area, including floodgate failure risk, extreme precipitation risk, and overlaid maps of disadvantaged communities in Sacramento with inundation areas. It also serves as an informative example of how to evaluate and, if warranted, obtain funding for adaptation projects related to flood management infrastructure.
2018 City of Sacramento Department of Public Works Floodgate Assessment Management Briefing 	**Summary**: This document outlines the critical role that floodgates play in safeguarding the City of Sacramento against flooding. Managed by the Department of Public Works, the city's primary and secondary levees protect the city from riverine flooding. Floodgates are managed to allow the road and railroad facilities that cross the city's flood protection levees to operate continuously in the absence of extreme flooding. The majority of the city's floodgates are over 50 years old and are in need of various degrees of updates and upgrades. This assessment reviewed 18 floodgates to evaluate whether they meet current standards. Among those reviewed, six were found to have major issues leading to inoperability or ineffectiveness in a flood.

	The 2023 City of Sacramento Department of Public Works Floodgate Modernization and Resilience Project Scope was developed in response to this assessment (see document above). **Relevance to SacAdapt:** See preceding row.
2024 City of Sacramento Department of Utilities Comprehensive Flood Management Plan 	**Summary**: This flood management plan is the City's strategic plan to reduce flood risk from 2024-2029. It provides an extensive overview of flood risk in Sacramento and describes seven risk reduction tools to reduce this flood risk: land use planning and development guidelines, emergency management, levee and other structural improvements, internal drainage improvements, risk communication (program for public information), National Flood Insurance Program (NFIP)/Community Rating System (CRS), and levee security. **Relevance to SacAdapt**: The document provides essential context and information for SacAdapt's evaluation of flood risk to the transportation system and assessment of transportation adaptation strategies. For flood protection assets included in SacAdapt, adaptation strategies may be directly related to the flood management plan's tools, particularly (1) levee and other structural improvements and (2) internal drainage improvements.
2022 Sacramento Transportation Priorities Plan 	**Summary:** The Sacramento Transportation Priorities Plan is the Council-adopted strategy for prioritizing the city's transportation efforts through collaborative efforts to improve mobility. The TPP strategy and initial list of projects – in total, almost $5 billion in needed investments – were adopted in 2022. Prioritization in the TPP is based on five values: equitable investment; improvement of air quality, climate, and health; access to destinations; improvement of safety for all road users; and maintenance of the system. **Relevance to SacAdapt:** SacAdapt can identify opportunities to enhance the climate resilience of the TPP's projects. The TPP will be reviewed for certain project types that are candidates for higher priority general adaptation solutions, such as designing culverts or bridges for projected increases in flow or incorporating tree planting for urban heat island mitigation. In addition, a geospatial review of project locations overlaid with hazard areas and disadvantaged communities will allow for identification of specific projects that may be candidates for project-specific adaptation solutions.
2021 Sacramento Valley Station Area Plan and Living Community	**Summary:** The Sacramento Valley Station (SVS) Area Plan is a living community plan for a regional transportation hub in the midst of a large, developing urban center on a former Brownfield site. Project goals include revitalizing downtown livability to make a positive regional asset, reducing carbon emissions from transportation and

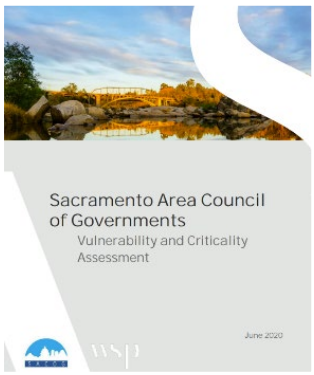
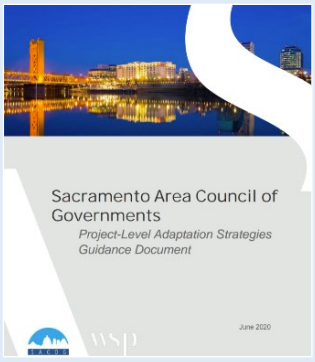
Challenge Vision Plan[1]  	buildings, preserving and enhancing the local ecosystems of Sacramento, and enabling sustainable mobility choices by mending discontinuities in the circulation network for active transportation modes. The plan includes a vision for resilient community connections with a disaster response plan to disseminate to all residents and tenants on a yearly basis; assignments and trainings for two block captains for every 500 residents that are highly versed in disaster response, first aid, and general safety procedures; maintenance of an emergency contact program; cultivation of an active neighborhood watch that has a mandate to look out for resident well-being and safety; and assuring that sensitive infrastructure is not located within the floodplain. **Relevance to SacAdapt:** Imperative 10 – Resilient Community Connections describes how SVS will prepare for extreme weather and natural disasters, and can serve as an example for resilient transportation hubs.
2020 Mayors' Commission on Climate Change Report  	**Summary**: In 2018, former mayors Darrell Steinberg of Sacramento and Christopher Cabaldon of West Sacramento launched the Mayors' Commission on Climate Change (MCCC) to develop recommendations to achieve net zero carbon by 2045 in the cities of Sacramento and West Sacramento. The commission made recommendations across the following sectors: the built environment, mobility, and community health & resilience. The recommendations from the MCCC were considered as part of the City's CAAP. **Relevance to SacAdapt:** The report recommends the city undertake a climate vulnerability assessment to better map its risk to climate hazards and for wider investment in green infrastructure in order to mitigate against climate impacts such as extreme heat and flooding.
2020 City of Sacramento Traffic Signal Operations and Standards	**Summary**: The City of Sacramento Traffic Signal Operations and Standards document outlines the specifications, drawings, and qualified product lists for traffic lights and signals. **Relevance to SacAdapt:** This document provides specifications and parameters for SacAdapt to reference if there are any proposed changes to the city's traffic signals and operations. Standards regarding temperature are particularly relevant for adaptation options affecting signals. A potential procedural adaptation strategy would be to update the standards to incorporate expected future climate impacts.

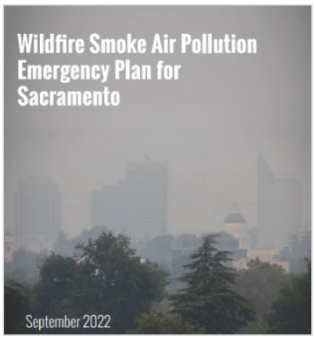
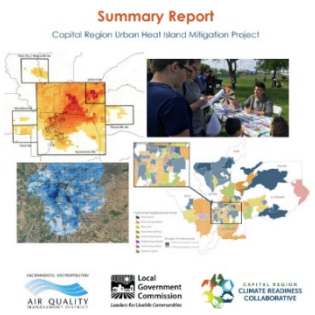
[1] The SVS Site Plan appendix is a publicly accessible summary of the LCC Plan that contains similar information as the LCC Vision Plan

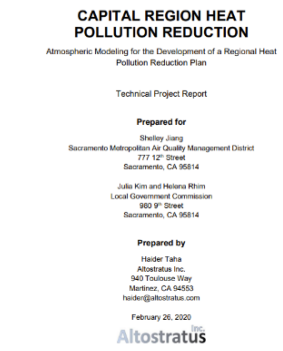
	
2018 City of Sacramento Emergency Operations Plan 	**Summary:** The City of Sacramento Emergency Operations Plan (EOP) details the City's planned response to emergency situations, including natural disasters and human-induced disasters. The EOP lays out the roles and responsibilities of various departments in these situations. The EOP identifies the following climate hazards that may affect the city: severe weather, flooding, wildfires, drought, freezing temperatures, and landslides/subsidence. The City of Sacramento Evacuation Plan is an annex to the City's EOP. **Relevance to SacAdapt:** Any TIAP adaptation strategies that focus on emergency management (including evacuation-related strategies or considerations) shall align with this plan, particularly Function D (Transportation) and Function G (Evacuation and Public Protection).
City of Sacramento Flood Zone Construction Requirements 	**Summary**: The City of Sacramento flood zone construction requirements detail building codes and procedures designed to protect lives and property in the event of a 100-year or 200-year flood. Specific floodplain management regulations and building codes are enforced to regulate construction in at-risk areas throughout the city. New FEMA regulations went into effect in July 2024 in the A99 flood zone, which includes the Natomas Basin, a Special Flood Hazard Area. **Relevance to SacAdapt:** The construction requirements reflect flood risk tolerance in the city, and may guide potential adaptation strategies. Furthermore, it may be helpful to examine how the return period events (e.g., 100-year and 200-year events) described in the requirements are expected to change over time. A potential procedural adaptation strategy would be to update the standards to incorporate expected future climate impacts.
2009 Design and Procedures Manual: Street Design Standards	**Summary**: This manual outlines the city's street standards to be used in the preparation of plans, specifications, and estimates for projects within the city right of way. These standards aim to ensure the safe

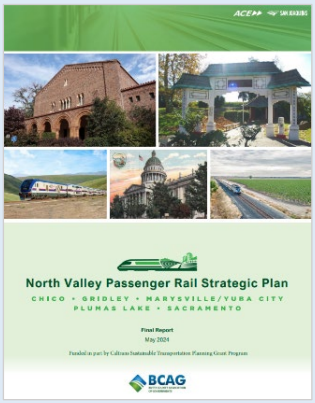
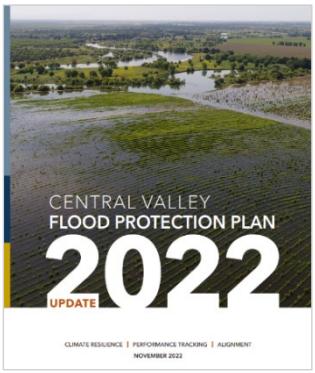
	and efficient movement of vehicles, bicycles, and pedestrians, and to be considerate of future maintenance costs to sustain desired levels of service. These standards are in the process of being updated, estimated to be finalized by the end of 2025. **Relevance to SacAdapt:** SacAdapt can reference the City's Street Design Standards in any plans that may modify city streets. The standards can also help estimate risks to existing assets by understanding what standards transportation assets were designed to meet. A potential procedural adaptation strategy would be to update the standards to incorporate expected future climate impacts.
Sacramento Regional Transit District (SacRT)	
2023 SacRT Battery-Electric Bus Feasibility Study 	**Summary:** This report provides an updated evaluation of the Battery-Electric Bus (BEB) feasibility study using the latest 2023 technology specifications and the most recent service schedule. The findings are intended to inform strategic decisions regarding the transition to ZEBs, including potential solutions for enhancing range, such as opportunity charging, service changes, and the integration of fuel cell electric buses. This study focuses exclusively on BEB performance. **Relevance to SacAdapt:** SacAdapt will include a focused analysis on SacRT's ZEB infrastructure, including identifying climate risks and adaptation strategies. This study and related plans provide the basis of what assets that ZEB analysis will focus on.
2023 SacRT Updated Design Guidelines for Bus and Light Rail Facilities 	**Summary**: These guidelines for bus and light rail facilities are used for new construction and retrofitting of existing facilities. The guidelines are meant to promote convenient, comfortable, and safe bus and light rail facilities for transit users, and to assist SacRT in providing consistent, high-quality facilities that increase ridership and public support for mass transit. **Relevance to SacAdapt:** These guidelines are important to reference and align with for any TIAP adaptation strategies that require changes to bus and light rail facilities. The standards can also help estimate risks to existing assets by understanding what standards transit assets were designed to meet. A potential procedural adaptation strategy would be to update the standards to incorporate expected future climate impacts.
2022 SacRT Short Range Transit Plan (FY 2022-2027)	**Summary**: The Short Range Transit Plan (SRTP) represents SacRT's plan for transit service from 2022-2027. The FTA requires that any

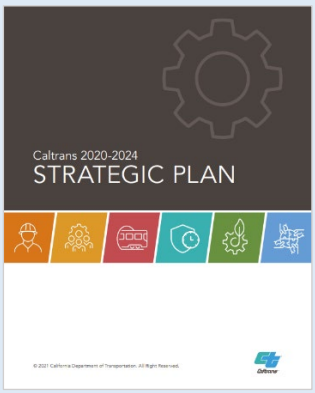
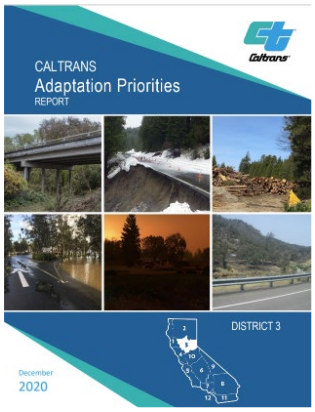
	transit agency receiving federal funds directly must have a current SRTP. The SRTP is guided by several SacRT planning documents, including the Transit Master Plan and the TransitAction Plan, including the vision, goals, and strategies for accommodating the long-range transit needs of Sacramento's traveling public. **Relevance to SacAdapt:** SacAdapt should align with the operational and strategic goals set out in the SRTP. The SRTP also provides important contextual information on SacRT's assets, systems, and priorities.
2022 SacRT Revised Transit Asset Management (TAM) Plan 	**Summary**: The Transit Asset Management (TAM) Plan is designed to increase awareness and improve asset management, providing SacRT with specific applications of asset management concepts, processes, and tools. The multi-pronged approach to asset management outlined in the plan includes establishing asset specifications and requirements, condition assessment, asset analysis, asset management decision-making, and continuous improvement. Part of the asset management strategy is planning for climate change. **Relevance to SacAdapt:** The TAM outlines the importance of cost-effectively maintaining SacRT's assets and managing the risks they face. While climate hazards are not explicitly called out as a risk to SacRT's assets, this is an important element that SacAdapt can link to.
Regional Entities	
2023 Sacramento Area Council of Governments (SACOG) Regional Emergency Preparedness Strategy 	**Summary**: This strategy document summarizes existing practices and identifies emergency preparedness gaps in the SACOG region, specifically as they relate to transit and the broader transportation system as well as interagency and interjurisdictional coordination. It is meant to complement existing emergency management plans by allowing transit agencies to better integrate into public safety and emergency management organizations. **Relevance to SacAdapt:** The strategy's recommendations may inform emergency management-related adaptation strategies. The infrastructure recommendations regarding contra flow, transit facility relocation, and ZEB emergency preparedness could have direct tie-ins to infrastructure-based adaptation strategies. 'Enhancing emergency management' may be considered in SacAdapt as a factor in strategy prioritization.

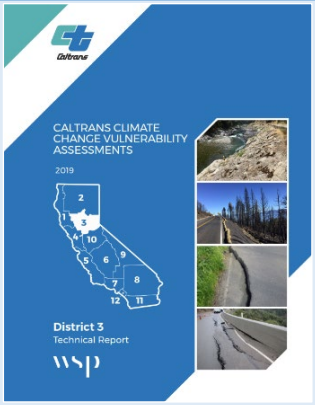
[2020 SACOG Vulnerability and Criticality Assessment] 	**Summary**: The SACOG Vulnerability and Criticality Assessment analyzes how climate-related hazards will affect the SACOG region's transportation system through the end of the century. The report evaluates expected future hazards including wildfire, riverine flooding, sea level rise and storm surge, and extreme heat. **Relevance to SacAdapt:** At a systemwide scale, the assessment analyzes which assets are most critical to the transportation network. The asset types reviewed include roadways, bridges, airports, transit stops, and light rail lines. Additionally, each of these asset types' vulnerabilities were evaluated against each climate hazard, which can help identify the scope of key transportation assets in SacAdapt analysis. Portions of the approach used to prioritize assets could be leveraged for SacAdapt.
[2020 SACOG Transportation Project-Level Climate Adaptation Strategies for Transportation] 	**Summary:** The Project-Level Climate Adaptation Strategies for Transportation in the SACOG Region examines risks facing individual transportation assets and evaluates potential adaptation strategies. The climate hazards evaluated include extreme heat, wildfires, delta sea level rise, and riverine flooding. The projects evaluated include transit stop pilots, the US highway 50 corridor, bridge equipment protection, and bridge retrofitting/replacement. **Relevance to SacAdapt:** Both the analysis approach and types of adaptation strategies covered in this guidance document will inform the development and prioritization of TIAP adaptation strategies.
[2015 SACOG Transportation Climate Adaptation Plan] 	**Summary:** This SACOG plan outlines the key strategies and actions that the Sacramento region can take to ensure its transportation assets can adapt to climate risks and hazards. This plan includes climate hazard analysis for extreme heat, wildfire, landslides, precipitation, runoff, and flooding as well as their impact on transportation systems in the region. **Relevance to SacAdapt:** The plan succinctly summarizes the impacts of extreme heat, precipitation, wildfire, and landslides on various transit assets and systems including roadways, railways, bridges, drainage systems, and traffic flow. The plan outlines specific approaches to address these challenges, which can inform SacAdapt.
2024 Sacramento Metropolitan Air Quality Management District (SMAQMD) Cool Pavement Overview	**Summary**: This document provides an overview of cool pavement types, including product and cost comparisons. The overview gives context to the potential scale and benefits of cool pavements, since pavement makes up 45% of the city's surfaces, and over half of paved areas are roads. Urbanized areas in Sacramento range from 3-9°F

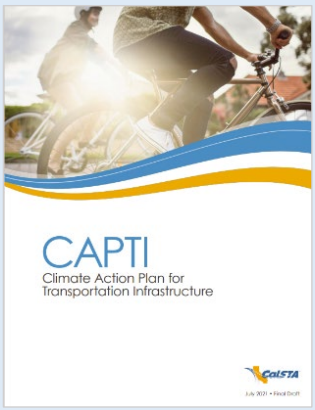
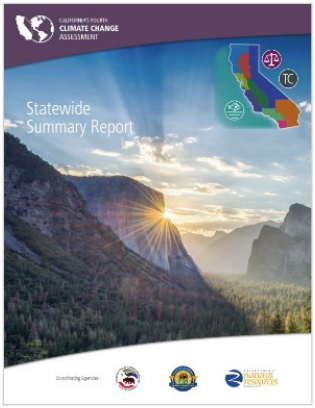
	warmer than surrounding areas due to the urban heat island effect, fueled by heat-absorbing surfaces like dark pavement. Cool pavement can help to lower pavement temperatures and avoid infrastructure damage, and provide other co-benefits. **Relevance to SacAdapt:** This overview of cool pavements can inform similar resources and adaptation strategies for SacAdapt. This resource additionally presents an opportunity to learn from nearby local agencies implementing cool pavements (e.g., City of Elk Grove, City of Roseville) to understand the efficacy of this strategy in practice.
2022 SMAQMD Wildfire Smoke Emergency Plan 	**Summary**: This plan includes general information on air quality, forecasting, and monitoring, and provides a basic overview of health impacts from smoke. It outlines best practices for different sectors to better prepare for and respond to a wildfire event. Quick-reference tools like the sector-specific Air Quality Action Charts are designed to help agencies respond promptly to reduce smoke exposure when smoke descends. The plan also contains standardized messaging tools for public agencies to use. **Relevance to SacAdapt:** The recommendations and best practices for public agencies listed in the plan are relevant for TIAP adaptation strategies related to preparing for, responding to and adapting to wildfire smoke, including specific actions for vulnerable populations.
2020 SMAQMD Capital Region Urban Heat Island Mitigation Project 	**Summary:** The Capital Region Urban Heat Island Mitigation Project, led by SMAQMD and CivicWell, generated detailed models of the current and future urban heat island (UHI) effect in the Sacramento region and used them to evaluate the effectiveness of a range of heat mitigation measures. The report found that from today to 2050, the UHI will increase in almost all locations, reaching as high as 9 to 12°F in North Sacramento. **Relevance to SacAdapt:** This Plan offers information on UHI measures specifically for transportation agencies and provides best practices for addressing this hazard, including cool and green roofs at transit stations, cool pavements, vegetation cover and the associated planning-based and financial incentives, and community-focused tools and programs to implement these measures.
2020 SMAQMD Atmospheric Modeling for the Development of a Regional Heat Pollution Reduction Plan	**Summary:** This report contains detailed atmospheric modeling that informed the development of a heat mitigation plan for the Sacramento region (see row above). The study was carried out to evaluate the effects of various mitigation measures on urban heat in the counties of Sacramento, El Dorado, Placer, Yuba, Sutter, and Yolo.

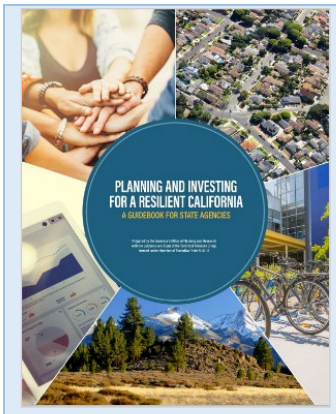
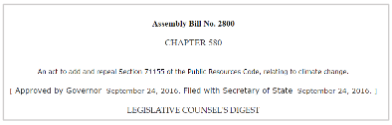
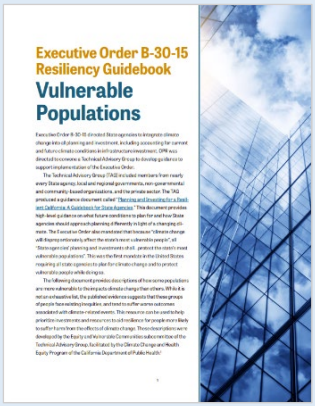
	The modeling aimed to characterize and rank heat mitigation measures in their ability to support urban cooling. **Relevance to SacAdapt:** The mitigation strategies assessed in this report include cool roofs, walls, and pavements; vegetation canopy cover; vehicle electrification and EV ownership; solar photovoltaic cells; and smart growth. The report identifies certain locations within Sacramento that could be priority project areas for implementing each mitigation measure, which may be useful for the development of the adaptation strategies for SacAdapt.
2021 Sacramento County Multi-Jurisdictional Local Hazard Mitigation Plan 	**Summary**: The Sacramento County Local Hazard Mitigation Plan (LHMP) is a guide to reducing risks from hazards and serves as a tool to help decisionmakers direct mitigation activities and resources. The hazards outlined in the plan include dam failure, drought and water shortage, earthquakes and earthquake liquefaction, stormwater and riverine flooding, landslides, mudslides and debris flow, levee failure, extreme cold and freeze, extreme heat, heavy rain and storms, wind and tornadoes, subsidence, and wildfires. **Relevance to SacAdapt:** The Hazard Identification Assessment data set outlines the climate hazards the county faces based on likelihood, geographic extent, magnitude, and significance. It also outlines the relevant mitigation actions across the county, which will be useful for the development of SacAdapt adaptation strategies.
Valley Rail Intercity Rail Project 	**Summary**: The Valley Rail Intercity Rail Project aims to improve and expand both Amtrak San Joaquins and the Altamont Corridor Express (ACE), focusing on providing improvements and better connections between the Sacramento area and the San Joaquin Valley. **Relevance to SacAdapt**: This project highlights the Sacramento region—and SVS in particular—as a critical hub for the intercity rail system. The Project identifies rail connections that may be considered for specific adaptation projects.
2024 Butte County Association of Governments North Valley Passenger Rail Strategic Plan	**Summary**: The North Valley Passenger Rail Strategic Plan is a blueprint for establishing a new passenger rail service to link Butte, Yuba, and Sutter Counties with Sacramento and the rest of the state. **Relevance to SacAdapt**: This plan demonstrates the broader regional significance of Sacramento—and SVS in particular—as a passenger rail hub and the importance of intercity rail connections. The Project

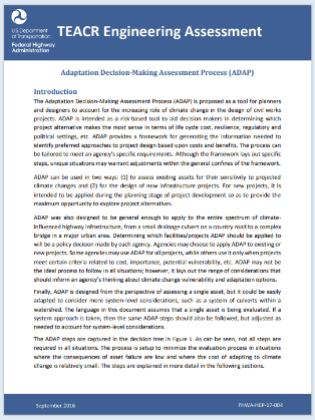
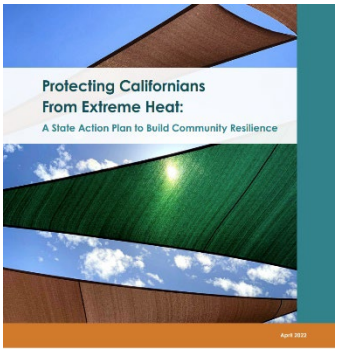
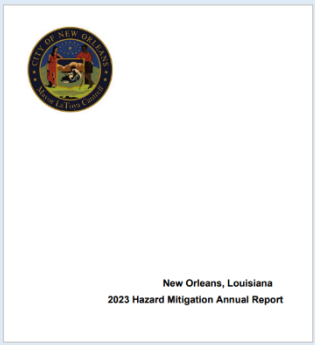
	identifies rail connections that may be considered for specific adaptation projects.
2022 Central Valley Flood Protection Plan 	**Summary:** This plan describes a programmatic vision for improving flood risk management throughout California's Central Valley, guiding the state's participation in managing flood risk in areas protected by the State Plan of Flood Control (SPFC). It recommends actions and policies informed by engagement with stakeholders and partners and prioritizes investments over a 30-year horizon. This Plan has a corresponding Technical Analysis Summary Report. **Relevance to SacAdapt:** This plan includes the Lower Sacramento River-Delta North Region—including the key flood protection measures that have been implemented in the region and the relevant challenges and priorities—which provide useful lessons learned to apply to the flood mitigation strategies of SacAdapt. For example, expected changes to peak flows may be an important input to the risk analysis and adaptation strategy evaluation.
State	
2021 Caltrans Climate Change Vulnerability Assessment: Statewide Summary Report 	**Summary**: The Caltrans Climate Change Vulnerability Assessment Statewide Summary provides an overview of the 12 Caltrans district Summary Reports and Caltrans' planned next steps, which include developing district-level adaptation priority approaches, conducting facility-level assessments, and integrating resilience at the project level. The main climate stressors evaluated throughout are temperature rise, precipitation, wildfire, sea level rise, storm surge, and cliff retreat. Caltrans is in the process of updating this statewide report; the Climate Change Vulnerability and Risk Assessment is expected to be completed in mid-2025. **Relevance to SacAdapt:** The report provides graphs and tables demonstrating the impacts of each climate hazard across each of the

	12 Caltrans districts, including District 3, which provides useful context for SacAdapt.
2021 Caltrans Strategic Plan 2020-2024 	**Summary:** The Caltrans Strategic Plan outlines the short-term goals of the agency. The six goal areas are safety, equity and livability, climate action, multimodal transportation networks, stewardship and efficiency, and cultivating excellence. One of Caltrans' goals is to lead climate action, with a focus on resilience, to strengthen the capability to withstand and recover from the impacts of climate change. **Relevance to SacAdapt:** The Strategic Plan presents an opportunity for SacAdapt to align with Caltrans' intended outcomes, including improving asset conditions within the state and strengthening their capability to withstand and recover from the impacts from climate change.
2020 Caltrans Adaptation Priorities Report: District 3 	**Summary**: This report was developed for Caltrans to identify District 3 State-owned transportation assets that are exposed to climate hazards and prioritize which assets will undergo detailed asset-level climate assessments. This document contains exposure findings of extreme temperatures, precipitation, wildfire, sea level rise, storm surge, and cliff retreat on assets. **Relevance to SacAdapt:** Caltrans outlines its Climate Adaptation Framework, applicable for all transportation system owners or managers, including the City and SacRT. This will be part of SacAdapt and subsequent adaptation planning. The framework shows how agencies can incorporate climate resilience into different functions. In terms of the asset-level analysis, several of the asset classes covered include: roadways (including Delta storm surge impacts and temperature impacts to pavement), bridges (including riverine flood impacts), and large and small culverts (including riverine flood impacts). The analytical process for prioritizing assets according to their climate risks will inform SacAdapt.
2019 Caltrans Climate Change Vulnerability Assessment: District 3 Technical Report	**Summary**: The Caltrans District 3 Vulnerability Assessment outlines the vulnerabilities that District 3 faces on a portion of the State Highway System (SHS). This assessment was performed to better understand the types of weather-related climate events that will occur, determine the Caltrans assets that are vulnerable to climate hazards, and develop a method and process to prioritize projects that are responsive to climate change concerns. **Relevance to SacAdapt:** This study developed climate hazard datasets relevant to transportation practitioners. Some, such as the wildfire projections, may still be useful for SacAdapt, while others are less

	relevant given the more recent projections from the California Fifth Assessment.
[2021 California Transportation Plan 2050] 	**Summary**: The California Transportation Plan (CTP) 2050 is California's long-range transportation roadmap that provides a unifying and foundational policy framework for making effective, transparent, and transformational transportation decisions in California; addresses the varied transportation needs of urban, suburban, rural, and Tribal communities; emphasizes implementation; and identifies a timeline, roles, and responsibilities for each plan recommendation. The CTP does not contain projects; rather, it includes policies and strategies required to close the gap between what regional transportation plans aim to achieve and how much more is required to meet 2050 goals. **Relevance to SacAdapt:** The CTP notes enhancing transportation system resiliency as one of the overarching goals of the plan. The CTP outlines several key recommended action items to support meeting this goal, which SacAdapt can align with. The key action items are as follows: 1) Seek new funding sources to address the growing risks of climate change, pandemics, earthquakes, and other natural disasters; 2) Develop and maintain a statewide transportation risk management plan to identify and respond to future disruptions; 3) Develop a statewide repository of location-specific adaptive strategies that can be incorporated into infrastructure maintenance and rehabilitation projects; 4) Identify and prioritize deployment of resiliency strategies in the state's most vulnerable communities; 5) Integrate natural land, resource, and ecosystem protection strategies into resiliency planning; 6) Increase the use of simulation systems and predictive technologies to understand how future disruptions may impact infrastructure and travel patterns; 7) Develop statewide performance measures on resiliency and include resiliency as a criterion in statewide project prioritization and funding allocation; 8) Increase collaboration and communication with MPOs around resiliency planning and integrating resiliency into SCSs; 9) Accelerate implementation of the Caltrans District Vulnerability Assessment recommendations; 10) Expand adaptation planning grants for local and regional partners and support implementation; 11) Expand funding for seismic retrofits of bridges, highways, rail, airports and

	other infrastructure; 12) Preserve and enhance critical access routes for emergency response.
2021 California State Transportation Agency Climate Action Plan for Transportation Infrastructure (CAPTI) 	**Summary:** California's Climate Action Plan for Transportation Infrastructure (CAPTI) sets out a strategic plan for the state to ensure its transportation infrastructure can adapt to the impacts of climate change and ensure state transportation infrastructure investments are aligned with the state's wider climate, health, and social equity goals. **Relevance to SacAdapt:** The CAPTI has an overarching strategy to "Support Climate Resilience through Transportation System Improvements and Protections for Natural and Working Lands." The accompanying actions include: • S5.1 Develop Climate Risk Assessment Planning and Implementation Guidance • S5.2 Update Transportation Infrastructure Competitive Program Guidelines to Incentivize Climate Adaptation and Climate Risk Assessments/Strategies • S5.3 Explore Incentivizing Land Conservation through Transportation Programs
2018 California Fourth Climate Change Assessment 	**Summary**: California's Fourth Climate Change Assessment represents the most recently completed state climate assessment, while the Fifth Assessment is currently underway. The Assessment is a regionally-focused report that projects climate change impacts under different future emissions scenarios utilizing a set of global climate models. This report used a commonly recognized statistical downscaling technique, Localized Constructed Analogs (LOCA), to downscale global climate models to California. It also includes data from 44 state-funded research reports to support adaptation efforts at the local level. The Assessment outlines how vulnerable the state's transportation assets are to the effects of climate change. **Relevance to SacAdapt:** The datasets with projected future climate conditions in California, from both the Fourth and Fifth Assessments, will be used as inputs to SacAdapt's vulnerability assessment and more in-depth subsequent analysis of adaptation strategies.
2018 Planning and Investing for a Resilient California: A Guidebook for State Agencies, created by the Office of Planning and Research	**Summary**: The Office of Planning and Research (OPR), now known as the Office of Land Use and Climate Innovation (LCI), released this 2018 guidebook, which outlines the decision-making processes and approaches that state agencies can take to prepare for the impacts of climate change. The four-step recommended process includes: 1) Identify how climate change could impact a project or plan, 2) Conduct an analysis of climate risks, 3) Make a climate-informed decision, and 4) Track and monitor progress.

	The guidebook includes projected average temperature rise in California, estimating that annual average temperatures will increase between 4.1°F and 5.3°F by the middle of this century, and between 5.0°F and 8.5°F by the end of the century. **Relevance to SacAdapt:** The four step process to building resilience may inform decision-making processes in SacAdapt.
2016 Assembly Bill (AB) 2800  Assembly Bill No. 2800 CHAPTER 580 An act to add and repeal Section 71155 of the Public Resources Code, relating to climate change. [Approved by Governor September 24, 2016. Filed with Secretary of State September 24, 2016.] LEGISLATIVE COUNSEL'S DIGEST	**Summary**: AB 2800 requires state agencies to take into account the expected impacts of climate change when planning, designing, building, and investing in state infrastructure. An update to the bill in 2020 clarified that State agencies must account for the economic damages and financial liabilities associated with climate change impacts. **Relevance to SacAdapt:** While not directly subject to this bill, SacAdapt will help the City and SacRT align with this bill, particularly for projects implemented with support from state funding.
2015 Executive Order (EO) B-30-15: Vulnerable Populations 	**Summary**: This Resiliency Guidebook outlines the different populations who are most vulnerable to the impacts of climate change. This guidebook aims to support agencies in planning and adapting to climate change by addressing the needs of highly vulnerable populations. Vulnerable groups include children, immigrants and refugees, incarcerated populations, the LGBTQ community, linguistically isolated populations, older adults, outdoor workers, people of color, people with chronic health conditions, low-income groups, people with mental illnesses and physical disabilities, pregnant people, homeless populations, indigenous people, and people who lack private vehicles. **Relevance to SacAdapt:** This resource can help prioritize investments and resources to support building resilience for communities most likely to suffer harm from the effects of climate change.
Best Practices & Key Examples	
Federal Highway Administration (FHWA) Adaptation Decision-Making Assessment Process (ADAP)	**Summary**: ADAP is a framework to assess climate risk to individual transportation assets and evaluate adaptation alternatives compared to a do-nothing baseline based on cost-effectiveness and other factors.

	**Relevance to SacAdapt:** ADAP is a step-by-step process for analyzing climate risk at the project level and evaluating cost-effectiveness of adaptation options. It, or a simplified version of it, can be used for the adaptation options analysis in SacAdapt.
2022 Protecting Californians from Extreme Heat 	**Summary:** This plan outlines California's all-of-government approach to mitigating the health, economic, cultural, ecological, and social impacts of increasing average temperatures and heat waves. It constitutes California's response to extreme heat and accompanying extreme heat events. **Relevance to SacAdapt:** Recommended actions and goals to strengthen resilience to extreme heat can be used to inform heat-related adaptation solutions for SacAdapt.
2023 New Orleans Hazard Mitigation Annual Report 	**Summary:** This Hazard Mitigation Plan and Annual Report published by the City of New Orleans provides a structure for understanding the risks and vulnerabilities of the city and identifying actions that can reduce future loss of life and property due to climate hazards. **Relevance to SacAdapt:** New Orleans and Sacramento are two of the nation's most vulnerable cities to flooding. There are many valuable opportunities to learn from New Orleans in their ongoing hazard mitigation efforts and recommended adaptation measures. Examples of flood response and risk planning action items outlined in this report include: • Planning for flooding by changing development patterns and methods and relocating assets and populations • Building and implementing an equity strategy for floodplain management programs • Expanding the scope of coastal habitat restoration, protection, and preservation to include individuals and communities in those locations • Addressing stormwater retention needs by improving infrastructure

	• Scoping potential drainage projects • Implementing green infrastructure improvements along high-risk corridors • Implementing citywide urban design standards to guide the community's response to stormwater management • Promoting tree clustering strategies • Creating an online, interactive tool utilizing city monitoring data around flood mitigation initiatives for public use and education • Advocating for National Flood Insurance Program (NFIP) reform • Creating an in-house HAZUS model, a nationally standardized methodology from FEMA for estimating potential losses from natural disasters, designed to support risk-informed decision-making efforts

Asset & Hazard Datasets

This section focuses on relevant datasets provided by the City and SacRT. Given the geographic nature of climate hazards, accurate spatial data (i.e., Geospatial Information Systems [GIS] data) is a key component for the subsequent analysis. Figure 1 shows the study area. SacAdapt will focus on transportation assets within the city of Sacramento, as well as SacRT Light Rail and maintenance facilities outside of the city of Sacramento.

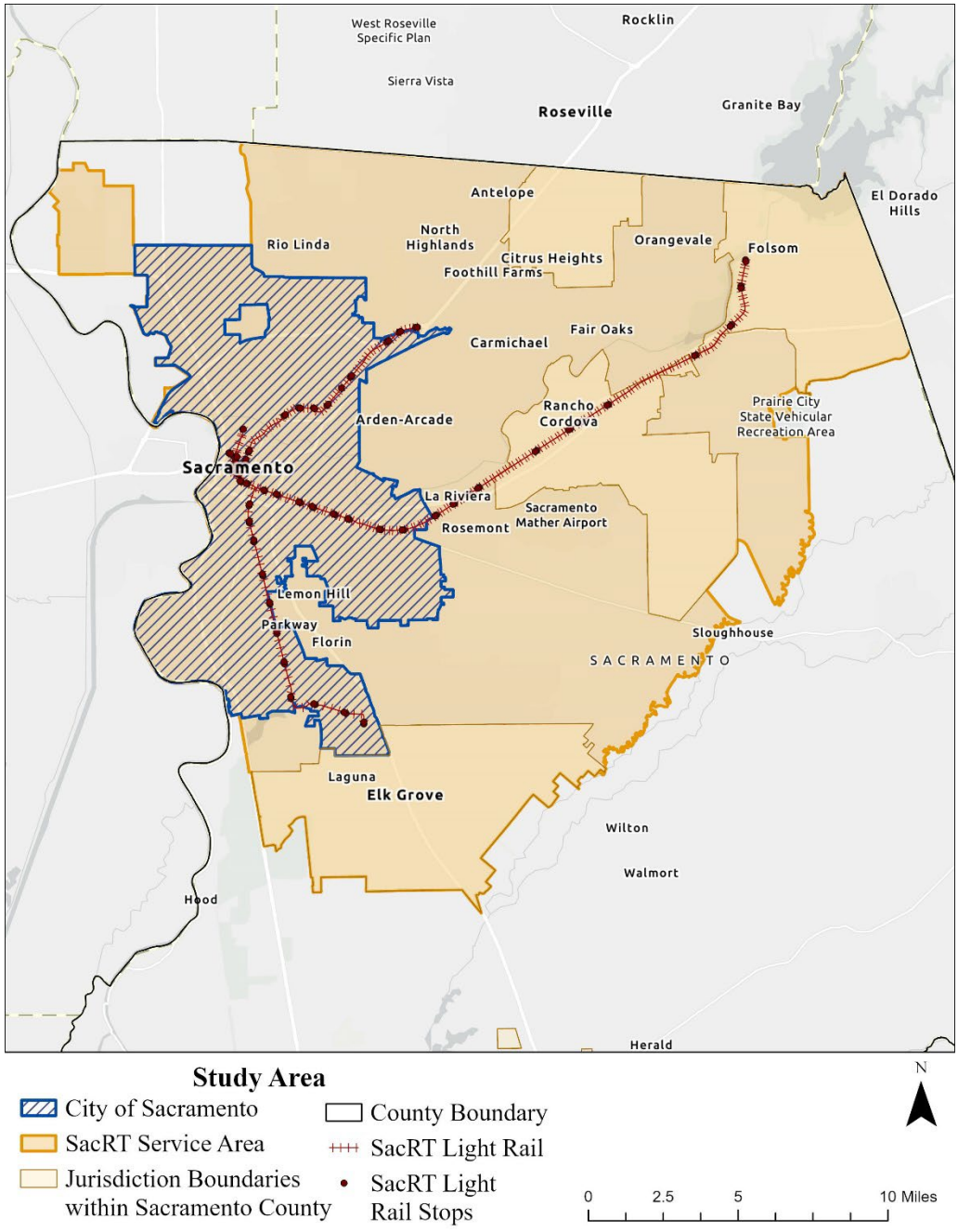


Figure 1. Study area

Roadway linework by functional class is shown in Figure 2. While roadway linework and road type data appear to be accurate, only a small portion of the roadway linework has associated traffic count data.

Bridge locations are represented as points, and their attribute information regarding physical characteristics and conditions is documented in an associated table.

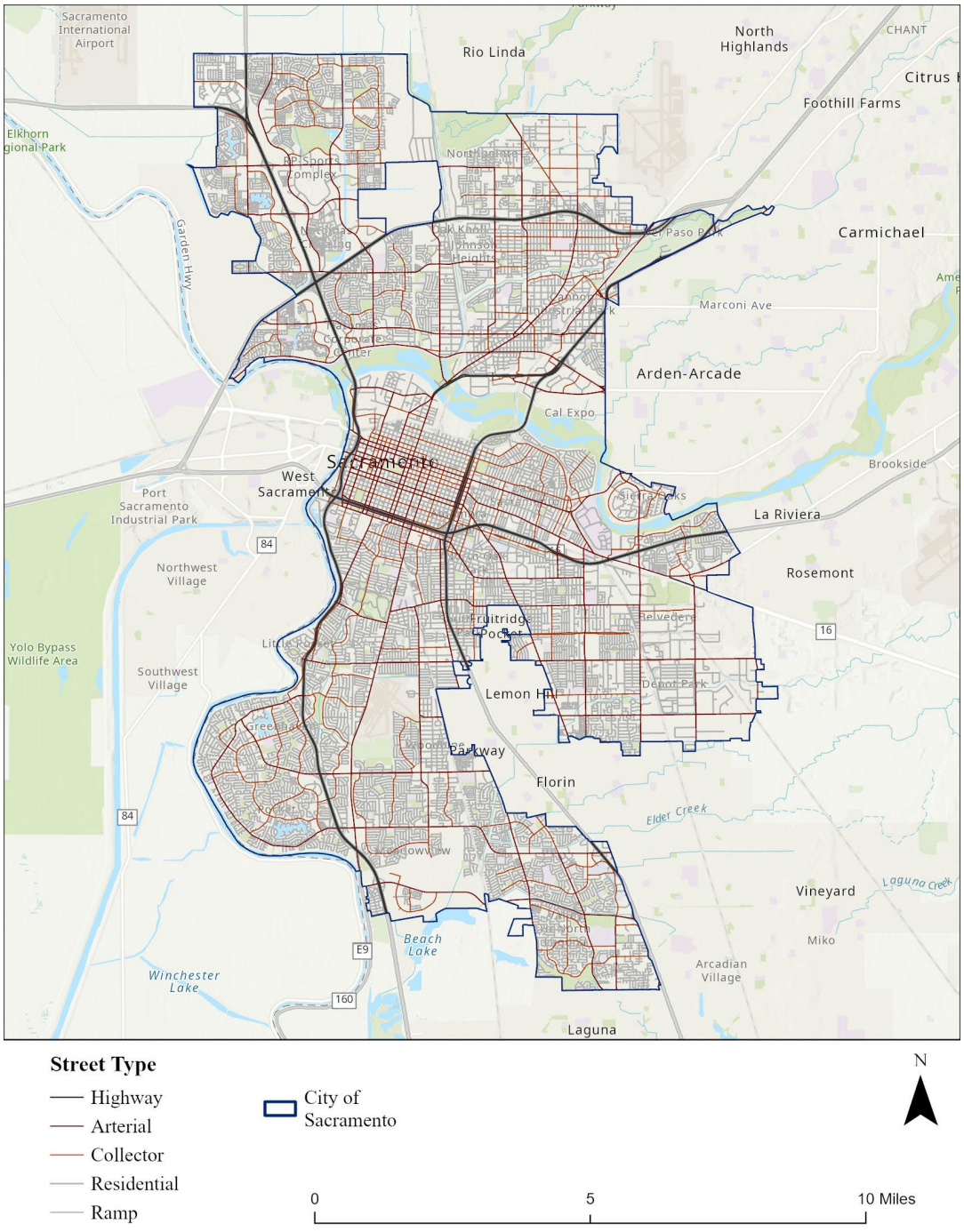


Figure 2. Roadways

Figure 3 shows SacRT's assets. The light rail linework appears to have an acceptable degree of accuracy to the Digital Elevation Model (DEM) and aerial imagery. In the more urbanized parts of the city, linework slightly deviates from its actual location. Light rail stops and bus stops are represented by points. These points have information regarding location, but are lacking information about stop structures, which can be used to provide shelter from inclement or hot weather. Ridership counts from 2019 to 2024 for these assets are provided at the system level or rail or bus line level.

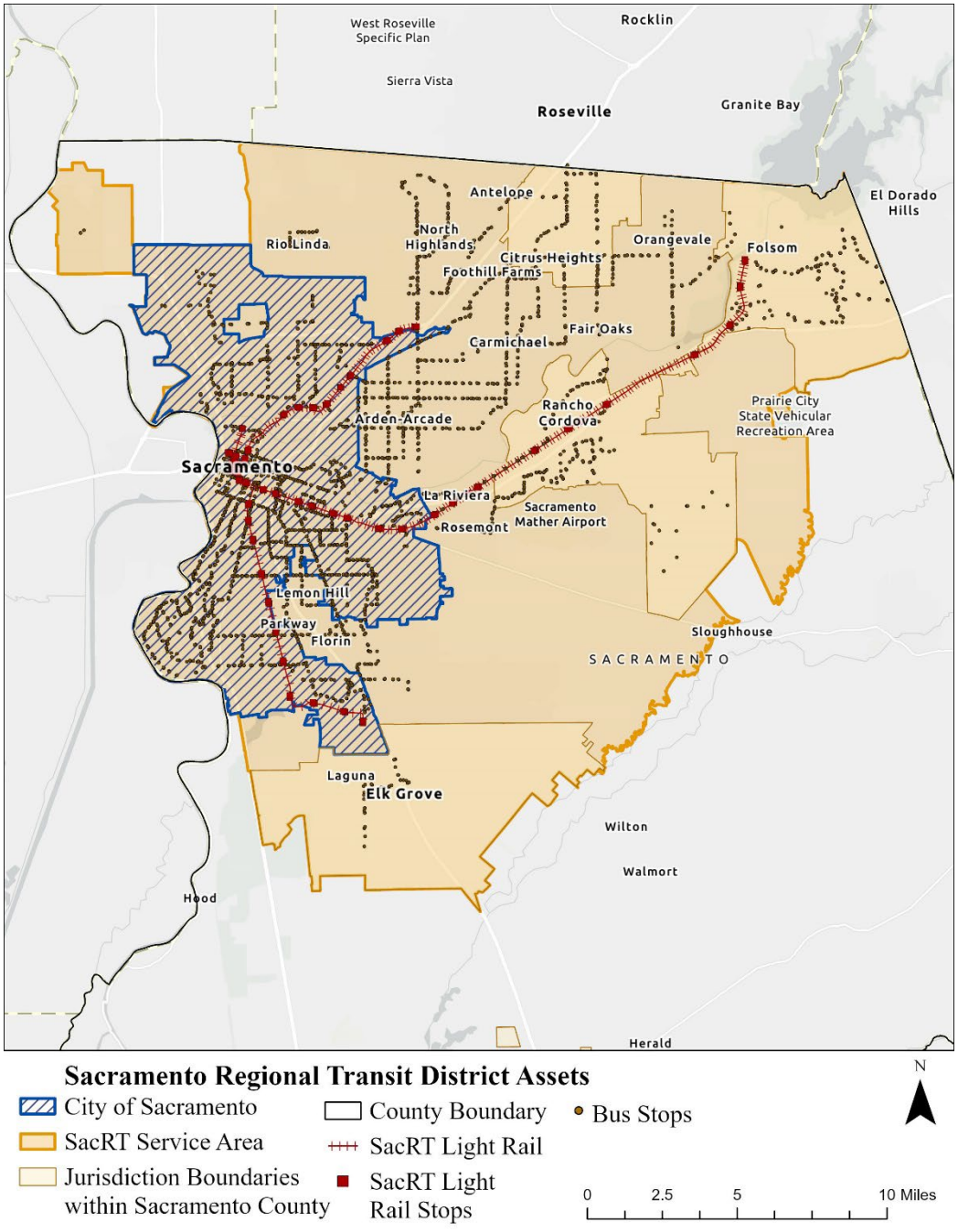


Figure 3. SacRT assets

Demographic and equity-related data, including EPA Environmental Justice Communities[2] and CalEnviroScreen 4.0,[3] help to understand transportation system users and how they are impacted by climate hazards. The CalEnviroScreen 4.0 dataset is available at the census tract level.

Hazard datasets often include historical, present, and future conditions of natural hazards or current environmental conditions, which are crucial for justifying the analysis results. To perform comprehensive risk assessments, hazard datasets should cover the entire study area. The provided hazard datasets include FEMA floodplains[4] and the Urban Heat Island (UHI) Index. FEMA 100-year and 500-year floodplains are shown in Figure 4.

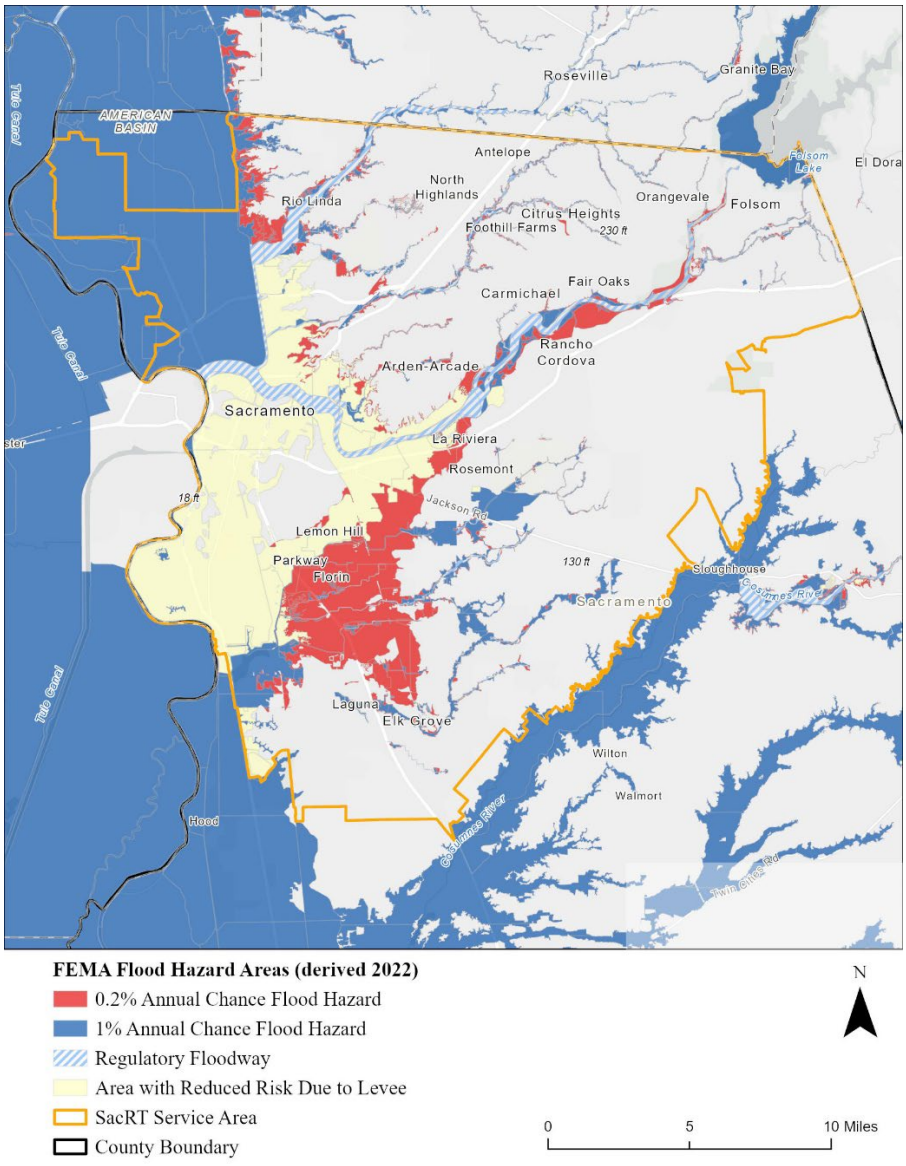


Figure 4. FEMA flood hazard areas

[2] https://www.epa.gov/ejscreen/download-ejscreen-data
[3] https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-40
[4] https://www.fema.gov/flood-maps/national-flood-hazard-layer

UHI[5] data were averaged over 2013-2016, and analyzed for most of the region under different scenarios, such as vegetation and albedo increases. These data were developed by SMAQMD through the Capital Region Urban Heat Island Mitigation Project, which built detailed models of the UHI effect in the Sacramento region, focused on the transportation sector and vulnerable communities.

The data showcase the average temperature differences between various areas of Sacramento using the UHI Index (UHII), or the difference between a specific urban census tract and a nearby rural reference area. The larger the index, the larger the difference between rural and urban temperatures, and the more intense the UHI effect. The dataset is in points, which can be interpolated by the user. An interpolation of the urban heat island effect for the region at 3pm is shown in Figure 5.

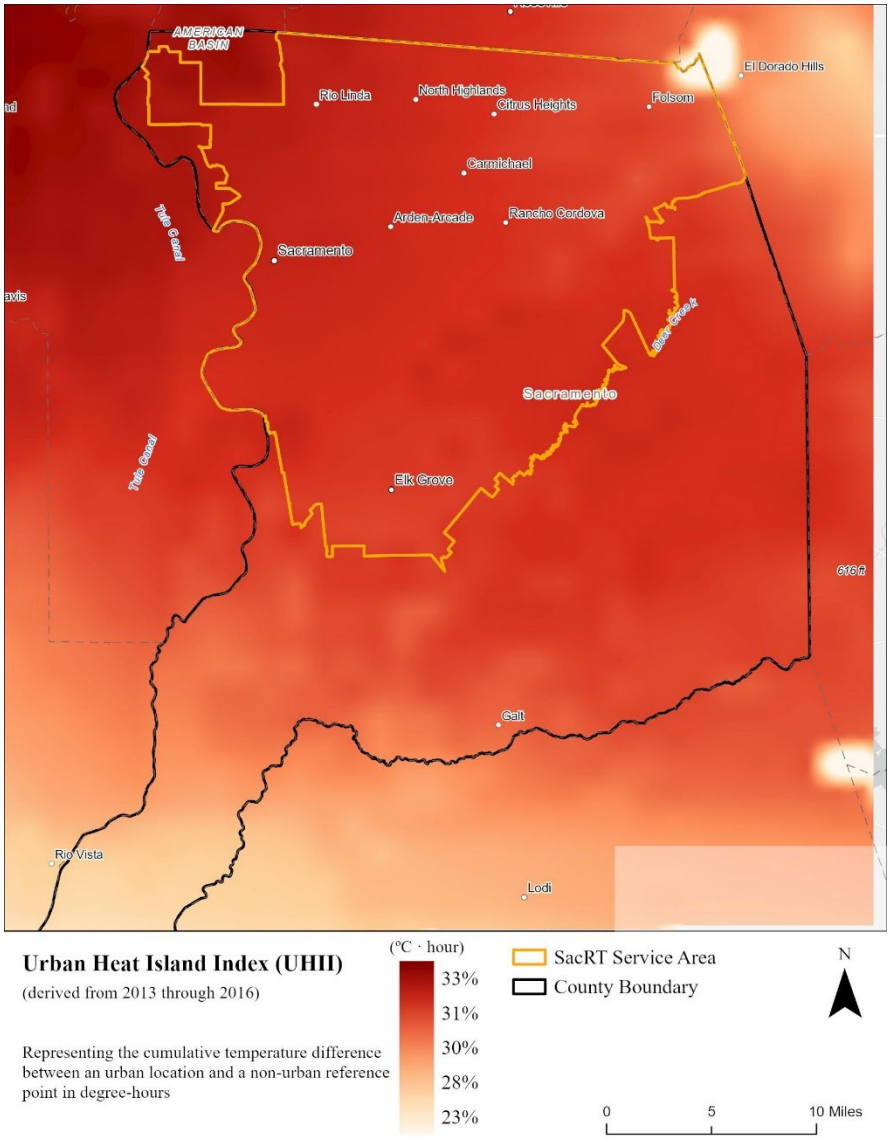


Figure 5. Interpolation of UHI effect at 3pm (units are % difference in degrees Celsius from base case), 2013-2016

[5] https://urbanheat-smaqmd.hub.arcgis.com/

Table 2. Relevant datasets for SacAdapt for assets and hazards.

Asset/Hazard	Dataset
Critical Facilities	
Community Centers	City of Sacramento Community Centers.
Fire Stations	City of Sacramento Fire Stations.
Government Buildings	City of Sacramento government buildings.
Hospitals	City of Sacramento Hospitals.
Libraries	City of Sacramento libraries with operational days and hours as of April 2023.
Schools	City of Sacramento school data. School types include public, charter, and private schools.
Hazard Data	
Extreme Heat and Vulnerability Map	Story map available online, data available to download by census tract here. Each neighborhood is given a percentile from least to most vulnerable within the City of Sacramento. Factors like poverty, ethnicity, pre-existing medical conditions like asthma, employment status, and age contributed to the vulnerability score.
Hazard datasets developed by previous City, SacRT, or other stakeholders	**Urban Heat Island** – This dataset shows the differences in temperature throughout the Sacramento area at different times during the day for the base case and different scenarios, like increased vegetation and albedo. This data is represented in points, so interpolation should be used to get continuous data over the region. Data and study results are from the Capital Region Urban Heat Island Mitigation Project, led by Sacramento Metropolitan Air Quality Management District and CivicWell (formerly the Local Government Commission). **FEMA Floodplains** – 100-year and 500-year event extents are available. **Ultimate Flood Depths** – The County of Sacramento Water Resources and the City of Sacramento have prepared various detailed maps showing hypothetical levee breaks, inundation levels and the time it would take for waters to rise in affected neighborhoods, and rescue and evacuation zones. The Natomas, north of the American River, south of the American River, and the Delta area are the limits of the study. Maps show flood depths and evacuation routes.
Known issues/previous damage locations from natural hazards	SacRT provided lists of damaged assets from a storm in February 2024 (without locations and cost info) and crossing outages with latitude/longitude coordinates and cost information from January 2023. The City also provided 311 location data in GIS format as points. Features are categorized by type of incident. Categories are relatively broad; it may be difficult to infer damage locations for climate-related hazards specifically.

Demographic Data	
CalEnviroScreen	CalEnviroScreen 4.0 is at the census tract level with attributes including information regarding environmental pollution, human health, economics, population, and more.
Healthy Places Index	California Healthy Places Index score examines neighborhood measures linked to health outcomes and has key indicators of diversity and equity.
Asset and Topographic Data	
Municipal and study area limits/boundaries	City of Sacramento as a polygon.
Roadways/streets	Street centerline data including FHWA road classifications. Pavement condition data is mapped in the 2022 Pavement Condition Report, segmented in line data with Pavement Condition Index (PCI) ratings in data provided by the county, set to be updated in early 2025. This report summarizes key information about the city's street network and the funding needed to bring the street network to a state of good repair.
Traffic signals	City traffic signal locations in publicly available format. A separate spreadsheet with intersections and information on which are connected by fiber was also provided. Can join these two datasets using 'Signal ID'.
Streetlights	City street light locations in point format. Physical characteristics like pole type and lamp type are provided in the attribute table.
Trees	Tree Canopy Coverage for Sacramento County computed change between 2011 and 2021. Data from USA NLCD Tree Canopy Cover layer from Living Atlas, accessed Dec 13, 2023.
Traffic volume/travel ridership/other usage data (for both City and SacRT assets)	For SacRT, ridership counts for light rail are provided in excel format at the system and line level from 2019-2024. For the city, traffic volume does not appear to have geometry included, but name field can be used to relate it to the street centerline data. Traffic counts are for 24 hours and contain 4 directions of travel. There are 334 streets with known traffic count information. This leaves most of the street dataset null of traffic counts.
Evacuation routes	Evacuation routes are not specifically defined; rather there are evacuation zones represented as areas.
Flood protection assets that can impact transportation infrastructure, including floodgates and levees where applicable	Spatial data included for floodgates, floodwalls, and levees.
Light rail infrastructure (alignment, stops, etc.)	Light rail lines and stops.
Bus stops	Bus stops for SacRT service area.

Transit facilities (operations centers, maintenance buildings, bus lots, etc.)	List with satellite images of transit facilities like operations centers, maintenance buildings, bus lots, and security operations center. This data is not in GIS format.
Bridges and culverts	One feature class for bridges and culverts. The attribute table may be used to accurately separate culverts and bridges.
Bridge and culvert condition ratings	Bridge work recommendations and field inspection comments included in associated table. No culvert capacity included.
Shared use paths for walking and bicycling	Curb and sidewalk line features relevant attribute data includes details on physical characteristics as well as information to join with street data by centerline "UniqueID." Planned and existing bike facilities (lanes, routes, trails, buffered lanes, and separated bikeways) are sorted by project ID.
Planned city projects on transportation assets (e.g., Transportation Priorities Plan data in GIS format)	Includes information about the project, prioritization, cost, and what project implementation may support in the community (e.g., bicycling, EV, walking, types of community it may support, etc.). This is set to be updated after the adoption of the Streets for People Active Transportation Plan.
ZEB (Zero-emission bus) charging infrastructure	SacRT Battery-Electric Bus Feasibility Study May 2023 identifies locations. Park and Ride lots with planned charging stations are provided as coordinate pairs.
Infrastructure that supports public transit, including Sacramento Valley Station	Bus terminals and the Sacramento AMTRAK station points.
Digital Elevation Model (DEM)	City of Sacramento recommendation is to use 2018 1-meter DEM, a tiled dataset.
Drainage basins	City of Sacramento, Department of Utilities Drainage Basins.
Sewer basins	City of Sacramento, Department of Utilities Sewer Basins.
High Frequency Transit Areas	High Frequency Transit Areas 2036 (HFTAs) are areas of the region within one-half mile of an existing or planned major transit stop, or an existing or planned high-quality transit corridor included in the MTP/SCS.
SACOG Transit priority areas	SB 743 Transit Priority Areas buffers and stops. SB 743 Transit Priority Areas refer to an area within one-half mile of a major transit stop that is existing or planned, if the planned stop is scheduled to be completed within the planning horizon of the MTP/SCS. A major transit stop is defined in Section 21064.3 of the Public Resources Code, as a site containing a rail transit station or bus rapid transit station, a ferry terminal served by either a bus or rail transit service, or the intersection of two or more major bus routes with a frequency of service interval of 15 minutes or less during the morning and afternoon peak commute periods.