VTA Solutions that move you

CAAP CLIMATE ACTION & ADAPTATION PLAN

Draft

VTA Climate Action and Adaptation Plan

October 2023

Climate Action and Adaptation Plan

Welcome Letter from VTA General Manager/CEO

It is my pleasure to introduce you to VTA's first Climate Action and Adaptation Plan. VTA recognizes that climate change is not just another environmental issue or future phenomenon. It is a reality that is causing irreversible changes to our planet and impacts the quality of life and well-being of our riders, workers, and communities.

Our initiative, ***VTA Forward,*** is aimed to strengthen and prepare our workforce to take on future opportunities in three phases. VTA is currently completing the **Revitalize** phase that focuses on elevating our people and our services with an emphasis on developing our workforce and delivering multi-modal transit options, projects, and programs in an **equitable** and **sustainable** way. The Climate Action and Adaptation Plan provides direction in addressing impacts that allows us to **transform** VTA, part of the third phase of ***VTA Forward***.

The environmental, social, and economic impacts associated with the climate crisis are broad, significant, and urgent. To lessen these impacts, VTA must take action to reduce the amount of greenhouse gas (GHG) emissions associated with transportation use and operations. This plan provides a list of actions prioritized according to their greatest potential to reduce GHG emissions based on well documented sources and analysis.

While reducing emissions is important, it is not enough. Actions must also be taken to adapt, and prepare for, the unavoidable effects of climate change due to the high concentration of GHG emissions already in the atmosphere. That is why this plan also considers adaptation strategies based on known vulnerabilities, consequences, and risk of hazards associated with flooding, extreme heat, wildfire, and drought.

Directing us away from the status quo and business-as-usual mindset, this plan builds off existing and parallel efforts to implement a Visionary Network of fast, frequent, and reliable transportation services. It serves as a working compass to achieve a cleaner environment for all who live and work in Santa Clara County, particularly future generations.

Acknowledgments

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CLIMATE ACTION & ADAPTATION PLAN

1. Introduction

Background

The Santa Clara Valley Transportation Authority (VTA) is an independent special district that provides sustainable, accessible, community-focused transportation options that are innovative, environmentally responsible, and promote the vitality of its region. VTA provides bus, light rail, and paratransit services, and participates as a funding partner in regional rail services, such as Caltrain, Capitol Corridor, and the Altamont Corridor Express. VTA provides these services throughout Santa Clara County (County), including Campbell, Cupertino, Gilroy, Los Altos, Los Altos Hills, Los Gatos, Milpitas, Monte Sereno, Morgan Hill, Mountain View, Palo Alto, San Jose, Santa Clara, Saratoga, and Sunnyvale. Additionally, VTA serves as the county's congestion management agency, and is responsible for countywide transportation planning, including congestion management; design and construction of specific highway, pedestrian, and bicycle improvement projects; and promotion of transit-oriented development (TOD). VTA continually builds partnerships to deliver transportation solutions that meet the evolving mobility needs of the county (VTA 2023a).

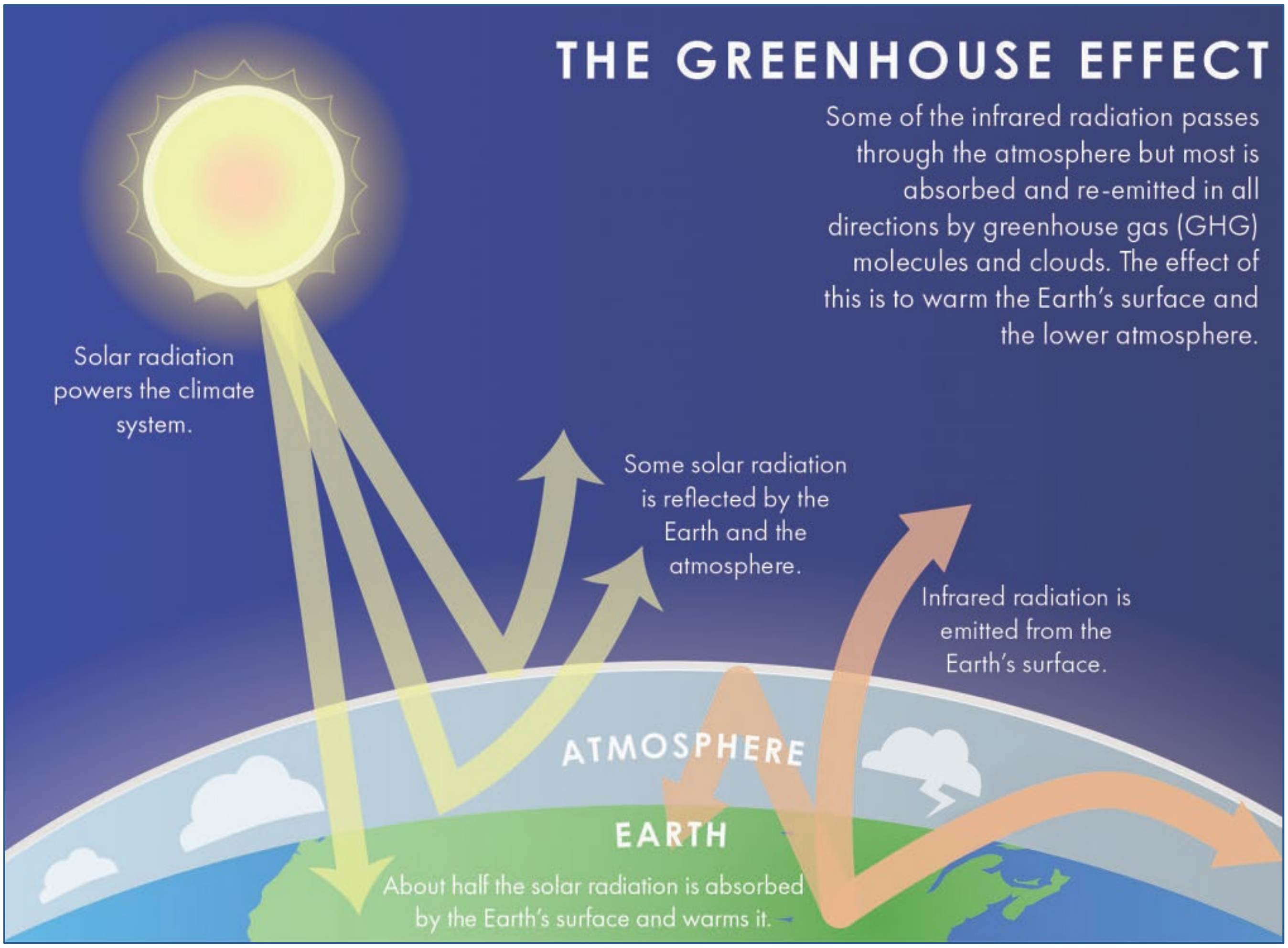
With the array of services that VTA provides and the range of vital roles and responsibilities that VTA is tasked with, the agency is in a unique position to build upon its longstanding commitment to sustainability and resilience, especially in the context of climate change. On February 6, 2020, VTA formally declared a climate change emergency, becoming one of the first transit agencies in the country to make such a declaration and joining with local governments to demand immediate climate action. Additionally, the declaration directed VTA to take several specific actions, including developing a plan to guide its climate change emergency response (VTA 2020a). In alignment with this, and reflective of VTA's commitment to sustainability and resilience, VTA has developed this *Climate Action and Adaptation Plan* (CAAP)—its first ever—to supplement other similar planning efforts, such as VTA's *Sustainability Plan 2020* (Sustainability Plan).

Climate Change Science, Risk Perceptions, and Impacts

The greenhouse effect is a necessary and natural process to sustain life on Earth. However, due to human activities, this process has intensified and led to an increased and unprecedented rate of warming around the world.

The greenhouse effect, illustrated in **Figure 1-1**, is a natural process that insulates the Earth and helps regulate its temperature. After absorbing sunlight, the Earth emits heat in the form of infrared radiation. This radiation is then absorbed by a collection of naturally occurring atmospheric gases called greenhouse gases (GHGs). These gases, which consist mainly of water vapor, carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), all act as effective global insulators by absorbing some of the infrared radiation that is emitted by Earth and re-emitting it back down towards the planet. This process, where some heat is prevented from escaping out of the atmosphere, is what keeps temperatures on Earth conducive to life. Without the greenhouse effect, Earth would not be able to support life. However, because of human-caused (i.e., anthropogenic) activities, notably the combustion of fossil fuels, excess GHGs have increasingly been released into the atmosphere, causing the greenhouse effect to intensify and the Earth's climate to warm at an unprecedented rate. This is known as climate change and is the primary driver behind changes in more extreme weather patterns, the rapid melting of the polar ice caps, rising sea levels, and other impacts to people, infrastructure, and natural systems.

There is scientific evidence that observed increases in atmospheric GHG concentrations and the consequential warming of Earth's atmosphere, oceans, and land are linked to human activities and influence. Human activities are estimated to have caused approximately 2 degrees Fahrenheit (°F) of warming across the globe compared to pre-industrial era levels (i.e., prior to the year 1900), and global average temperature is expected to increase by up to 8 °F by the end of the century unless additional efforts to reduce GHG emissions are made (IPCC 2021). The GHG emissions that have created this warming—those released between the pre-industrial era and the present—will persist for hundreds to thousands of years and create further long-term impacts to the climate system (IPCC 2018).



Source: Developed by Ascent in 2023.

Figure 1-1 The Greenhouse Effect

VTA and county residents recognize that climate change is here. In fact, 76 percent of residents are worried about climate change and 58 percent state that they have already personally experienced the effects of climate change (YPCCC 2023).

As a result of climate change, it is projected that by 2100, California will (OPR, CEC, and CNRA 2019):

- See average annual maximum daily temperature increase between 5.6 and 8.8 °F;
- See water supply from snowpack decline by two-thirds; and
- Experience an increased frequency of extreme wildfires, with the average area burned statewide increasing by 77 percent, among a vast array of other impacts.

"The science that, decades ago, predicted the impacts we are currently experiencing is even stronger today and unambiguously tells us what we must do to limit irreversible damage: we must act with renewed commitment and focus to do more and do it sooner" (CARB 2022a: 13).

Acknowledging the seriousness of these projections, VTA recognizes that the communities it serves are already experiencing climate change impacts today. For example, in September 2022, there was an uninterrupted 10-day stretch of triple-digit heat within VTA's service area. A few months later, between December 26, 2022, and January 17, 2023, VTA's service area, and California as a whole, was hit by severe storms that caused widespread flooding and successive days of high winds and heavy rains (VTA 2023b). As California continues to experience rising temperatures, destructive wildfires, intense periods of drought, increasingly volatile winter storms, and sea level rise, among a range of other climate hazards and cascading impacts on communities, it has become more than evident that climate change is already occurring, and that VTA is presented with its own unique set of related risks that could adversely affect its assets and operations. With this CAAP, VTA is reaffirming its commitment to sustainability and resilience by directly addressing the challenges that climate change presents.

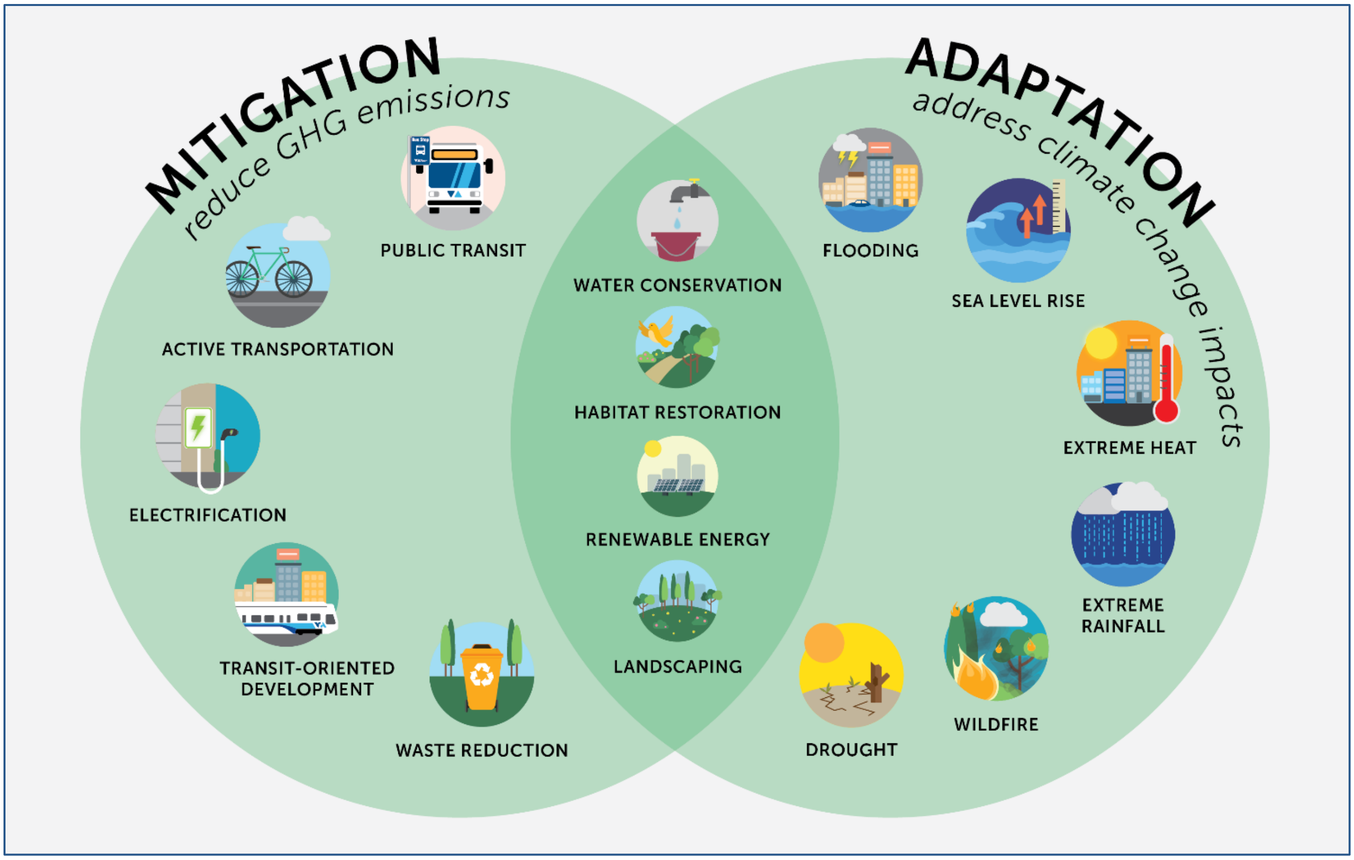
Purpose and Objectives

Climate change is a global issue, but like every other entity, VTA plays a significant role in reducing GHG emissions and preparing for the impacts of climate change.

Purpose

The purpose of this CAAP is to provide a comprehensive plan for VTA to address climate change. It includes actions VTA will implement to both reduce GHG emissions (i.e., climate change mitigation) and address climate change impacts by adapting to and building resilience of VTA's assets and operations (i.e., climate change adaptation). This comprehensive and integrated approach is illustrated in **Figure 1-2**.

Caltrans Activates Statewide Electronic Highway Signs Due to Severe Weather in January 2023



Source: Developed by VTA in 2023.

Figure 1-2 Climate Change Mitigation and Adaptation

Objectives

The primary objectives for the CAAP are listed below, with references to specific CAAP chapters that align with these objectives:

- Quantify GHG emissions from VTA operations and countywide transportation (see **Chapter 2**: **Greenhouse Gas Emissions**).
- Identify strategies and actions to reduce VTA's contribution to climate change by reducing GHG emissions from its operations, as well as actions VTA can take in partnership with other agencies and the community to reduce vehicle miles traveled (VMT) and associated GHG emissions (see **Chapter 3: GHG Reduction Strategies**).[1]
- Conduct a vulnerability assessment that identifies the risks to VTA's transportation assets and operations from climate change impacts (see **Chapter 4: Climate Change Vulnerability**) and identify adaptation strategies and actions VTA can take to protect its assets and improve overall resilience to address growing climate risk and uncertainty (see **Chapter 5: Adaptation Strategies**).

[1] Please note that this CAAP is not intended to be used as a qualified plan for the reduction of GHG emissions under the California Environmental Quality Act (CEQA).

Scope of the CAAP

VTA's CAAP focuses on actions that VTA can take, either alone or in partnership with others, to reduce GHG emissions and advance climate adaptation across VTA operations and the countywide transportation system. The scope of the CAAP includes the following:

- **VTA Operations** include all vehicles, buildings, equipment, infrastructure, or other assets owned and operated by VTA within the county; employee activities associated with physical assets and operations; and employee commuting.
- **Countywide Transportation** includes the network of streets, highways, and expressways throughout the county, as well as the rail system, and the activities of users on these systems.

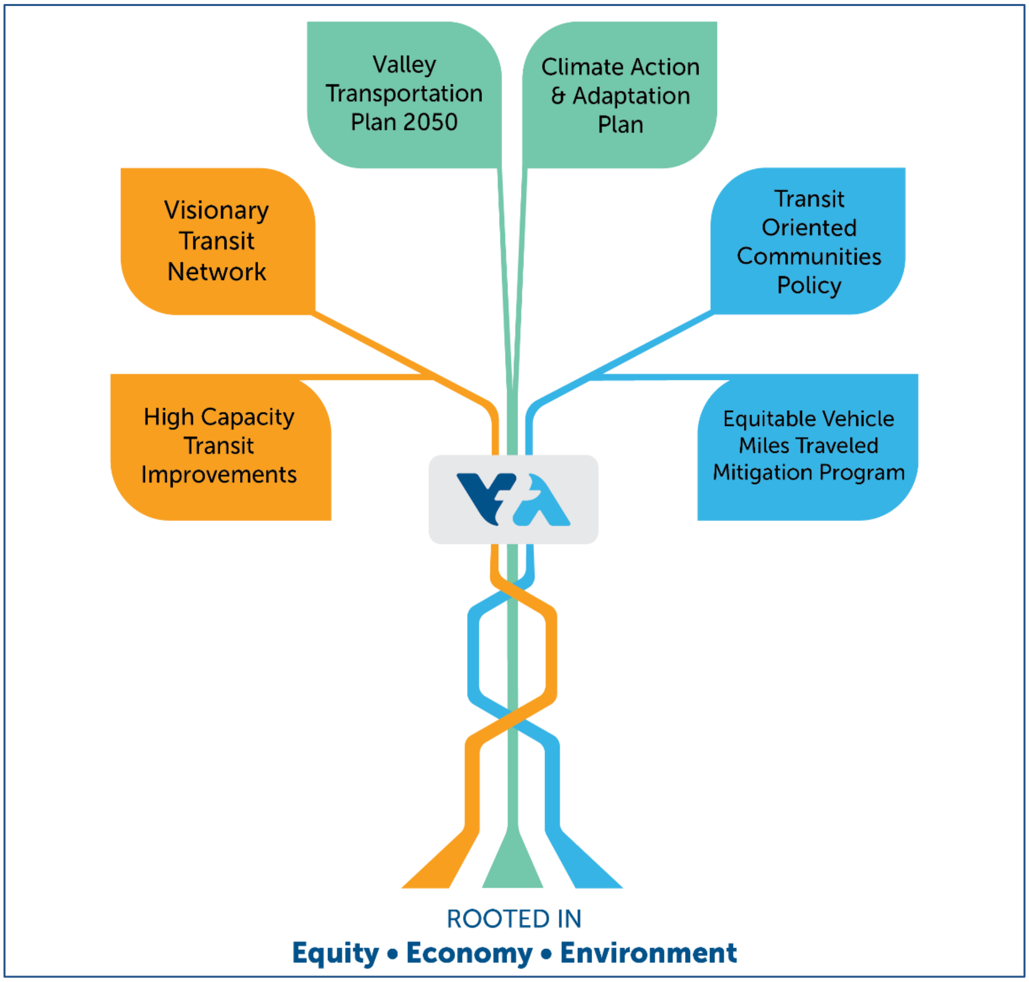
Implementation of the CAAP

A comprehensive implementation program is needed to ensure that all measures and actions identified in the CAAP are successfully implemented and achieve their intended outcomes over time (see **Chapter 6: Implementation**). VTA is committed to advancing climate equity by ensuring that the diverse needs of the community are considered during this implementation process. This is especially critical in historically marginalized and disadvantaged communities, who have suffered from historical disinvestment and environmental injustice and are among the most vulnerable to and slowest to recover from the impacts of climate change.

Summary of the Development Process

This document was developed in collaboration with VTA staff from multiple disciplines and is informed by the feedback received from the Mineta Transportation Institute at San Jose State University (SJSU), County of Santa Clara's Office of Sustainability, VTA Advisory and Standing Committees, VTA Board of Directors, Caltrans, and community stakeholders.

The CAAP is part of an interconnected planning effort that includes the development of Valley Transportation Plan 2050, and planning for VTA's Visionary Transit Network, High Capacity Transit Improvements, Transit-Oriented Communities Policy, and Equitable VMT Mitigation Program. Rooted in equity, the environment, and the economy, these efforts are being developed concurrently, as shown in **Figure 1-3**. These efforts work together towards achieving the following common goal: to make Silicon Valley a sustainable, resilient, healthy, equitable, and economically and socially thriving place to live, work, learn, and play.



Source: Developed by VTA.

Figure 1-3 Relationship of VTA's Concurrent Efforts

Summary of Stakeholder Engagement

This section summarizes the outreach efforts by VTA to inform, involve, and collaborate with stakeholders, including community-based organizations (CBOs); transit riders; youth; and state, regional, and local agencies. The feedback received was used to guide the formulation of GHG reduction measures and the potential actions for adaptation, which are described in further detail in **Chapters 3** and **5**.

Community Survey and Project Launch

An online survey was conducted to introduce and launch the project. The survey was open from May 10, 2022, to June 3, 2022. The survey link was posted on social media and VTA's website and was distributed to community stakeholders via email. VTA received a total of 261 unique responses. The responses helped VTA to understand what current and future climate issues are of most concern to transit riders and residents of Santa Clara County. Overall, respondents were most concerned about sea level rise, extreme heat events and higher temperatures, drought and water scarcity, and higher risk of wildfire. A copy of the initial survey is provided in **Appendix A.**

VTA participated in the following in-person events to introduce the CAAP and gather ideas on what type of actions and projects the community would like for VTA to investigate as a means of reducing GHG emissions and VMT:

- Youth Leadership Summit hosted by Silicon Valley Youth Climate Action (SVYCA) on August 6, 2022, at the Quinlan Center in Cupertino;
- Day on the Bay hosted by Supervisor Otto Lee, City of San Jose District 3, on October 8, 2022, in Alviso; and
- Climate Change and Sustainability Fair on October 18, 2022, at SJSU.

VTA Booth at Day on the Bay, October 8, 2022

Additionally, VTA held a virtual public workshop on October 25, 2022, from 6:00 pm to 7:30 pm on Zoom. The event was publicized through flyers, social media, VTA's website, Eventbrite, Nextdoor, and emails to youth organizations and CBOs. Workshop participants were invited to share ideas and engage with VTA staff about climate action planning, including how to minimize contributions to climate change and increase resiliency of transportation infrastructure for the future. The workshop started with a short presentation followed by an online activity on the Mural platform and small breakout group discussions hosted by staff from VTA, County of Santa Clara, and Caltrans. A total of 21 attendees participated in the workshop. A copy of the presentation is provided in **Appendix A**. The following summarizes some of the comments and ideas received during the Mural online activity portion of the workshop (see **Appendix A** for a complete list):

- Community members mentioned investing in active transportation, which includes walking and bicycling, to create a safe, connected, and convenient network to reduce transportation-related GHG emissions.
- Several participants encouraged more engagement in land use planning, focusing on TOD and transportation-demand management (TDM).
- Comments also mentioned making transit faster, more frequent, and expanding the existing network.
- When asked about ways that VTA can prepare for climate change impacts in the community, participants expressed the need for more shade and access to drinking water to cope with extreme heat.
- Stakeholders also mentioned prioritizing vulnerable populations in resource planning and additional training for VTA's workforce to be aware of health implications from extreme heat.
- A few comments suggested that VTA should collaborate with other entities in Santa Clara County to prepare for adaptation projects near the shoreline, expand microgrid and battery storage for back-up electricity, and to develop Emergency Action Plans.

Consultation and Coordination with Agencies and Organizations

Various meetings and presentations were conducted throughout the development process of the CAAP. These efforts are described below in chronological order:

VTA Earth Day Booth at Mission College, April 19, 2023

- VTA met with representatives from Silicon Valley Clean Energy on July 18, 2022, to discuss opportunities for collaboration on outreach efforts.
- VTA met with staff from Climate Resilient Communities, a non-profit organization, on July 21, 2022, to hear about their work on cultivating environmental awareness to vulnerable populations in San Mateo County and Santa Clara County.
- VTA discussed common goals and opportunities to collaborate with staff from Valley Water on December 6, 2022.
- An overview of the CAAP was presented to professors from the Mineta Transportation Institute at SJSU on February 1, 2023.
- An overview of the CAAP was presented to high school students on the Sustainability Committee at Fremont Union High School District on February 24, 2023.
- An overview of the CAAP was presented to the Sustainability Committees at Mission College on March 8, 2023, and West Valley College on March 10, 2023.
- The project team participated in an Ask VTA event, which is a series of webinars that provide an opportunity for the public to have a deeper discussion about the projects and programs that VTA delivers to the residents of Santa Clara County. An Ask VTA event centered around Climate, Sustainability, and Innovation occurred on April 13, 2023.
- As part of Earth Day, VTA participated in various tabling events and panel discussions at SJSU (April 18, 2023), Mission College (April 19, 2023), and West Valley College (April 20, 2023).
- VTA met with the Bay Area Transportation Sustainability Working Group on June 6, 2023, to provide a project update.
- VTA discussed opportunities to collaborate with Caltrans District 4 Climate Change Planning Coordinators on climate adaptation and resiliency strategies on July 28, 2023.
- The project team participated in SVYCA's Youth Leadership Summit on July 29, 2023, at De Anza College.
- VTA met with Mothers Out Front Silicon Valley on September 5, 2023, to provide a project update and discuss opportunities for collaboration.
- The project team participated in the Open House for VTP 2050 event on September 27, 2023, to provide information on the CAAP and showcase the integration of VTA's various projects into long-range planning efforts.

Santa Clara County Climate Collaborative

The Climate Collaborative (Collaborative) established by Santa Clara County is a cross-sector network and community of practice for public agencies, academia, nonprofit and CBOs, and business and community leaders to advance regional solutions to climate change through resource and expertise sharing, joint-funding opportunities, and partnership development. VTA staff continuously engages with the Collaborative as one of the Core Members by attending meetings and sharing information. VTA also participates in the Heat and Air Quality Resiliency Work Group and Flooding and Sea Level Rise Work Group. **Appendix A** includes more information regarding the structure and goals of the Collaborative.

VTA Booth at SVYCA's Youth Leadership Summit, July 29, 2023.

Public Review

This CAAP is being released for public review. The purpose of this public review period is to solicit feedback to help further refine GHG reduction measures and adaptation actions. VTA will host a public workshop to provide an overview of the purpose and contents of the CAAP, including a discussion of the key findings. This section will be updated with a summary of the public workshop and comments received on the draft.

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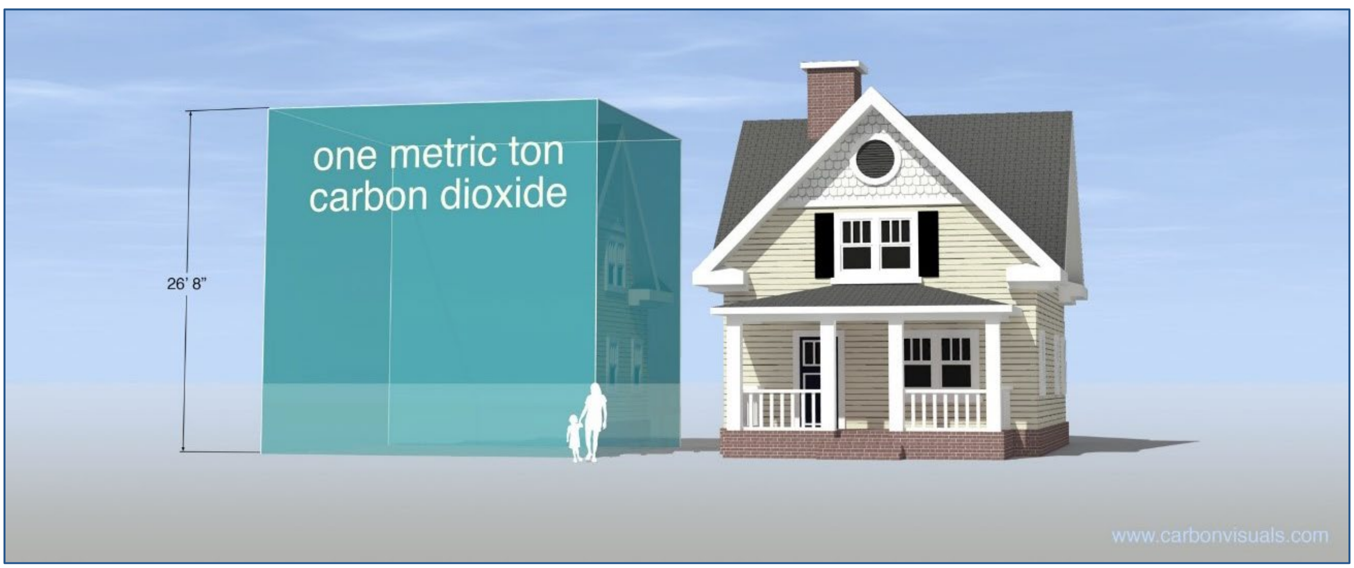
CLIMATE ACTION & ADAPTATION PLAN

2. Greenhouse Gas Emissions

Introduction

The transportation sector is the largest source of anthropogenic GHG emissions in California. Over 50 percent of total statewide emissions in 2019 were generated by the transportation sector (CARB 2022b). In addition, the transportation sector accounts for over 80 percent of statewide nitrogen oxide (NOx) emissions and 30 percent of fine particulate matter emissions, including toxic diesel particulate matter. These emissions are released as a byproduct of combusting fossil fuels and have serious adverse impacts to public health (CARB 2022a: 184). The health effects of air pollution can include asthma, decreased lung function, cancer, and premature death. Young people, older adults, people with preexisting disease, people of low socioeconomic status, and people of color are among those at higher risk due to disproportionate exposure. Reducing emissions in the transportation sector is thus critical to meet statewide and local climate goals and ensuring a much healthier future for the public.

The critical first step in the overall climate action planning process is to prepare a GHG emissions inventory. This inventory, which typically measures GHG emissions from a specific community or agency over the course of one year, helps to provide a comprehensive understanding of the emissions that are already being generated within a communty's geographic boundary or an agency's scope of operations. GHG emissions inventories not only serve to provide this knowledge, but they also act as the basis for measuring progress and provide a framework to track emissions over time and assess the effectiveness of plan implementation. For further context, a GHG emissions inventory typically includes CO_2 along with other GHG emissions such as CH_4, N_2O, or fluorocarbons (also known as "F-gases"). GHG emissions are commonly measured and expressed in terms of metric tons of carbon dioxide equivalent ($MTCO_2e$); one $MTCO_2e$ is visualized in **Figure 2-1** below. Measuring emissions in terms of carbon dioxide equivalent (CO_2e) helps to normalize all GHG emissions to CO_2, which is the most prevalent GHG emitted by human activities and has a global warming potential (GWP) value of 1. Using this metric is important because other classes of GHG emissions have GWP values that are dozens, hundreds, and even thousands of times the base GWP value of CO_2. Thus, normalizing all GHG emissions in terms of CO_2e, helps to measure and track all types of GHG emissions together using a common metric.



Note: At standard pressure and 59 °F, one metric ton (2,205 lbs) of CO_2 occupies 117,631 gallons; it would fill a cube 26 feet and 8 inches tall.

Source: Carbon Visuals n.d.

Figure 2-1 Visualization of One Metric Ton of Carbon Dioxide

After GHG emissions have been inventoried, GHG emissions forecasts can be prepared. GHG emissions forecasts provide a modeled estimate of future GHG levels based on a continuation of trends in activity, population, and job growth. Additionally, forecasts may account for known regulatory actions by state and federal agencies (i.e., “legislative” actions) that are expected to reduce GHG emissions in the future. GHG emissions forecasts highlight the scale of local reductions necessary to achieve GHG emissions reduction targets after applying anticipated reductions from regulatory actions.

Once the inventory and forecasts have been established, GHG reduction targets can be identified to help set measurable goals relative to baseline and forecasted emissions levels, while also taking into account estimated future emissions with legislative adjustments applied. In this way, targets help us identify the scale of local actions needed relative to actions that may be taken by others in the future. GHG reduction targets may be established for both the short- and long-term, and may be expressed in terms of mass emission levels of GHG reduction achieved by a specific year or time period, or more commonly as a percentage reduction below a specified level by a specific year.

As part of this CAAP, VTA prepared GHG emissions inventories, forecasts, and targets for both countywide transportation and VTA’s internal operations. These are discussed further in the sections below. An explanation of the methodologies and data sources used for developing the inventories and forecasts, along with the technical analyses and more detailed results, can be found in **Appendix B**.

Countywide Transportation Inventory and Forecasts

This section provides a summary of the GHG emissions inventory and forecasts for countywide transportation in Santa Clara County. The inventory was prepared for the baseline year of 2019, and the forecast years of 2030, 2035, 2040, 2045, and 2050. For the purposes of this CAAP, GHG emissions related to countywide transportation refer to those generated by surface transportation modes within the county’s boundaries, including on-road motor vehicles and rail. Specific on-road transportation sources from motor vehicles that were evaluated in the inventory and forecasts include passenger vehicles and commercial vehicles, as shown in **Table 2-1** below. Rail sources that were evaluated include both passenger rail and freight rail. Emissions from air travel or indirect activities that occur entirely outside of the county are not included in the inventory (see **Appendix B** for further discussion regarding protocols and methods used to establish the scope and boundaries of the inventory). Annual VMT projections were also evaluated for surface transportation modes.

VMT is a metric for measuring how much motor vehicle activity occurs on the roadway network, and it is a key input into measuring GHG emissions from motor vehicles broadly at various scales.

Table 2-1 On-Road Transportation Source Descriptions

Source	Description
Passenger – DA	Trips taken by vehicles with a single occupant.
Passenger – Carpool	Trips taken with two or more occupants in a vehicle.
Passenger – TNC	Trips taken by TNC vehicles (e.g., Uber and Lyft); includes customer and deadhead (i.e., no customer) VMT.
Passenger – AV	Trips taken by a driverless autonomous vehicle; includes customer and deadhead VMT.
Commercial – Very Small	Two-axle, four-tire vehicles.
Commercial – Small	Two-axle, six-tire vehicles.
Commercial – Medium	Three-axle vehicles.
Commercial – Large	Four-or-more-axle vehicles.

Notes: Deadhead VMT refers to VMT from trips without a customer, taken in anticipation of the next customer trip; AV = autonomous vehicle; DA = drive alone; TNC = transportation network company; VMT = vehicle miles traveled.

Source: Prepared by Ascent in 2023.

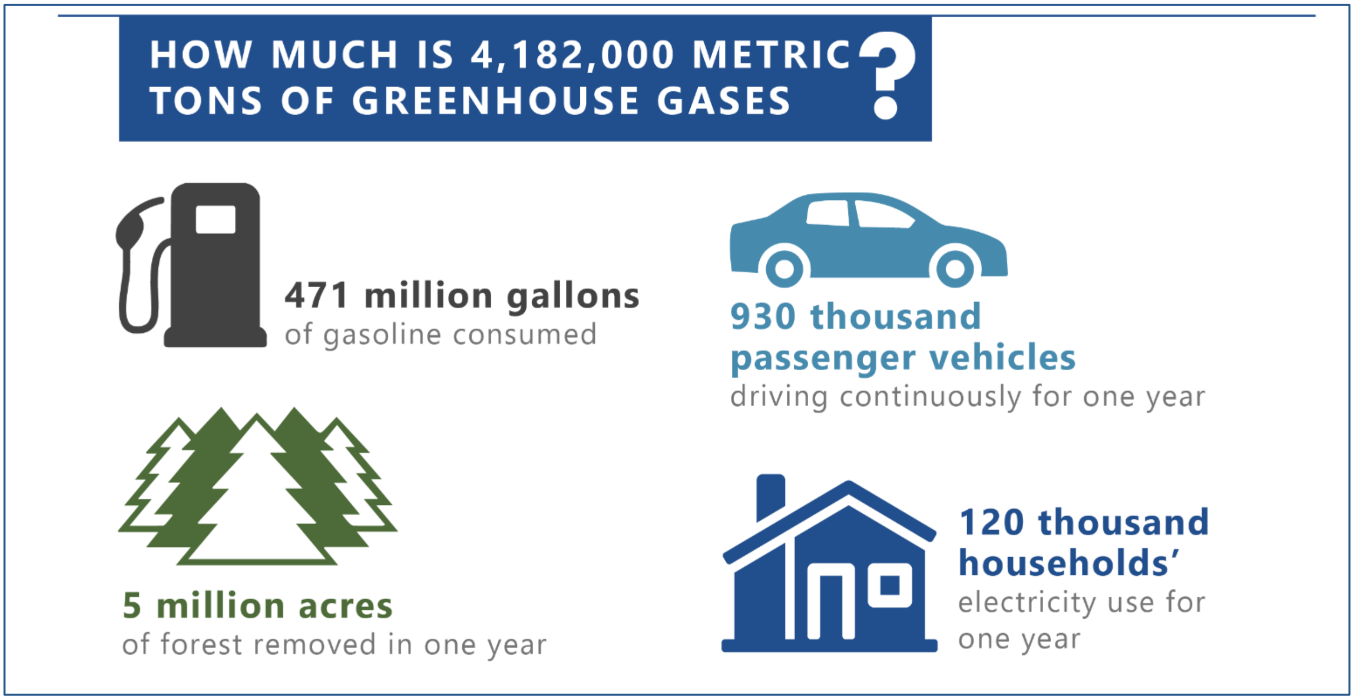
Countywide Transportation GHG Emissions Inventory

Driving alone with no passengers is the primary mode of travel in the county, amounting to 73% of GHG emissions in 2019

Countywide transportation sources emitted almost 4.2 million $MTCO_2e$ in 2019. As shown in **Figure 2-2**, this is equivalent to approximately 471 million gallons of gasoline consumed, 930,000 passenger vehicles driving continuously for one year, 5 million acres of forest removed, or 120,000 household's electricity use for one year. Annual VMT and GHG emissions from on-road transportation and rail are shown by source in **Table 2-2** below. Approximately 99 percent of these total GHG emissions were from on-road transportation sources, with 73 percent solely coming from "drive alone" trips, or private vehicle trips where the driver is the only person in the vehicle. The remaining one percent of GHG emissions were attributable to rail activity in the county.

In 2019, public transit provided by VTA helped offset emissions by approximately 23,000 $MTCO_2e$. While these "avoided emissions" were not factored into the countywide emissions inventory, they are highlighted here to demonstrate the ongoing benefits of VTA's transit services in reducing or avoiding emissions.

Figure 2-2 2019 Countywide Transportation GHG Emissions Equivalencies



Notes: In the context of this figure, "greenhouse gases" is an alternate way of saying "carbon dioxide equivalent;" and each activity in this figure provides an illustration of what would generate an equivalent amount of 4,182,000 $MTCO_2e$ individually, not cumulatively.

Source: EPA 2023; adapted by Ascent in 2023.

Table 2-2 2019 Countywide Transportation VMT and GHG Emissions Inventory

Source	Annual VMT	Percent VMT (%)	GHG Emissions ($MTCO_2e$)	Percent GHG Emissions (%)
On-Road Transportation				
Passenger – DA	8,991,351,330	73	2,905,000	69
Passenger – Carpool	2,075,863,530	17	669,000	16
Passenger – TNC	104,907,270	<1	34,000	<1
Passenger – AV	53,628,058	<1	17,000	<1
Commercial – Very Small	817,666,890	7	279,000	7
Commercial - Small	219,336,690	2	104,000	2
Commercial - Medium	14,299,110	<1	8,000	<1
Commercial - Large	75,046,320	<1	128,000	3
On-Road Transportation Total	12,352,099,198	100	4,143,000	99
Rail				
Rail – Freight	N/A	N/A	17,000	<1
Rail – Passenger	N/A	N/A	22,000	<1
Rail Total	N/A	N/A	39,000	1
Total	12,352,099,198	100	4,182,000	100

Notes: GHG emissions results are independently rounded to the nearest thousand to account for any variability with actual emissions, and totals may not sum exactly due to rounding. Percentages are independently rounded to the nearest whole percentage (unless they are below 1 percent, in which case they are presented as "<1"), and total percentages may not sum exactly due to rounding. AV = autonomous vehicles; DA = drive alone; GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent; N/A = not applicable; TNC = Transportation Network Company; VMT = vehicle miles traveled.

Source: Calculated by Ascent in 2023.

Countywide Transportation GHG Emissions Forecasts

Using the results of the 2019 countywide transportation GHG inventory, two forecast scenarios were provided to characterize potential future GHG levels from countywide transportation sources. The first scenario, “business as usual” (BAU), is based on a continuation of current trends in activity and does not account for GHG emissions reductions resulting from laws and regulations adopted by local, regional, state, or federal agencies. The BAU scenario illustrates how much emissions would increase due to population and economic growth if no actions to reduce emissions were taken. The BAU forecast scenario reflects worst-case conditions. The second forecast scenario, the legislative-adjusted forecast, shows emissions reductions from laws and regulations already enacted by regional, state, and federal agencies; however, it does not reflect local actions to reduce GHG emissions. Both forecast scenarios for countywide transportation are presented below. See **Chapter 3** for a discussion of the CAAP’s GHG reduction strategies and targets.

BAU GHG Emissions Forecasts

The following BAU GHG emissions forecasts, displayed in **Table 2-3**, provide an assessment of how emissions generated by countywide transportation would change over time without further local, regional, state, or federal action. Compared to 2019 levels, GHG emissions are projected to increase 7 percent by 2030, 13 percent by 2035, 15 percent by 2040, 20 percent by 2045, and 27 percent by 2050.

Table 2-3 2030-2050 Countywide Transportation BAU GHG Emissions Forecasts

Source	GHG Emissions ($MTCO_2e$) 2030	GHG Emissions ($MTCO_2e$) 2035	GHG Emissions ($MTCO_2e$) 2040	GHG Emissions ($MTCO_2e$) 2045	GHG Emissions ($MTCO_2e$) 2050
On-Road Transportation					
Passenger – DA	2,962,000	2,988,000	2,871,000	2,754,000	2,638,000
Passenger – Carpool	729,000	756,000	730,000	705,000	680,000
Passenger – TNC	69,000	85,000	95,000	105,000	115,000
Passenger – AV	154,000	301,000	490,000	796,000	1,220,000
Commercial – Very Small	268,000	263,000	272,000	282,000	291,000
Commercial - Small	101,000	99,000	103,000	106,000	110,000
Commercial - Medium	8,000	8,000	8,000	9,000	9,000
Commercial - Large	132,000	134,000	140,000	146,000	151,000
On-Road Transportation Total	4,423,000	4,635,000	4,710,000	4,903,000	5,214,000
Rail					
Rail – Freight	23,000	25,000	28,000	28,000	28,000
Rail – Passenger	47,000	59,000	71,000	71,000	71,000
Rail Total	70,000	84,000	98,000	98,000	98,000
Total	4,492,000	4,719,000	4,809,000	5,001,000	5,313,000
Percent Change from 2019 (%)	+7	+13	+15	+20	+27

Notes: GHG emissions results are independently rounded to the nearest thousand to account for any variability with actual emissions, and totals may not sum exactly due to rounding. AV = autonomous vehicles; DA = drive alone; GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent; TNC = Transportation Network Company.

Source: Calculated by Ascent in 2023.

Legislative-Adjusted GHG Emissions Forecasts

The legislative-adjusted GHG emissions forecast scenario provides an assessment of how emissions generated by countywide transportation will change over time considering legislative and regulatory actions that are already being implemented at the regional, state, or federal levels. The legislative reductions applied to estimate emissions under this forecast are listed in **Table 2-4** below.

Table 2-4 Legislative Reductions Summary for Countywide Transportation GHG Emissions Forecasts

Source	Legislative Reduction	Description
State	Advanced Clean Car I Regulations	Establishes GHG emissions reduction standards for model years 2017-2025 that are more stringent than federal CAFE standards.
State	Advanced Clean Car II Regulations	Establishes a target for all new passenger cars, trucks, and SUVs sold in California to be 100 percent zero-emission vehicles by 2035.
State	Truck and Bus Regulation	Requires diesel trucks and buses that operate in California to be upgraded to reduce GHG emissions by 2035.
State	Innovative Clean Transit Rule	Requires 100 percent of new bus purchases by transit agencies to be zero emissions starting in 2029 and achieving full transition to ZEBs by 2040.
Federal	Fuel Efficiency Standards for Medium- and Heavy-Duty Vehicles	Establishes fuel efficiency standards for medium- and heavy-duty engines and vehicles.

Notes: CAFE = Corporate Average Fuel Economy; GHG = greenhouse gas; SUV = sport utility vehicle; ZEB = zero-emission bus.

Source: Compiled by Ascent in 2023.

Table 2-5 presents the legislative-adjusted GHG emissions forecasts. With legislative actions, emissions from countywide transportation would decrease about 26 percent from 2019 baseline levels by 2030, 46 percent by 2035, 64 percent by 2040, 74 percent by 2045, and 78 percent by 2050. This is in stark contrast compared to the BAU GHG emissions forecasts (without legislative actions), which have projected increases in emissions for each forecast year compared to the 2019 baseline. **Figure 2-3** displays the legislative-adjusted GHG emissions forecasts by source, total BAU GHG emissions forecasts, and projected VMT. Projections show a steady increase in VMT primarily driven by population growth. Therefore, although GHG emissions are expected to decline due to cleaner vehicles and fuels, rising VMT could potentially offset some of the benefits of these regulations.

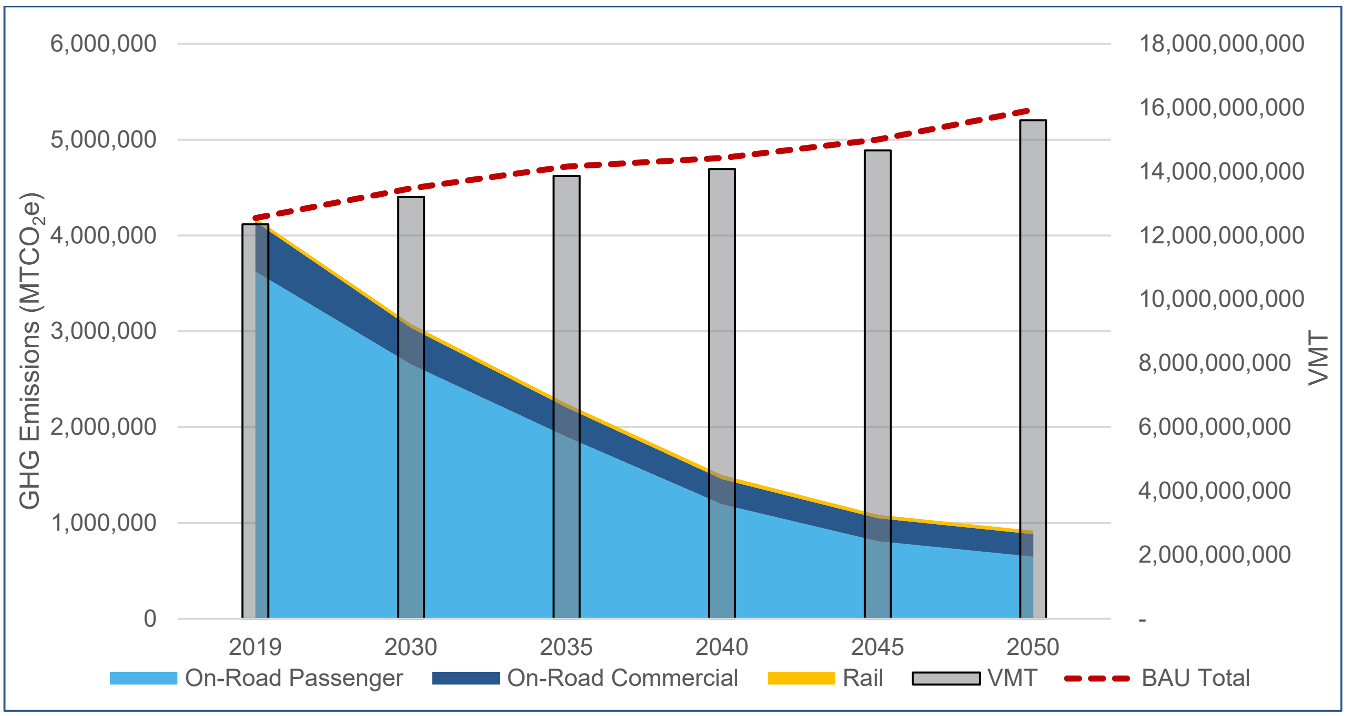
Table 2-5 2030-2050 Countywide Transportation Legislative-Adjusted GHG Emissions Forecasts

Source	GHG Emissions ($MTCO_2e$) 2030	GHG Emissions ($MTCO_2e$) 2035	GHG Emissions ($MTCO_2e$) 2040	GHG Emissions ($MTCO_2e$) 2045	GHG Emissions ($MTCO_2e$) 2050
On-Road Transportation					
Passenger – DA	2,010,000	1,377,000	823,000	517,000	374,000
Passenger – Carpool	493,000	346,000	206,000	129,000	93,000
Passenger – TNC	47,000	39,000	27,000	19,000	16,000
Passenger – AV	104,000	138,000	138,000	145,000	167,000
Commercial – Very Small	188,000	135,000	100,000	80,000	72,000
Commercial - Small	77,000	71,000	70,000	71,000	73,000

Source	GHG Emissions ($MTCO_2e$) 2030	GHG Emissions ($MTCO_2e$) 2035	GHG Emissions ($MTCO_2e$) 2040	GHG Emissions ($MTCO_2e$) 2045	GHG Emissions ($MTCO_2e$) 2050
Commercial - Medium	6,000	6,000	5,000	5,000	5,000
Commercial - Large	110,000	94,000	87,000	84,000	84,000
On-Road Transportation Total	3,036,000	2,205,000	1,457,000	1,051,000	883,000
Rail					
Rail – Freight	23,000	25,000	28,000	28,000	28,000
Rail – Passenger	18,000	17,000	16,000	8,000	8,000
Rail Total	41,000	42,000	43,000	36,000	36,000
Total	3,077,000	2,247,000	1,501,000	1,087,000	919,000
Percent Change from 2019 (%)	-26	-46	-64	-74	-78

Notes: GHG emissions results are independently rounded to the nearest thousand to account for any variability with actual emissions, and totals may not sum exactly due to rounding. AV = autonomous vehicles; DA = drive alone; GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent; TNC = Transportation Network Company.

Source: Calculated by Ascent in 2023.



Notes: BAU = business as usual; GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent; VMT = vehicle miles traveled.

Source: Prepared by Ascent in 2023.

Figure 2-3 Countywide Transportation GHG Emissions Inventory (2019), Legislative-Adjusted GHG Emissions Forecasts Through 2050 by Source, BAU GHG Emissions Forecasts, and VMT

VTA Operations Inventory and Forecasts

This section summarizes the latest GHG emissions inventory and forecasts for VTA's internal agency operations. VTA initially prepared an internal operations baseline inventory for 2009 and has been monitoring and updating its inventory annually as part of VTA's sustainability commitments outlined in the Sustainability Plan. VTA prepared an updated internal operations inventory for the year 2021 and forecasts through 2050 to inform the preparation of this CAAP. Emissions from VTA's internal operations can be grouped into six primary sectors: (1) revenue fleet; (2) non-revenue fleet; (3) building energy; (4) waste; (5) employee commute; and (6) water. Fleet-related emissions result from the combustion of diesel, natural gas, gasoline, and electricity used in buses, maintenance and administrative vehicles, paratransit, and other related vehicles. Building energy emissions are generated from on-site natural gas and propane combustion and indirectly at power plants or other sources that supply electricity to VTA facilities. Waste-related emissions result from the anaerobic decay of organic material disposed at landfills, generating CH_4. Employee commute activities generate emissions from fuel combustion in employee vehicle trips to and from work. Lastly, water consumption generates emissions indirectly through the conveyance, treatment, and distribution of water.

VTA Operations GHG Emissions Inventory

VTA internal operations emitted over 39,000 $MTCO_2e$ in 2021. The vast majority of these GHG emissions came from revenue fleet, equating to 83 percent of total emissions. Building energy also generated a considerable amount of emissions, with over 3,000 $MTCO_2e$ emitted, or 8 percent of total emissions. Each of the remaining sectors contributed to 4 percent or less of total emissions. Total GHG emissions generated by VTA's internal operations in 2021 are shown in **Table 2-6** below, broken down by sector. VTA's 2021 operational emissions were 44 percent lower than the initial baseline year of 2009 where emissions were over 69,000 $MTCO_2e$, reflecting ongoing actions VTA has already taken to reduce GHG emissions in combination with ongoing state and federal legislative and regulatory actions (see **Appendix B** for a detailed analysis of VTA's previous operational inventories and comparison to the most recent 2021 inventory).

Table 2-6 2021 VTA Operations GHG Emissions Inventory

Sector	GHG Emissions ($MTCO_2e$)	Percent GHG Emissions (%)
Revenue Fleet	32,820	83
Non-Revenue Fleet	1,198	3
Building Energy	3,024	8
Waste	1,548	4
Employee Commute	832	2
Water	8	<1
Total	39,431	100

Notes: Percentages are independently rounded to the nearest whole percentage (unless they are below 1 percent, in which case they are presented as "<1"), and total percentages may not sum exactly due to rounding; GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent.

Source: Calculated by Ascent in 2023.

VTA Operations GHG Emissions Forecasts

Similar to countywide transportation, and using the results of the 2021 VTA internal operations GHG inventory, two forecast scenarios are provided to estimate future GHG levels from VTA's internal operations: the BAU scenario and the legislative-adjusted scenario. Both forecast scenarios are presented below. Specific forecast years include 2030, 2035, 2040, 2045, and 2050.

BAU GHG Emissions Forecasts

The following BAU GHG emissions forecasts, displayed in **Table 2-7**, provide an assessment of how emissions generated by VTA's internal operations will change over time without further local, regional, state, or federal action. Compared to 2021 levels, GHG emissions are projected to decrease 34 percent by 2030, 59 percent by 2035, and 76 percent by 2040, 2045, and 2050.

Table 2-7 2030-2050 VTA Operations BAU GHG Emissions Forecasts

Sector	GHG Emissions ($MTCO_2e$) 2030	GHG Emissions ($MTCO_2e$) 2035	GHG Emissions ($MTCO_2e$) 2040	GHG Emissions ($MTCO_2e$) 2045	GHG Emissions ($MTCO_2e$) 2050
Revenue Fleet	20,071	10,283	3,691	3,766	3,840
Non-Revenue Fleet	1,358	1,285	1,318	1,365	1,415
Building Energy	2,064	2,067	2,070	2,073	2,076
Waste	1,573	1,504	1,434	1,364	1,294
Employee Commute	1,107	1,072	1,038	1,003	969
Water	5	5	5	4	4
Total	26,178	16,216	9,555	9,575	9,598
Percent Change from 2021 (%)	-34	-59	-76	-76	-76

Notes: GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent.

Source: Calculated by Ascent in 2023.

Legislative-Adjusted GHG Emissions Forecasts

The legislative-adjusted GHG emissions forecasts provide an assessment of how emissions generated by VTA's internal operations will change over time considering legislative and regulatory actions taken at the regional, state, or federal levels. The legislative reductions applied to estimate emissions under this forecast are listed in **Table 2-8** below.

Table 2-8 Legislative Reductions Summary for VTA Operations Emissions Forecasts

Source	Legislative Reduction	Description	Sectors Applied
State	Renewable Energy and Zero-Carbon Electricity Requirements (SB 1020 and SB 100)	Requires California energy utilities to procure 60 percent of electricity from eligible renewable and zero-carbon sources by 2030, 90 percent by 2035, 95 percent by 2040, and 100 percent by 2045.	Building Energy
State	Advanced Clean Car I Regulations	Establishes GHG emissions reduction standards for model years 2017 through 2025 that are more stringent than federal CAFE standards.	Revenue and Non-Revenue Fleet
State	Advanced Clean Cars II Regulations	Establishes a target for all new passenger cars, trucks, and SUVs sold in California to be 100 percent zero-emission vehicles by 2035.	Revenue and Non-Revenue Fleet
State	Truck and Bus Regulation	Requires diesel trucks and buses that operate in California to be upgraded to reduce GHG emissions by 2035.	Revenue Fleet

Source	Legislative Reduction	Description	Sectors Applied
State	Innovative Clean Transit Rule	Requires 100 percent of new purchases by transit agencies to be zero emissions starting in 2029 and achieving full transition to ZEBs by 2040.	Revenue Fleet
Federal	Fuel Efficiency Standards for Medium- and Heavy-Duty Vehicles	Establishes fuel efficiency standards for medium- and heavy-duty engines and vehicles.	Revenue and Non-Revenue Fleet

Notes: CAFE = Corporate Average Fuel Economy; GHG = greenhouse gas; SB = Senate Bill; SUV = sport utility vehicle; ZEB = zero-emission bus. Note also that CARB's Advanced Clean Fleet Regulation was not yet adopted at the time the legislative-adjusted forecasts were prepared for this CAAP (see Chapter 3 for further discussion of this pending regulation and its relationship to the CAAP).

Source: Compiled by Ascent in 2023.

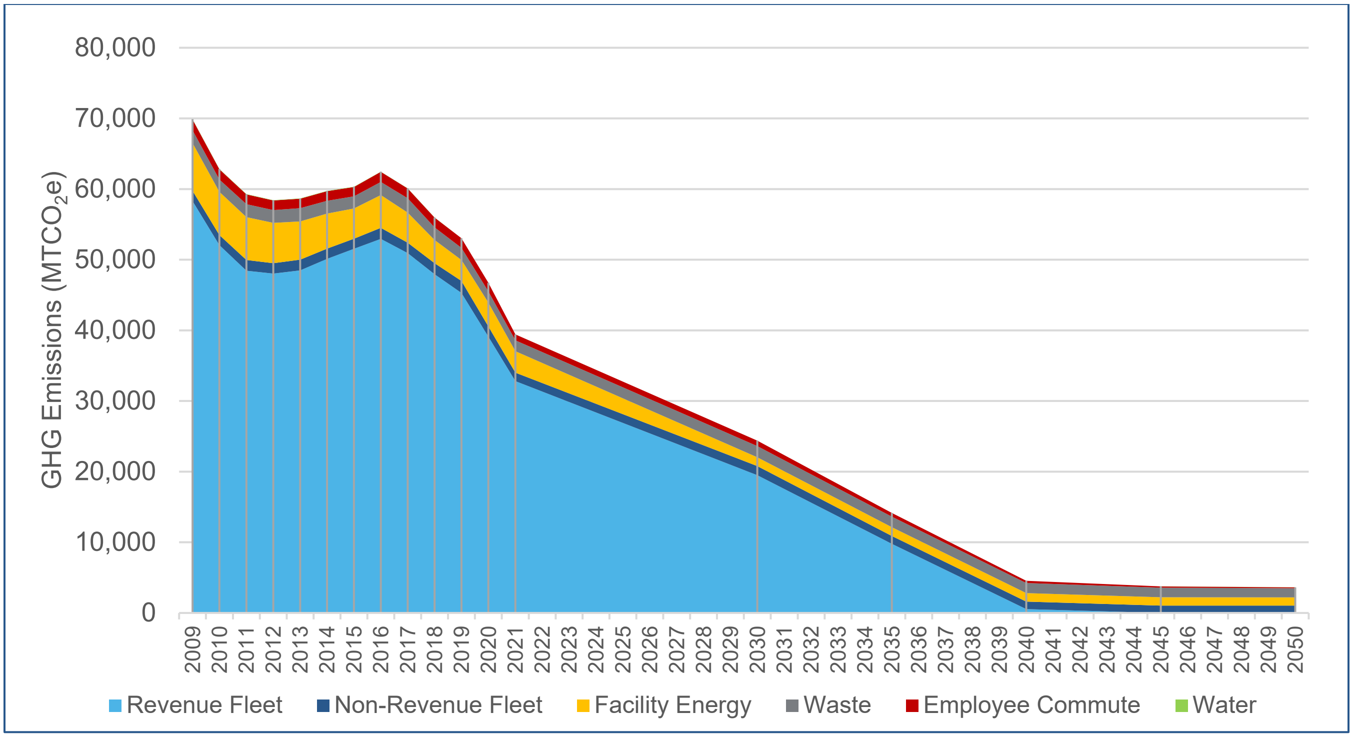
Table 2-9 presents the legislative-adjusted GHG emissions forecasts. With legislative actions, emissions from VTA's internal operations would decrease about 38 percent from 2021 baseline levels by 2030, 64 percent by 2035, 88 percent by 2040, 90 percent by 2045, and 91 percent by 2050. Though there were already projected decreases for each forecast year in the BAU scenario, the decreases for the legislative-adjusted forecasts are even greater. **Figure 2-4** also visually displays the legislative-adjusted GHG emissions forecasts for VTA's internal operations, coupled with the 2021 baseline and historical data dating back to 2009, broken down by sector.

Table 2-9 2030-2050 VTA Operations Legislative-Adjusted GHG Emissions Forecasts

Sector	GHG Emissions ($MTCO_2e$) 2030	GHG Emissions ($MTCO_2e$) 2035	GHG Emissions ($MTCO_2e$) 2040	GHG Emissions ($MTCO_2e$) 2045	GHG Emissions ($MTCO_2e$) 2050
Revenue Fleet	19,506	9,786	541	0	0
Non-Revenue Fleet	1,273	1,115	1,058	1,038	1,041
Building Energy	1,261	1,231	1,201	1,170	1,161
Waste	1,573	1,504	1,434	1,364	1,294
Employee Commute	779	516	311	191	133
Water	3	2	1	0	0
Total	24,396	14,154	4,546	3,763	3,629
Percent Change from 2021 (%)	-38	-64	-88	-90	-91

Notes: GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent.

Source: Calculated by Ascent in 2023.



Notes: GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent.

Source: Prepared by Ascent in 2023.

Figure 2-4 VTA Operations GHG Emissions Inventory (2009-2021) and Legislative-Adjusted GHG Emissions Forecasts Through 2050 by Source

Setting Targets

Establishing a GHG emissions reduction goal, often referred to as a “GHG reduction target,” is a key step in the local climate action planning process. Local GHG reduction targets are often developed consistent with statewide GHG emissions goals or targets established under state law.

The state’s current GHG reduction targets were established by Senate Bill (SB) 32 and Assembly Bill (AB) 1279 and incorporated into the state’s most recent Climate Change Scoping Plan. They include the following:

- Reduce statewide anthropogenic GHG emissions to 40 percent below 1990 levels by 2030 (SB 32);
- Reduce statewide anthropogenic GHG emissions to 85 percent below 1990 levels by 2045 (AB 1279); and
- Achieve statewide net zero GHG emissions (i.e., “carbon neutrality”) no later than 2045 and achieve and maintain net negative GHG emissions thereafter (AB 1279).

The concept of net zero GHG emissions applies to all GHG emissions regulated by the state, not just CO_2. However, sometimes net zero GHG emissions is equated conceptually with the term “carbon neutrality.” AB 1279 defines net zero GHG emissions to mean that any remaining GHGs that may be emitted into the atmosphere by the year 2045 must be balanced by removals of GHG emissions over the same time. AB 1279 further defines “removals” to include a range of carbon capture, utilization, and storage (CCUS) activities. A related bill, SB 905, requires CARB to create a statewide regulatory program for CCUS and to establish a governance framework, tracking systems, and unified permitting regulations for CCUS projects. Furthermore, natural carbon sequestration activities are included in the state's GHG reduction policies, and pursuant to AB 1757, the California Natural Resources Agency (CNRA) must establish a range of natural carbon sequestration targets by January 1, 2024, that support efforts to achieve carbon neutrality and incorporate interventions that work with nature to improve resiliency, otherwise known as nature-based solutions, for the years 2030, 2038, and 2045.

The state's 2030 and 2045 targets are aligned with the scientifically established levels needed to limit the rise in global temperature to no more than 2 degrees Celsius (°C), or 3.6 °F, above pre-industrial levels. A 2 °C rise in global temperature is the warming threshold at which major climate disruptions, such as mega droughts and rising sea levels, are projected. These targets also pursue efforts to limit the global temperature increase even further to no more than 1.5 °C, or 2.7 °F, in alignment with the goals of the United Nations Framework Convention on Climate Change (UNFCC) Paris Agreement of 2015 (UN 2015).

Carbon Neutrality by 2045

As noted in this chapter and **Chapter 3**, VTA is focused on reducing GHG emissions from both its internal operations and the countywide transportation system. VTA has a high degree of jurisdictional control over its own operations, and it also plays a significant role in shaping and influencing countywide transportation in the broader community and region through its role as a congestion management agency and countywide transportation agency.

Electric Bus Chargers at Cerone Division

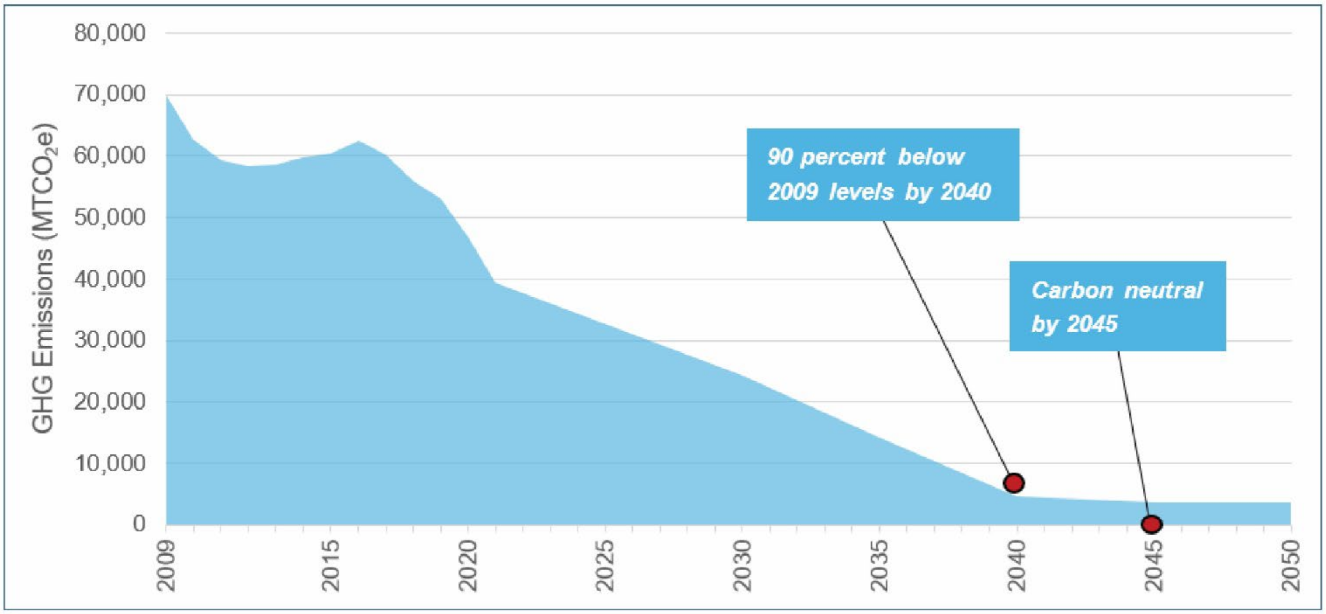
VTA's GHG emissions reduction targets should be aligned with statewide targets for achieving carbon neutrality (i.e., net zero GHG emissions) by 2045. This is consistent with the Climate Emergency Declaration adopted by the Board in 2020, which included a commitment to support legislative efforts to reduce GHG emissions in the transportation sector.

Carbon Neutrality in VTA Operations

Carbon neutrality by 2045 for VTA operations is an achievable long-term target that builds on VTA's Sustainability Plan, which established a GHG emissions reduction target of 90 percent below a 2009 baseline by 2040 for VTA operations (VTA 2020b). VTA is already on track to achieve a 96 percent reduction in GHG emissions for its internal operations relative to the 2009 baseline by the year 2040 because of state and federal legislative actions. **Figure 2-5** shows VTA's established 2040 target for operations, as well as the 2045 carbon neutrality target, in comparison to legislative-adjusted emissions forecasts for VTA operations.

No specific pathway to achieving full carbon neutrality by 2045 is included in this CAAP. Given the constantly evolving nature of climate change policies, laws, and regulations; ongoing innovation around new technologies and market-based mechanisms to increase the effectiveness of GHG emissions reduction measures, CCUS activities, and natural sequestration activities; and other factors, VTA expects that pathways for demonstrating how carbon neutrality will be fully achieved by 2045 will become more defined and feasible over time.

VTA will continue to monitor and report on the CAAP's progress, and future CAAP updates will provide more clarity on how full carbon neutrality will be achieved by 2045 (see **Chapter 6**, which outlines further details on the monitoring and reporting components of the CAAP's implementation strategy).



Notes: GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent.

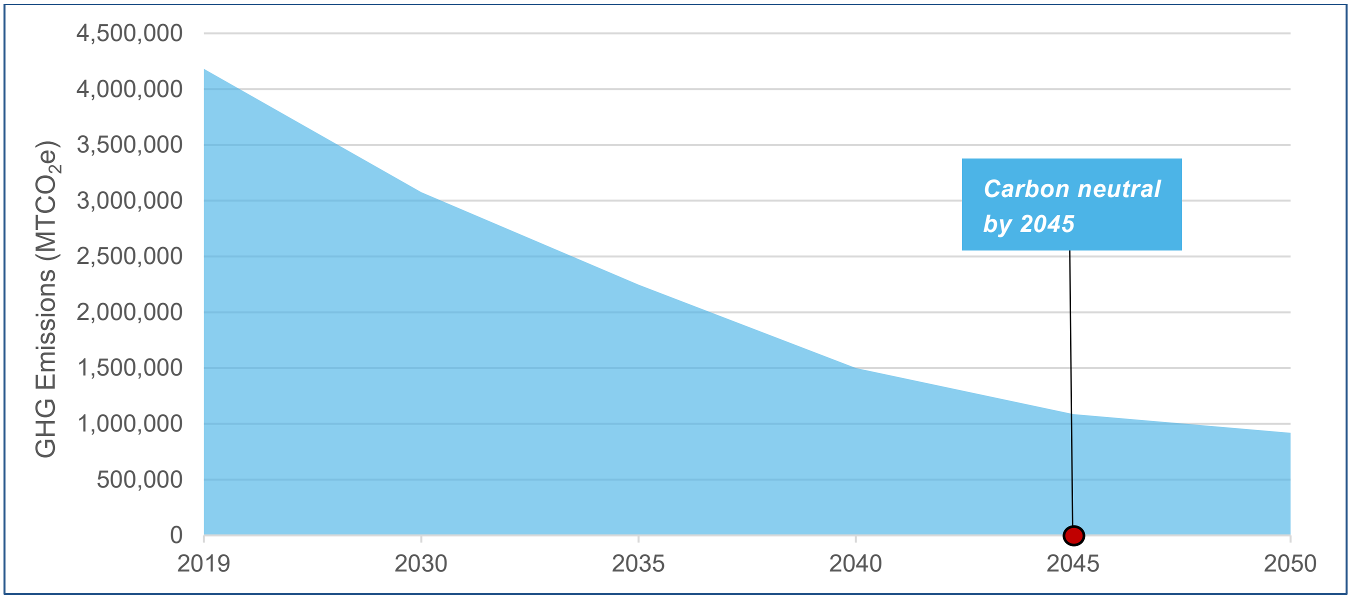
Source: Prepared by Ascent in 2023.

Figure 2-5 GHG Emissions Reduction Targets for VTA Operations and Legislative-Adjusted Forecasts

Carbon Neutrality in Countywide Transportation

Achieving carbon neutrality by 2045 in the countywide transportation system is a critically important goal; however, it cannot be achieved by VTA alone. It will require ongoing partnerships and collaboration across multiple sectors and scales and, perhaps most importantly, ongoing community engagement and a sustained and increased commitment to individual action. **Figure 2-6** shows the 2045 carbon neutrality target for countywide transportation in comparison to the legislative-adjusted countywide transportation emissions forecast.

VTA is committed to implementing GHG reduction measures identified in the next chapter. These measures will provide important contributions to bolster local and regional efforts and provide quantifiable GHG emissions reduction contributions towards reducing countywide transportation emissions. However, many additional actions will be required to achieve further reductions in transportation emissions that are not within VTA's jurisdictional control and will require action by other public agencies and other partnering entities. For example, the state's latest Climate Change Scoping Plan, Climate Action Plan for Transportation Infrastructure (CAPTI), regional plans such as Plan Bay Area 2050, and local climate action plans or related land use and transportation planning efforts by cities, the County of Santa Clara, and local jurisdictions across the region, all have important roles to play in reducing VMT and GHG emissions. VTA will continue to partner and collaborate by supporting actions that are under the jurisdictional control or authority of others.



Notes: GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent.

Source: Prepared by Ascent in 2023.

Figure 2-6 GHG Emissions Reduction Target for Countywide Transportation and Legislative-Adjusted Forecasts

CLIMATE ACTION & ADAPTATION PLAN

3. GHG Reduction Strategies

Introduction

This chapter focuses on the strategies, measures, and actions that VTA will take to reduce GHG emissions and make progress towards the GHG reduction targets identified in **Chapter 2**.

Regulatory Setting

The state's GHG emissions reduction strategy is guided by many laws, plans, and regulations that are important to consider when developing a local climate action plan. The following is not an exhaustive list of all statewide policies and actions, but highlights some key policies that provide important context for the CAAP.

- **AB 32** established the state's first legislative GHG reduction target of reducing statewide emissions to 1990 levels by the year 2020. This target was achieved in 2016, four years ahead of schedule (CARB 2023).
- **SB 32** established a subsequent target of further reducing statewide GHG emissions to 40 percent below 1990 levels by 2030.
- **AB 1279** established additional long-term targets, including reducing GHG emissions to 85 percent below 1990 levels by 2045, and achieving net zero GHG emissions by 2045. AB 1279 defines net zero GHG emissions to mean that any remaining GHGs that may be emitted into the atmosphere by the year 2045 must be balanced by removals of GHG emissions over the same time. AB 1279 further defines "removals" to include a broad suite of carbon capture, utilization, and storage (CCUS) activities.
- The **Climate Change Scoping Plan** is the state's climate action plan designed to provide a statewide strategy for achieving the targets established in AB 32 and subsequent laws. The first Scoping Plan was adopted in 2008, and the California Air Resources Board (CARB) updates the Scoping Plan approximately every five years, as required by law. The most recent update to the Scoping Plan was adopted in 2022 and provides a statewide strategy for achieving the latest targets established in AB 1279. It includes a broad range of existing, ongoing, and proposed new programs or regulations that the state will implement to achieve its targets (CARB 2022a).

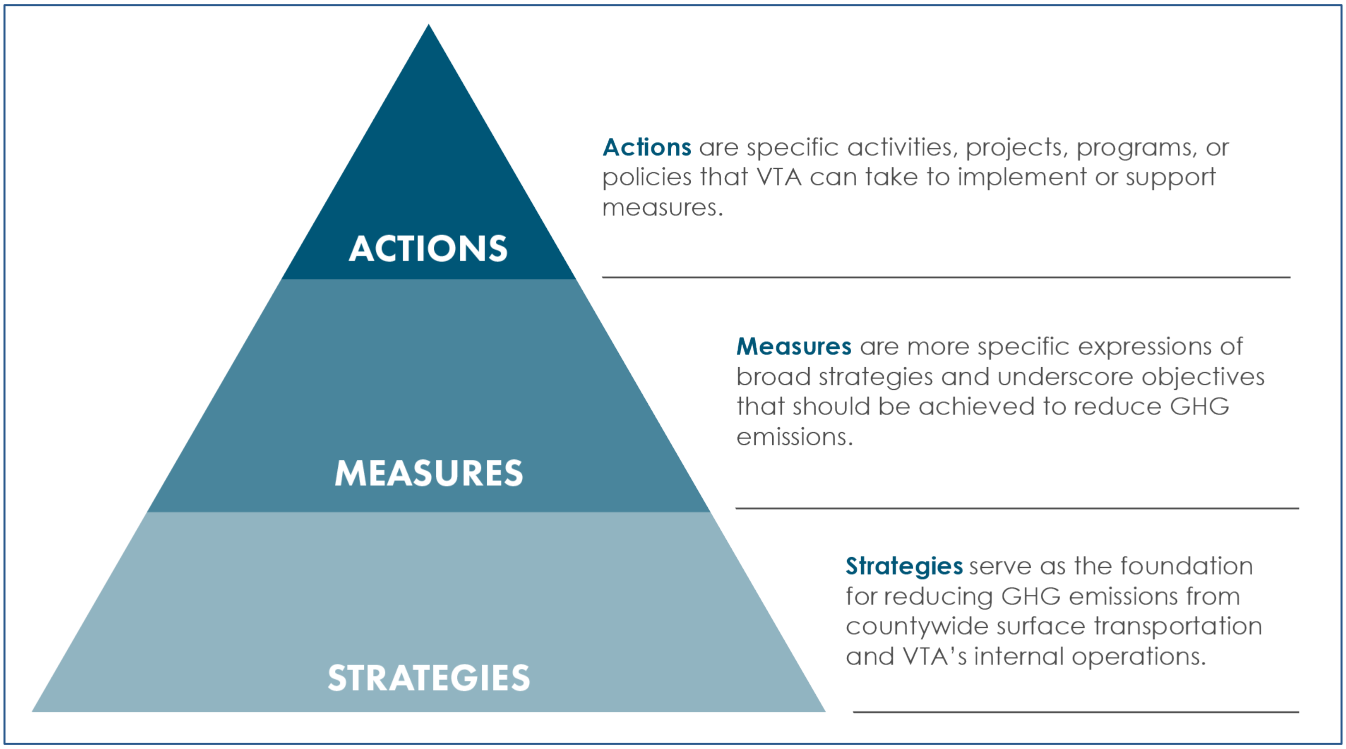
In addition, numerous laws and regulations are already achieving GHG emissions reductions in sectors where state or federal agencies have jurisdictional authority. **Chapter 2** includes a list of applicable state or federal laws and regulations that were included in the legislative-adjusted GHG emissions forecasts for both countywide transportation and VTA operations.

GHG Reduction Framework

The overall structure and approach for reducing GHG emissions from both the countywide transportation system and VTA's operations are based on a framework that consists of focus areas, strategies, measures, and actions. As the broadest category within the framework, **focus areas** represent the major sectors of the GHG emissions inventory where GHG reduction potential would be the greatest. These focus areas, discussed in more detail later, include:

- Transportation and Land Use
- Buildings and Facilities
- Fleet and Employee Commute
- Materials and Waste

Under each focus area are broad **strategies** that serve as the foundation for reducing GHG emissions. Each strategy contains a series of **measures** that are more specific expressions of what can be achieved to reduce GHG emissions. Lastly, **actions** are the specific activities, projects, programs, or other steps that VTA can take to implement and support the measures. Some measures can be quantified in terms of their GHG reduction potential, depending on the level of detail included in each measure and associated actions. The hierarchy of strategies, measures, and actions serves as VTA's framework for reducing GHG emissions and is visualized in **Figure 3-1** below.



Notes: GHG = greenhouse gas; VTA = Santa Clara Valley Transportation Authority.

Source: Prepared by Ascent in 2023.

Figure 3-1 Hierarchy of GHG Reduction Strategies, Measures, and Actions

Evaluation Criteria and Co-Benefits

For all GHG reduction measures considered, VTA used a qualitative set of evaluation criteria to understand the relative potential for each measure to contribute to achieving GHG emissions reduction goals, as well as other considerations including cost effectiveness, degree of jurisdictional control, implementation timeframe, and co-benefits related to environmental, equity, public health, quality of life, and engagement goals. The full set of evaluation criteria and each of their associated scoring rubrics are presented in **Table 3-1**. Further details and the full array of scoring results for each GHG reduction measure can be found in **Appendix C.**

Table 3-1 Evaluation Criteria and Scoring Rubric for GHG Reduction Measures

Evaluation Criteria	Scoring Rubric
GHG Reduction Potential	▪ Low = The measure has a low (between 0-2%) GHG reduction potential. ▪ Medium = The measure has a medium (between 2-5%) GHG reduction potential. ▪ High = The measure has a high (over 5%) GHG reduction potential.
Cost Effectiveness	▪ Low = Conceptual implementation costs are high relative to GHG reduction potential. ▪ Medium = Conceptual implementation costs are moderate relative to GHG reduction potential. ▪ High = Conceptual implementation costs are low relative to GHG reduction potential.
Jurisdictional Control	▪ Low = For this measure, VTA would be the "influencer." VTA would not have any direct control over measure implementation, but VTA still has the ability to partner, coordinate with, encourage, or influence the efforts of others. ▪ Medium = For this measure, VTA would be the "regulator" or "initiator." VTA would have some degree of jurisdictional control, either directly or indirectly, but is not solely responsible for enacting all efforts required to achieve the full potential of the measure. For example, VTA may act as a regulator or initiator for some efforts, but the broader community or other agencies may also need to respond with some degree of action. ▪ High = For this measure, VTA would be the "actor." VTA would likely have sole authority and full jurisdictional control over measure implementation.
Implementation Timeframe	▪ Long-Term = Measure could be operational after 5+ years. ▪ Mid-Term = Measure could be operational in the next 2-5 years. ▪ Near-Term = Measure could be operational in the next 1-2 years.
Environmental (Co-Benefit)	▪ No = This measure would not result in any environmental (e.g., air, water, habitat) benefits OR unclear what environmental impact this measure may have. ▪ Yes = This measure would result in environmental (e.g., air, water, habitat) benefits.
Equity (Co-Benefit)	▪ No = This measure would not directly or indirectly enhance social equity OR unclear what impact this measure may have on social equity. ▪ Yes = This measure would directly or indirectly enhance social equity by providing benefits to vulnerable or disadvantaged populations.
Public Health (Co-Benefit)	▪ No = This measure would not enhance public health OR unclear what impact this measure may have on public health. ▪ Yes = This measure would enhance public health.
Quality of Life (Co-Benefit)	▪ No = This measure would not influence the quality of life of VTA staff, riders, and/or the broader community OR unclear what impact this measure may have on quality of life. ▪ Yes = This measure would improve the quality of life of VTA staff, riders, and/or the broader community.
Engagement (Co-Benefit)	▪ No = This measure would not require or facilitate engagement with internal staff, the general public, member agencies, and/or other stakeholders OR unclear what impact this measure may have on engagement. ▪ Yes = This measure would require or likely facilitate engagement with internal staff, the general public, member agencies, and/or other stakeholders.

Notes: GHG = greenhouse gas; VTA = Santa Clara Valley Transportation Authority.

Source: Prepared by Ascent in 2023.

Most of the selected measures were found to achieve multiple co-benefits, including protecting the environment and public health, and advancing social equity, which is achieved when everyone – no matter their race, socioeconomic status, identity, where they live, or how they travel – has access to what they need to thrive. Some of the recommended GHG reduction measures were found to have relatively low GHG reduction on their own, however, they may still have considerable GHG reduction potential when grouped within a particular strategy or set of strategies, or when bundled together with other strategies, in addition to achieving important co-benefits. For example, for the suite of measures identified under Strategy GHG-TL-4: Sustainable Land Use, Planning, and Development; Strategy GHG-TL-5: Parking Management and Pricing; and, Strategy GHG-TL-6: Smart Mobility and TDM, VTA has an ongoing opportunity to support and collaborate in planning, development review, and community design-focused activities of member agencies, who have a higher degree of jurisdictional control over local land use planning, development project review, or local right of way improvements, which these strategies are intended to influence.

As discussed in **Appendix C**, not all of the GHG reduction measures originally studied by VTA are included in the CAAP. Some measures were removed from further consideration given duplication or overlap with existing regulatory requirements or because they were found to be infeasible due to VTA's lack of jurisdictional control or influence. In the case of zero-emission bus (ZEB) and paratransit ZEV replacements, the project team did consider a measure to accelerate bus and vehicle replacements to ramp up and reduce GHG emissions faster, relative to existing regulations and expected phase-out timelines. However, it was determined that the transition of VTA's fleet is already occurring at a measured pace that balances cost, risk, and potential disruptions to service.

GHG Reduction Strategies, Measures, and Actions

All GHG reduction strategies, measures, and actions in this CAAP are organized into four focus areas:

1. ***Transportation and Land Use***
2. ***Buildings and Facilities***
3. ***Fleet and Employee Commute***
4. ***Materials and Waste***

All of the selected GHG reduction strategies, measures, and actions are presented in the subsections below, organized by focus area and tagged using a classification system. The strategies are first denoted with "GHG" to differentiate from the adaptation strategies presented in **Chapter 5**, which are denoted with an "AD." This is then followed with a two-letter combination that denotes which focus area the strategy is associated with: "TL" for Transportation and Land Use; "BF" for Buildings and Facilities; "FE" for Fleet and Employee Commute; and "MW" for Materials and Waste. Following this two-letter combination is the strategy number, along with the measure and action number (if applicable). For example, the first strategy presented in the Transportation and Land Use focus area is classified as Strategy GHG-TL-1, with the first associated measure being classified as Measure GHG-TL-1.1, and the first action under that measure being classified as Action GHG-TL-1.1.1. Though this classification is applied to each strategy, measure, and action for identification purposes, it should be noted that the order is random and not related to level of importance, effectiveness, or otherwise. See **Chapter 6**, Implementation, for more information on determining prioritization. In addition to the scoring for evaluation criteria and co-benefits, matrices included within **Appendix C** also include a tagging system that demonstrates whether each measure applies to VTA's internal operations, countywide transportation, or both.

Transportation and Land Use

The Transportation and Land Use focus area provides VTA a significant opportunity to reduce GHG emissions associated with the countywide transportation system. The strategies, measures, and actions under this focus area, presented in **Table 3-2** below address the overall efficiency of the transportation system itself, the behaviors and potential choices made by those who use it, as well as current and future land use plans, land development projects, and community design approaches in both cities and unincorporated county areas that relate to transportation activity. Reducing VMT, avoiding or reducing vehicle trips, investing in a sustainable transportation system, and promoting sustainable land use patterns and development decisions to spur mode shift are all key objectives of the Transportation and Land Use focus area.

Table 3-2 Transportation and Land Use GHG Reduction Strategies, Measures, and Actions

Measure	Action
	Strategy GHG-TL-1: Sustainable Roadway Networks and Pricing
GHG-TL-1.1: Assist VTA member agencies in implementing SB 743 and mitigating VMT from new land development projects and transportation projects.	GHG-TL-1.1.1: Evaluate the feasibility of a countywide VMT exchange, VMT mitigation bank, or similar program that helps mitigate transportation impacts from land use projects in a way that reduces VMT and GHG emissions, works across jurisdictional boundaries and enhances equity. If determined to be feasible, work with VTA's member agencies to implement a countywide VMT mitigation program.
GHG-TL-1.2: Continue to build out the countywide Express Lane network to use roadway pricing as a tool to provide reliable travel options and generate a revenue stream for projects that improve the operations of HOV lanes and transit.	GHG-TL-1.2.1: Develop and implement an Express Lanes Strategic Plan to explore options that will achieve VTA's goals for reducing VMT and GHG emissions while also managing travel demand and improving reliability. GHG-TL-1.2.2: Collaborate with regional partners to explore region-wide Bay Area tolling and the future of Express Lanes and dynamic pricing in Santa Clara County relative to potential shifts in regional policy.
	Strategy GHG-TL-2: Safe and Accessible Active Transportation for All
GHG-TL-2.1: Implement bicycle and pedestrian infrastructure that reduces VMT or improves the safety of existing facilities, prioritizing investments in disadvantaged communities.	GHG-TL-2.1.1: Evaluate VMT reduction potential for projects included in VTA's countywide planning documents, such as the Countywide Bicycle Plan, Bicycle Superhighway Implementation Plan, and Pedestrian Access to Transit Plan. GHG-TL-2.1.2: Conduct a study to identify under-served areas and develop a program to prioritize active transportation investments for disadvantaged communities, in partnership with member agencies. For example, there could be opportunities to align with SB 1000 requirements to address active transportation for disadvantaged communities in environmental justice elements in local general plan updates. GHG-TL-2.1.3: Advocate for adequate funding for bicycle and pedestrian capital projects and maintenance from existing funding sources and identify new funding streams where necessary.
GHG-TL-2.2: Encourage and support efforts to plan and build walkable and bikeable communities, accessible to people of all income levels and races.	GHG-TL-2.2.1: Collaborate with planners and public works officials from member agencies by participating in development project reviews, community planning, or corridor planning efforts, to ensure pedestrian/bicycle infrastructure and connectivity to transit are included in projects and area-wide plans. GHG-TL-2.2.2: Promote and provide local support/technical assistance for using VTA's Community Design and Transportation (CDT) Manual, Bicycle Technical Guidelines, and Pedestrian Access to Transit Plan. GHG-TL-2.2.3: Support collaborative funding opportunities for shared investments between VTA and partner agencies.
GHG-TL-2.3: Support local, county, state, and federal efforts to promote use of electric bicycles as an alternative to driving.	Actions from Measures GHG-TL-2.1 and GHG-TL-2.2 may also apply to this measure. GHG-TL-2.3.1: Seek funding through programs such as MTC's Bike Share Capital Program and California's Active Transportation Program, among others, which support electric bicycle and bicycle sharing projects. GHG-TL-2.3.2: Work to expand access and incentivize the use of electric bicycles and bicycle sharing in Santa Clara County by emulating current programs, such as the "Richmond-San Rafael E-bike Commuter Program," collaborating with relevant partners, as needed.
GHG-TL-2.4: Support education and encouragement programs that promote replacing polluting travel with low-emission travel.	GHG-TL-2.4.1: Support local and countywide Safe Routes to Schools efforts by providing funding and facilitating information-sharing. GHG-TL-2.4.2: Support local and countywide events that promote walking and biking, such as Viva CalleSJ and Bike to Wherever Days, by providing funding, cross-promoting, and facilitating information-sharing.

Measure	Action
	Strategy GHG-TL-3: Fast, Frequent, and Reliable Public Transportation for All
GHG-TL-3.1: Improve reliability and convenience of existing transit services through increased frequency of service, extended service hours, and improved facilities at stops and stations, prioritizing improvements that serve disadvantaged communities.	GHG-TL-3.1.1: Implement VTA's annual transit service plans based on the Visionary Transit Network's transit vision and recommended service enhancements. GHG-TL-3.1.2: Pursue new funding streams to support increased service, stops, reliability, extended hours, and capital projects identified in the Visionary Transit Network. GHG-TL-3.1.3: Implement service changes pursuant to available funding, in accordance with adopted service plans, and in compliance with VTA's service equity policies.
GHG-TL-3.2: Increase transit travel speed and reliability through transit-signal priority, dedicated bus lanes, and new or expanded Rapid bus service.	GHG-TL-3.2.1: Collaborate with member agencies and other relevant partners to make transit faster and more reliable with solutions like transit signal priority and transit-only lanes. GHG-TL-3.2.2: Implement transit signal priority, dedicated lanes, and other improvements in collaboration with member agencies. GHG-TL-3.2.3: Support member agencies through collaborative grant writing and project management of transit priority improvements.
	Strategy GHG-TL-4: Sustainable Land Use Planning and Development
GHG-TL-4.1: Collaborate with member agencies in advanced planning efforts to increase residential and employment densities and expand mixed-use development potential near rail stations, along Frequent Network bus routes, and in priority development areas (PDAs).	GHG-TL-4.1.1: Continue coordinating and collaborating with member agencies on advanced planning efforts through the LUTI Development Review Program and regularly scheduled coordination meetings, including on General Plan updates, station area plans, neighborhood/corridor plans, housing elements, zoning code updates, or other area-wide planning efforts, to ensure that densities, floor-area ratios, and land use designations are transit-supportive and aligned with existing system and planned transit investments. GHG-TL-4.1.2: Support member agencies through collaborative grant writing and project management of land use plans surrounding transit stations and priority corridors. GHG-TL-4.1.3: Promote and provide local support/technical assistance for using VTA's Community Design and Transportation (CDT) Manual and other resources.
GHG-TL-4.2: Increase development around transit stations and along transit corridors to facilitate multi-modal, carbon-neutral neighborhoods that are sustainable and resilient.	GHG-TL-4.2.1: Collaborate with member agencies to increase and facilitate (1) commercial and mixed-use development in or near job centers and (2) residential, commercial, and mixed use near rail stations, along Frequent Network bus routes, and in PDAs. GHG-TL 4.2.2: Continue to seek funding through the Strategic Growth Council's Affordable Housing and Sustainable Communities Program (AHSC) to reduce GHG's and produce affordable, equitable, and dense housing near VTA transit facilities.
GHG-TL-4.3: Strategically repurpose underutilized parking lots or other vacant lots at or near VTA transit stations and major transit stops into lively mixed-use, transit-oriented communities with activated ground floor uses that increase transit ridership, help provide revenue for transit capital investments and operations, and reduce VMT.	GHG-TL-4.3.1: Continue to implement VTA's TOC policy and TOD Development Programs. GHG-TL-4.3.2: Catalyze equitable and inclusive TOCs with thorough public engagement, resulting in thoughtful placemaking and place-keeping. GHG-TL-4.3.3: Focus on priority joint development parcels first and parcels that have the potential for achieving the highest VMT reductions and ridership improvements.
GHG-TL-4.4: Provide people of all generations and backgrounds with affordable housing and access to the necessities of daily life available within a short walk, bicycle ride, or transit trip.	GHG-TL-4.4.1: Continue to work through VTA's TOD program with local jurisdictions and the development community to produce mixed-use, mixed-income, and 100% affordable housing projects, consistent with VTA's Affordable Housing Goals identified in the TOC Policy. GHG-TL-4.4.2: Implement VTA-funded TOC Playbook strategies in Downtown San Jose, 28th Street/Little Portugal Station, and Santa Clara Station, in partnership with the cities of San Jose and Santa Clara and surrounding communities.

Measure	Action
GHG-TL-4.5: Work with member agencies and other partners to focus development where it already exists (i.e., promote infill development) and reduce the impact of development and transportation infrastructure on the environment by protecting open space, conserving and restoring habitat, enhancing biodiversity, increasing carbon sequestration, and improving wildlife connectivity.	GHG-TL-4.5.1: Explore opportunities for VTA to support local and regional efforts to protect and enhance natural and working lands. Partnering agencies could include Santa Clara Valley Open Space Authority, Santa Clara Valley Habitat Agency, City of San Jose, Santa Clara Valley Land Trust, Peninsula Open Space Trust, Mid-Pen Open Space District, MTC, ABAG, or others. GHG-TL-4.5.2: Collaborate with regional stakeholders to explore the potential for creating a TDR program to (1) prioritize compact development in closer proximity to transit corridors, and (2) avoid conversion of open space to low-density development, especially areas identified as high priority for conservation. A TDR program could potentially identify TOD/TOC areas in VTA's network as receiving areas for TDRs. GHG-TL-4.5.3: Explore opportunities to partner with existing community organizations in providing transportation services that increase equitable access to local open space to support recreational and educational opportunities, with a priority emphasis on increasing open space access in historically marginalized and disadvantaged communities.
	Strategy GHG-TL-5: Smart Parking and Curbside Management
GHG-TL-5.1: Support local efforts to reduce or eliminate minimum parking standards and institute parking maximums, require "unbundling" of parking costs from commercial leasing or residential rental rates, support shared parking, and introduce demand-based parking pricing in public on- and off-street parking facilities.	GHG-TL-5.1.1: Develop and implement demand-based pricing policies at existing VTA-owned off-street parking lots or garages. GHG-TL-5.1.2: Promote and provide local support/technical assistance for using VTA's CDT Manual, which includes guidance for "Rethinking Parking Requirements" and "Parking Management."
GHG-TL-5.2: Provide EV charging infrastructure at VTA parking facilities open to the public.	GHG-TL-5.2.1: Identify existing VTA facilities where additional publicly accessible EV charging stations, charging infrastructure, and solar canopies with EV charging could be installed. Develop an implementation plan and policy that identifies funding and/or agreements with vendors for installation and maintenance.
	Strategy GHG-TL-6: Smart Mobility and Transportation Demand Management (TDM)
GHG-TL-6.1: Increase participation in smart commute and mobility options throughout the county including bicycle sharing, ridesharing, car-sharing, mobility-as-a-service, guaranteed ride home programs, carpools, vanpools, and other emerging options.	GHG-TL-6.1.1: Promote VTA's countywide guaranteed ride home program to ease commuter anxiety and encourage transit and other sustainable transportation use. GHG-TL-6.1.2: Launch and expand a countywide web-based incentive platform that offers rewards and discounts to encourage use of alternative modes of travel other than solo driving. GHG-TL-6.1.3: Increase marketing activities for all smart commute and mobility options.
GHG-TL-6.2: Expand TDM programs and services in partnership with member agencies, employers, schools, and residential communities.	GHG-TL-6.2.1: Coordinate and collaborate with member agencies to implement TDM recommendations consistent with VTA's CDT Manual and other best practices guidance. GHG-TL-6.2.2: Coordinate and collaborate with member agencies, employers, and existing TMAs to increase options and identify opportunities for VTA to support connectivity across modes and services. Establish performance metrics and targets to measure the success of VTA's TDM strategies to decrease single-occupant vehicle commuting. GHG-TL-6.2.3: Consider forming a countywide TMA or joining existing local TMAs. VTA is actively exploring its role in countywide TDM efforts similar to other countywide transportation authorities in the region.

Notes: ABAG = Association of Bay Area Governments; CDT = Community Design and Transportation; EV = electric vehicle; GHG = greenhouse gas; HOV = high-occupancy vehicle; LUTI = Land Use and Transportation; MTC = Metropolitan Transportation Commission; PDA = priority development area; SB = Senate Bill; TDR = transfer of development rights; TMA = transportation management association; TOC = transit-oriented community; TOD = transit-oriented development; VMT = vehicle miles traveled; VTA = Santa Clara Valley Transportation Authority;

Source: Prepared by Ascent in 2023.

Buildings and Facilities

The Buildings and Facilities focus area is centered on reducing energy usage and decarbonizing the energy used in maintenance facilities, office buildings, bus stops, light rail stations, parking lots or garages, and any other buildings or facilities within VTA's internal operations portfolio. As discussed in the previous Chapter, building energy use accounts for 8 percent of VTA's GHG emissions. The strategies, measures, and actions presented in **Table 3-3** below align with or otherwise supplement the building energy consumption and GHG emissions reduction targets set in VTA's Sustainability Plan (VTA 2020b). Building energy consumption, and its associated GHG emissions, have been flagged by VTA staff as an area needing improvement, which the strategies here seek to address.

Table 3-3 Buildings and Facilities GHG Reduction Strategies, Measures, and Actions

Measure	Action
	Strategy GHG-BF-1: Clean and Renewable Energy
GHG-BF-1.1: Decarbonize existing VTA buildings by phasing out fossil fuel usage and electrifying water heating and space heating or using renewable fuels such as renewable natural gas where appropriate.	GHG-BF-1.1.1: Conduct studies and develop a comprehensive building retrofit program/plan that identifies energy efficiency measures, electrification opportunities, facility-specific decarbonization, renewable energy, and energy storage solutions. For example, converting Cerone Division from propane to electric sources of heating and replacing the natural gas radiant heaters in maintenance bays with electric heaters. GHG-BF-1.1.2: Identify funding needs and sources to fund or finance retrofits, along with potential incentives from energy utilities or other sources.
GHG-BF-1.2: Increase renewable energy, battery storage, and microgrid installations in existing VTA buildings, and/or procure 100% renewable options through local CCE providers, where applicable.	Actions from Measure GHG-BF-1.1 may also apply to this measure.
GHG-BF-1.3: Require all new VTA buildings to be 100% electric and include on-site renewable energy systems with battery storage and microgrids and achieve net-zero standards where feasible.	GHG-BF-1.3.1: Update VTA's Green Building Policy (adopted in 2018) to require 100% electric for all new construction. This may require VTA facility staff to identify specific standards or specifications per building codes, including reach codes, and/or rating systems, to achieve these outcomes. GHG-BF-1.3.2: Implement the amended policy in all new building design and construction projects moving forward, and evaluate space requirements, costs, financial incentives, and efficiencies for each potential technology used on a project-by-project basis.
GHG-BF-1.4: Increase use of electricity and alternative fuels in construction equipment on VTA projects.	GHG-BF-1.4.1: Develop and adopt specifications for electric and alternative fuel equipment that must be used in VTA construction projects. Specifications may also be identified in air quality or GHG mitigation measures that are required per CEQA documents prepared for projects in which VTA is designated as the CEQA lead agency.
	Strategy GHG-BF-2: Energy Efficiency and Reliability
GHG-BF-2.1: Upgrade outdoor lighting at VTA buildings, and at park-and-ride lots and stations to LEDs or other high-efficiency lighting.	GHG-BF-2.1.1: Conduct a study and develop a comprehensive plan that (1) identifies and prioritizes buildings and parking lots in need of more efficient replacement outdoor lighting, such as LEDs or other more efficient technologies; and (2) secure/allocate funding and labor to replace lighting.
GHG-BF-2.2: Reduce energy use in VTA buildings through conservation best practices consistent with LEED®, ENERGY STAR®, or other standards.	GHG-BF-2.2.1: Conduct a study and prioritize projects to retrofit buildings with energy-saving features such as dimmer switches or timers, replace older inefficient plug-load appliances with higher-efficiency ENERGY STAR® rated appliances, or implement conservation best practices through occupant behavioral changes (e.g., turning off lights in an empty room, unplugging appliances when not needed). Identify actions that could be taken in both LEED® and non-LEED® certified buildings. Identify and secure funding sources needed to complete retrofits.

Notes: CCE = community choice energy; CEQA = California Environmental Quality Act; GHG = greenhouse gas; LED = light-emitting diode; LEED® = Leadership in Energy and Environmental Design; VTA = Santa Clara Valley Transportation Authority.

Source: Prepared by Ascent in 2023.

Fleet and Employee Commute

The Fleet and Employee Commute focus area includes strategies, measures, and actions, presented in **Table 3-4** below, that are intended to reduce GHG emissions attributed to VTA's revenue fleet, non-revenue fleet, and employee commute. This sector accounts for 88 percent of VTA's GHG emissions, with 83 percent attributed to the revenue fleet, as discussed in the previous Chapter.

With respect to Strategy GHG-FE-1: Zero-Emission Vehicles, CARB approved the Advanced Clean Fleets regulation earlier in 2023, however VTA's operational GHG emissions forecasts and legislative adjustments were prepared prior to CARB's approval of the regulation. At the time this Draft CAAP was prepared, the regulation was still under final legal review by the Office of Administrative Law (OAL), and if approved by OAL, the regulation will take effect on January 1, 2024. The regulation would require 50 percent of medium- and heavy-duty vehicle purchases in public agency fleets to meet ZEV standards starting in 2024 and 100 percent by 2027; however alternative requirements would apply to public transit agencies that are subject to the Innovative Clean Transit regulation, and thus VTA's compliance timeframes would be 50 percent by 2027 and 100 percent by 2030. Measures FE-1.1 and FE-1.2 and any associated implementing actions would need to comply with this pending regulation.

Table 3-4 Fleet and Employee Commute GHG Reduction Strategies, Measures, and Actions

Measure	Action
	Strategy GHG-FE-1: Zero-Emission Vehicles
GHG-FE-1.1: Replace VTA diesel trucks and other non-revenue VTA vehicles to ZEVs.	GHG-FE-1.1.1: Develop and implement a ZEV replacement plan to replace non-revenue internal combustion engine vehicles with ZEVs as opportunities arise and take advantage of funding opportunities and/or rebates to minimize cost to VTA.
GHG-FE-1.2: Expand EV and electric bicycle charging infrastructure at VTA buildings to support VTA fleet EVs and employee bicycles.	GHG-FE-1.2.1: Identify existing facilities where additional EV charging stations could be installed and develop an implementation plan including securing funding and/or any agreements with vendors for installation and maintenance.
	Strategy GHG-FE-2: Zero-Emission Equipment
GHG-FE-2.1: Use cleaner fuel, such as renewable diesel, for off-road equipment and construction equipment where feasible.	GHG-FE-2.1.1: Explore and implement appropriate solutions to procure renewable diesel for use in VTA off-road equipment. GHG-FE-2.1.2: Update VTA's construction policies, specifications, and practices to require or encourage equipment that produces zero- or low-emissions where feasible.
GHG-FE-2.2: Require ZEV or LEV equipment in VTA projects.	GHG-FE-2.2.1: Update VTA's construction policies, specifications, and practices to require the use of zero-emissions or low-emissions equipment in VTA projects where feasible.
	Strategy GHG-FE-3: Operational Efficiency
GHG-FE-3.1: Maximize the operational efficiency of VTA vehicles, including reducing vehicle idling.	GHG-FE-3.1.1: Consider deploying software on VTA fleet vehicles to monitor vehicle trips, VMT, and idling via engine analytics. GHG-FE-3.1.2: Train VTA staff to operate diesel trucks, heavy-duty vehicles, and off-road equipment more efficiently and enforce current "no-idling" policies.
	Strategy GHG-FE-4: Employee Commute
GHG-FE-4.1: Monitor employee commute patterns to understand employee behaviors, needs, and overall contributions to VTA's operational GHG inventory.	GHG-FE-4.1.1: Conduct a new employee commute survey, annually or at least every five years, to understand commute patterns and quantify associated trips and VMT. Incorporate findings into future GHG inventory updates.

Measure	Action
GHG-FE-4.2: Encourage and enable VTA employees to use transit, carpool, bike, and telecommute to work to reduce single-occupancy vehicle commute trips and VMT.	GHG-FE-4.2.1: Develop and adopt an official VTA policy that supports an active workplace culture that makes it easier to walk, bike, share rides, or take transit, and provide training to ensure managers fully and consistently integrate mobility programs and policies into their departments. GHG-FE-4.2.2: In coordination with implementation of Strategy GHG-TL-6, develop and launch a comprehensive TDM program for VTA employees and/or align VTA's efforts with existing local TMAs. GHG-FE-4.2.3: Encourage and increase employee bicycle use, promote safe riding, and incentivize bicycle commuting. GHG-FE-4.2.4: Review VTA facilities to identify opportunities to increase amenities that encourage bicycling, such as bicycle parking/storage, shelters, end-of-trip facilities (e.g., repair stands, bicycle wash stations, showers, locker rooms), and electric bicycle charging infrastructure. Identify funding necessary to expand amenities as needed. GHG-FE-4.2.5: Improve support for teleworking by expanding technology and remote access to information and services consistent with VTA telework policies.

Notes: EV = electric vehicle; GHG = greenhouse gas; LEV = low-emission vehicle; TDM = transportation demand management; TMA = transportation management association; VMT = vehicle miles traveled; VTA = Santa Clara Valley Transportation Authority; ZEV = zero-emission vehicle.

Source: Prepared by Ascent in 2023.

Materials and Waste

The Materials and Waste focus area is centered on reducing GHG emissions associated with anaerobic decay of solid waste disposed in landfills. The strategy, measures, and actions, presented in **Table 3-5** below, are aligned with and supportive of VTA's goals to reduce the amount of waste generated by its operations (VTA 2020b).

Table 3-5 Materials and Waste GHG Reduction Strategies, Measures, and Actions

Measure	Action
	Strategy GHG-MW-1: Waste Management, Reduction, and Recycling
GHG-MW-1.1: Require procurement and operational practices that avoid generation of waste (e.g., reusable materials, reduced packaging, and compostable products).	GHG-MW-1.1.1: Review procurement policies and procedures; update as needed. For example, StopWaste developed a Sustainable Procurement Policy template that provides a framework and core strategies for waste reduction and avoiding waste generation that can be used by government agencies. CalRecycle also provides state guidance for Environmentally Preferable Purchasing and includes guidance on tools, resources, and a range of possible standards or guidelines to use for becoming a "Zero Waste Community." GHG-MW-1.1.2: Develop training for VTA staff on sustainable purchasing, procurement, and operations to maximize avoidance of waste generation. GHG-MW-1.1.3: Conduct periodic waste audits to measure the success of existing efforts and inform potential changes to policies or procedures, as necessary.
GHG-MW-1.2: Increase recycling and organic waste diversion at all facilities.	GHG-MW-1.2.1: Inventory facilities and identify needs for additional bins to ensure adequate recycling and food waste bins are available in all VTA buildings, including proper signage to inform and educate staff and the public on placing waste in the proper bins for waste, recycling, and food waste/compostable waste disposal. Identify potential costs and funding sources to implement, as needed.
GHG-MW-1.3: Reduce the generation of construction and demolition waste in VTA projects, and increase sustainable materials use and recovery.	GHG-MW-1.3.1: Coordinate with permitting agencies and design professionals to determine sustainable materials, construction and demolition waste diversion requirements, etc., to meet existing codes (e.g., CALGreen), and/or achieve green ratings (e.g., LEED®, Envision) consistent with VTA's Green Buildings Policy. GHG-MW-1.3.2: Update VTA specifications and Green Buildings Policy to increase the use of recycled materials and the diversion of construction and demolition waste from disposal to recycling and reuse.

Notes: CalRecycle = California Department of Resources Recycling and Recovery; LEED® = Leadership in Energy and Environmental Design; VTA = Santa Clara Valley Transportation Authority.

Source: Prepared by Ascent in 2023.

Quantifying GHG Reductions

Successful implementation of all measures presented in **Tables 3-2** through **3-5** would likely result in actual GHG emissions reductions for each measure. However, calculating estimated emissions reductions for each measure is not possible, as not every measure is quantifiable due to an array of reasons, such as lack of data or established methodologies. Noting this, seven of the selected GHG reductions measures spanning the four focus areas were determined to be quantifiable.

VTA Buses Under Solar Canopies

Methodology

The primary methods used for quantifying GHG reduction measures were based on guidance provided by the California Air Pollution Control Officers Association (CAPCOA), as well as customized methods for certain measures developed by Ascent, VTA's consultant on the CAAP. **Appendix C** provides a detailed description of all calculation methods used for each measure, along with data sources and assumptions used in the analysis.

Quantification Results

Table 3-6 summarizes the GHG reduction quantification results for the quantifiable measures selected for the CAAP. Results were calculated separately for GHG emissions reductions in VTA operations and countywide transportation emissions. In some cases, the quantified GHG reductions for specific measures are applicable to both VTA operations and countywide transportation, particularly because transportation-related sources in VTA's operations inventory (e.g., vehicle fleet or employee commute) are also reflected in the countywide transportation inventory. In other cases, the GHG reductions quantified only apply to VTA operations or countywide transportation, not both. A negative number in the table represents a reduction in emissions, and a positive number represents an increase. Only one measure, GHG-TL-3.1, would result in a shorter-term increase in emissions in VTA operations for 2030 and 2040 (gradually declining to no increase by 2045), due to transit vehicle VMT increases generated by increasing the frequency of transit services. However, the same measure would result in substantial reductions in on-road passenger vehicle VMT and associated GHG emissions in the countywide transportation sector, which would more than offset the gradually-declining increases in VTA's operations.

In summary, the implementation of all quantifiable measures selected for inclusion in the CAAP would result in annual GHG emissions reductions of approximately 3,017 $MTCO_2e$ by 2050 for VTA operations only, and 14,288 $MTCO_2e$ for countywide transportation. Many of the selected measures identified in this chapter were not quantified at the plan level because quantification is not possible without more details about the nature or scope of specific projects or programs to carry out GHG reducing activities. However, many of the measures are still considered to have at least moderate to high GHG reduction potential and thus were included in the CAAP. If project-specific details or more specific program details emerge in the future as specific implementing actions are taken by VTA or others, VTA may be able to quantify some measures and track their effectiveness in future updates to the CAAP (see **Chapter 6** for more detailed discussion on implementation).

Table 3-6 Quantified GHG Emissions Reductions for Quantifiable Measures ($MTCO_2e$)

Measure	VTA Operations 2030	VTA Operations 2040	VTA Operations 2045	VTA Operations 2050	Countywide Transportation 2030	Countywide Transportation 2040	Countywide Transportation 2045	Countywide Transportation 2050
GHG-TL-3.1: Improve reliability and convenience of existing transit services through increased frequency of service, extended service hours, and improved facilities at stops and stations, prioritizing improvements that serve disadvantaged communities.	+4,573	+381	0	0	-7,420	-12,305	-12,168	-13,240
GHG-TL-3.2: Increase transit travel speed and reliability through transit-signal priority, dedicated bus lanes, and new or expanded Rapid bus service.	-942	-6	0	0	-942	-6	0	0
GHG-BF-1.1: Decarbonize existing VTA buildings by phasing out fossil fuel usage and electrifying water heating and space heating or using renewable fuels such as renewable natural gas where appropriate.	-68	-295	-463	-675	N/A	N/A	N/A	N/A
GHG-BF-1.2: Increase renewable energy, battery storage, and microgrid installations in existing VTA buildings, and/or procure 100% renewable options through local CCE providers, where applicable.	-63	-22	0	0	N/A	N/A	N/A	N/A
GHG-FE-1.1: Replace VTA diesel trucks and other non-revenue VTA vehicles to ZEVs.	-394	-692	-859	-1,041	-394	-692	-859	-1,041
GHG-FE-4.2: Encourage and enable VTA employees to use transit, carpool, bike, and telecommute to work to reduce single-occupancy vehicle commute trips and VMT.	-32	-14	-9	-7	-32	-14	-9	-7
GHG-MW-1.2: Increase recycling and organic waste diversion at all facilities.	-570	-916	-1,101	-1,294	N/A	N/A	N/A	N/A
Total	+2,504	-1,564	-2,432	-3,017	-8,788	-13,017	-13,036	-14,288

Notes: Negative (-) values indicate a decrease in GHG emissions; positive (+) values indicate an increase in GHG emissions; CCE = community choice energy; $MTCO_2e$ = metric tons of carbon dioxide equivalent; VMT = vehicle miles traveled; VTA = Santa Clara Valley Transportation Authority.

Source: Calculated by Ascent in 2023.

Quantification Results for VTA Operations

Table 3-7 below summarizes the updated 2021 GHG inventory for countywide transportation, along with forecasted emissions in 2030, 2040, and 2050, relative to the 2009 baseline inventory, including the effect of both legislative reduction and quantifiable and applicable GHG reduction measures. VTA's Sustainability Plan established a GHG emissions reduction target of 90 percent below the 2009 baseline by 2040 for VTA operations. Without implementing the quantifiable measures described above, VTA is already projected to reduce its operational emissions by approximately 93 percent by 2040, and 95 percent by 2050. This is due largely to VTA's Zero ZEB Program, and additional legislative reductions described in **Chapter 2**. If the quantified measures identified above are implemented, however, VTA is projected to reduce its operational emissions by approximately 96 percent by 2040 and 99 percent by 2050. Both of these reduction percentages exceed the 2040 target of 90 percent reduction described in the Sustainability Plan and exceed the statewide goal of reducing GHG emissions 85 percent by 2045 under AB 1279. By focusing on GHG reductions across all sectors in VTA's operational inventory, VTA has the opportunity to achieve substantial reductions on the path to carbon neutrality.

Table 3-7 VTA Operations Emissions in 2030, 2040, and 2050 With and Without Implementation of Quantifiable Measures

Scenario	GHG Emissions ($MTCO_2e$) 2009	GHG Emissions ($MTCO_2e$) 2021	GHG Emissions ($MTCO_2e$) 2030	GHG Emissions ($MTCO_2e$) 2040	GHG Emissions ($MTCO_2e$) 2050
GHG Inventory and Legislative-Adjusted Forecast Emissions Without Implementation of Quantifiable Measures (With % Change from 2009 Levels)	69,895	39,431 (-43%)	24,396 (-65%)	4,546 (-93%)	3,629 (-95%)
Legislative-Adjusted Forecast Emissions With Implementation of Quantifiable Measures (With % Change from 2009 Levels)	N/A	N/A	26,900 (-62%)	2,982 (-96%)	613 (-99%)

Notes: % = percent; GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent.

Source: Calculated by Ascent in 2023.

Quantification Results for Countywide Transportation

Table 3-8 below summarizes forecasted emissions in 2030, 2040, and 2050, relative to the 2021 countywide transportation sector baseline inventory, including the effect of both legislative reduction and quantifiable GHG reduction measures applicable in this sector. While quantified GHG reductions in countywide transportation emissions from applicable measures may appear small in comparison with forecasted emissions with legislative reduction applied in the future, the steps VTA will take by implementing the measures in the Transportation and Land Use and Fleet and Employee Commute focus areas are still critically important to catalyze and support local action across the county. Furthermore, as noted earlier, many measures that are currently unquantifiable at the plan level will still have a measurable effect in reducing GHG emissions in the aggregate and in combination with quantified measures.

Table 3-8 Countywide Transportation Emissions in 2030, 2040, and 2050 With and Without Implementation of Quantifiable Measures

Scenario	GHG Emissions ($MTCO_2e$) 2021	GHG Emissions ($MTCO_2e$) 2030	GHG Emissions ($MTCO_2e$) 2040	GHG Emissions ($MTCO_2e$) 2050
GHG Inventory and Legislative-Adjusted Forecast Emissions Without Implementation of Quantifiable Measures (With % Change from 2021 Levels)	4,182,000	3,077,000 (-26.4%)	1,501,000 (-64.1%)	919,000 (-78%)
Legislative-Adjusted Forecast Emissions With Implementation of Quantifiable Measures (With % Change from 2021 Levels)	N/A	3,068,212 (-26.6%)	1,487,983 (-64.4%)	904,712 (-78.4%)

Notes: GHG emissions inventory and legislative-adjusted forecasts without implementation of quantifiable measures are independently rounded to the nearest thousand to account for any variability with actual emissions and to remain consistent with prior tables; GHG emissions inventory and legislative-adjusted forecasts with implementation of quantifiable measures are not rounded to account for actual GHG emissions reductions that would be achieved upon implementation of quantifiable measures, as displayed in Table 3-6; % = percent; GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent.

Source: Calculated by Ascent in 2023.

CLIMATE ACTION & ADAPTATION PLAN

4. Climate Change Vulnerability

Introduction

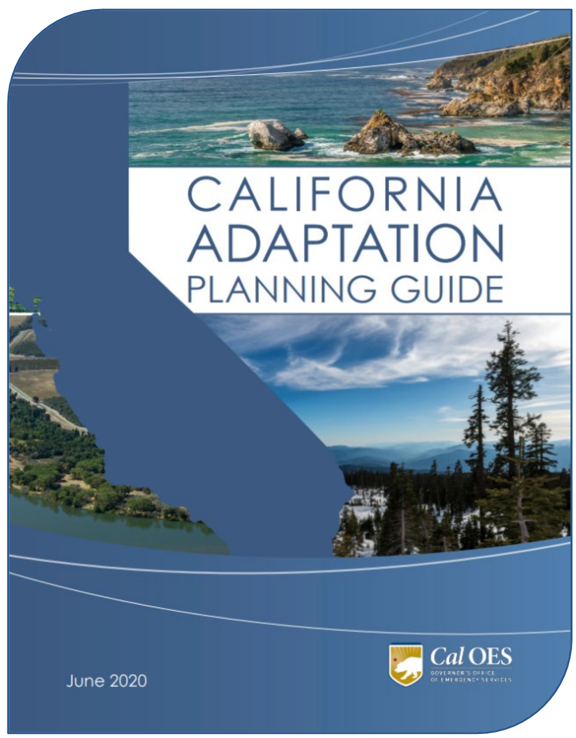
This chapter characterizes the vulnerability of VTA's physical assets and operations to climate change. First, it highlights the adaptation planning process that was followed, with emphasis on assessing vulnerability, along with brief discussions on data sources, assumptions, and classification of VTA's assets and operations. Additionally, it provides a summary of the vulnerability assessment, including projected climate trends and exposure, along with key vulnerability findings. The full vulnerability assessment and its detailed findings are included in **Appendix D**.

"With the increasing severity and frequency of drought, wildfire, extreme heat, and other impacts, Californians just have to look out their windows to know that climate change is real and rapidly getting worse. The impacts we thought we would see in the decades to come are happening now. We must act decisively to both reduce our GHG emissions and build resilience to these impacts for ourselves, future generations, and our iconic landscapes" (CARB 2022a)

Adaptation Planning Process

The *California Adaptation Planning Guide* (APG), developed by the California Governor's Office of Emergency Services (Cal OES) is the recommended guidance document to support local, regional, and tribal governments in California with climate change adaptation planning (Cal OES 2020). The climate adaptation components of this CAAP followed the process outlined in the APG as follows:

- **Phase 1, "Explore, Define, and Initiate,"** includes the initial actions needed to establish the project outcomes, scope, partners, resources, and the community engagement approach needed to complete the project. VTA completed this phase by scoping and defining the adaptation planning effort, including identifying key stakeholders, climate hazards, and important assets.
- **Phase 2, "Assess Vulnerability,"** includes an analysis of potential impacts and adaptive capacity to determine climate vulnerability (i.e., vulnerability assessment). VTA's work on this phase is described in detail below.
- **Phase 3, "Define Adaptation Framework and Strategies,"** focuses on creating an adaptation framework and developing adaptation strategies based on the results of the vulnerability assessment. The strategies that VTA developed are described in **Chapter 5**.
- **Phase 4, "Implement, Monitor, Evaluate, and Adjust,"** would take place after VTA completes this CAAP. **Chapter 6** describes VTA's implementation strategy.



California Adaptation Planning Guide

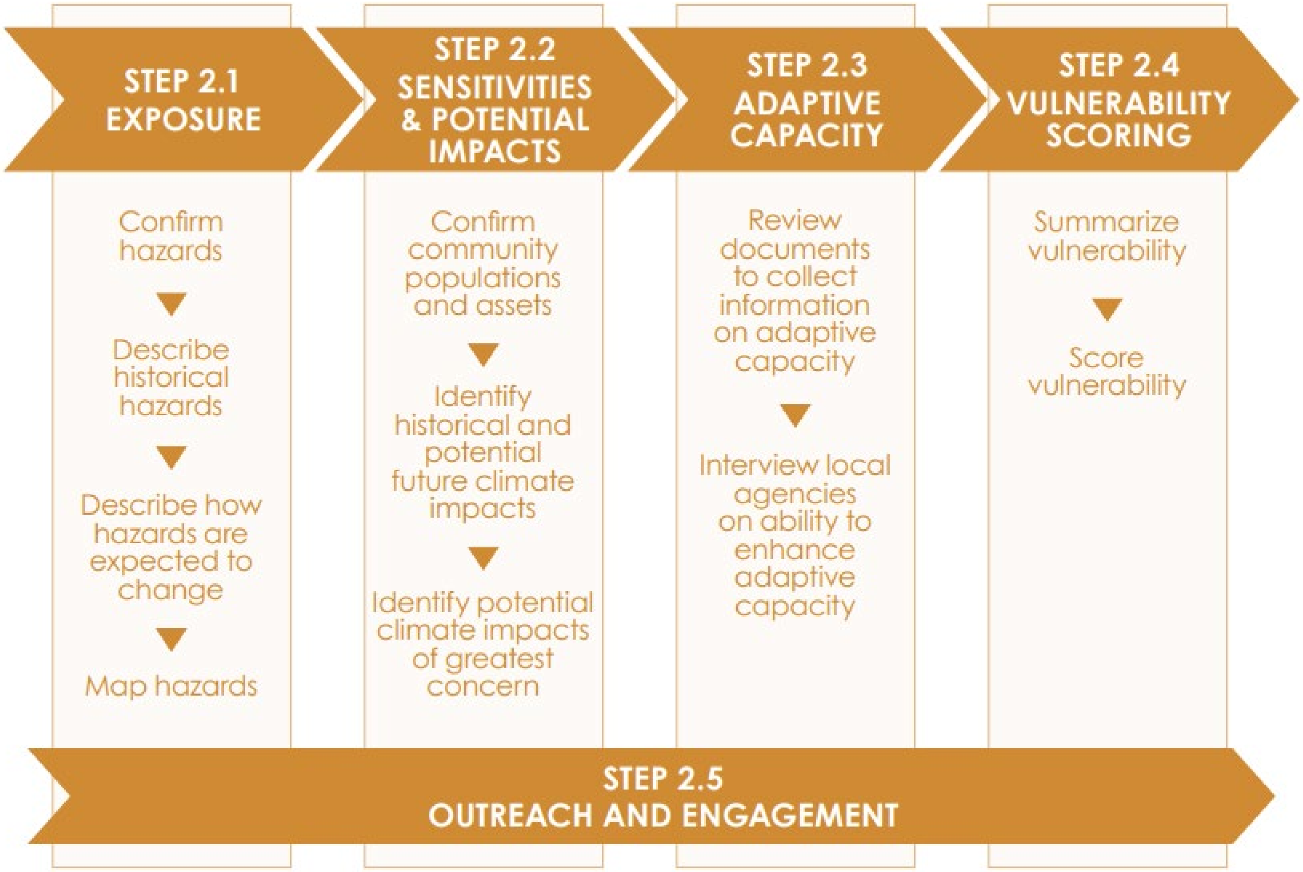
Source: Cal OES 2020.

Figure 4-1 Adaptation Planning Process

Assessing Vulnerability

Phase 2 of the adaptation planning process, as defined by the APG, includes the development of a vulnerability assessment. There are four primary components that must be determined as part of the vulnerability assessment, which are presented in further detail below and further contextualized in **Figure 4-2**.

- **Exposure**. This refers to the presence of systems in areas that are subject to climate hazards. The purpose of evaluating exposure is to narrow down which assets or populations have the potential to be affected by climate change.
- **Sensitivities and Potential Impacts**. This refers to how and the level to which a system would be affected by exposure to climate hazards. The purpose of evaluating sensitivities and potential impacts is to understand which climate hazards are of greatest concern for an asset or population.
- **Adaptive Capacity**. This refers to a system's current ability to cope with or adjust to the impacts of climate hazards. The purpose of evaluating adaptive capacity is to understand how an asset or population might be able to moderate the potential damages or take advantage of opportunities from climate change.
- **Vulnerability**. This refers to the degree to which natural, built, and human systems are susceptible to harm from exposure to stresses associated with climate change and from the absence of adaptive capacity.

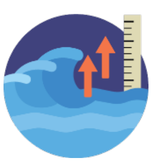


Note: The "steps" in the figure above begin with the number "2" because they are aligned with Phase 2 of the vulnerability assessment process, as outlined in the APG.

Source: Cal OES 2020.

Figure 4-2 Vulnerability Assessment Steps

All four components of the vulnerability assessment process were addressed for VTA's physical assets and operations, generally evaluating vulnerability to six specific climate hazards, including:



- Permanent Coastal Inundation

- Temporary Urban/Inland Flooding

- Temporary Coastal Flooding

- Wildfire

- Extreme Heat

- Drought

After exposure and sensitivity to these hazards was determined, VTA conducted an evaluation of potential impacts to and adaptive capacity of their physical assets and operations. Potential impact and adaptive capacity scores were assigned to each physical asset and operation and were informed by key drivers, existing conditions, and internal stakeholder input. The scores were based on a qualitative scale of Low, Medium, and High, as shown in **Tables 4-1** and **4-2** below.

Table 4-1 Potential Impact Scoring

Score	Scoring Description
Low	Minimal to no impact to asset/operation or minimal or no additional services required to maintain performance of asset/operation.
Medium	Moderate lapse of performance in asset/operation.
High	Major lapse in performance of asset/operation or cannot achieve key performance milestone.

Source: Cal OES 2020.

Table 4-2 Adaptive Capacity Scoring

Score	Scoring Description
Low	Inherent ability to adjust is insufficient to mitigate potential impacts.
Medium	Inherent ability to adjust will mitigate some potential impacts, but not all.
High	Inherent ability to adjust is sufficient to mitigate potential impacts.

Source: Cal OES 2020.

After potential impact and adaptive capacity scores were determined for VTA's assets and operations for each climate hazard, VTA then followed the APG's method of evaluating vulnerability by comparing each of those scores to assign an overall vulnerability score, as shown in **Table 4-3**. The overall scores helped VTA determine the most critical vulnerabilities for each asset and operation. Detailed scoring for all assets and operations, along with a description of data sources used and assumptions made, can be found in **Appendix D**.

Table 4-3 Vulnerability Scoring

Vulnerability Score				
Potential Impact	High	3	4	5
	Moderate	2	3	4
	Low	1	2	3
		High	Moderate	Low
		Adaptive Capacity		

Source: Cal OES 2020.

Classification of VTA Assets and Operations

The vulnerability assessment identified VTA's physical assets and operations to climate change. In general, there were four overarching classes of VTA assets and operations evaluated in the vulnerability assessment, including three physical asset classes, along with operations. The three physical asset classes are as follows: **facilities**, which include stations, station platforms, station shelters, park and ride lots, transit centers, and administration and operations buildings, among others; **bus and paratransit**, which includes bus routes, bus stops, popular paratransit destinations, and streets; and **light rail**, which includes light rail routes and supporting infrastructure. **Operations** includes broader themes of rider and workforce safety, maintenance, and service and ridership. In addition to these four overarching VTA asset classes, regional transit (i.e., BART stations, BART lines, bicycle routes, express lanes) and other sites (i.e., VTA-owned parcels, TOD) were also evaluated, though they were not the primary focus of the vulnerability assessment. They were included because the resilience of the larger transit network throughout the county is essential for VTA service.

Exposure and Vulnerability Findings

This section summarizes important analytical steps in the vulnerability assessment, including projected climate trends and exposure, along with key vulnerability findings.

Projected Climate Trends

Each of the climate hazards evaluated in the vulnerability assessment (i.e., permanent coastal inundation, temporary coastal flooding, temporary urban/inland flooding, wildfire, extreme heat, drought) are expected to pose greater risks in the future, as they are projected to increase in severity, frequency, duration, or otherwise, which equates to increased exposure. **Table 4-4** below provides a snapshot of some of the climate trends that were evaluated as part of the vulnerability assessment, which includes a description of each climate variable and related climate hazard, the climate variable's historic value, its mid-century projected value, and the difference between the historic value and mid-century projected value. The table provides a high-level snapshot but does not include all the variables included in the vulnerability assessment. Further details, methodologies, and datasets used to compile this data can be found in **Appendix D**.

Table 4-4 Projected Changes in Climate Variables for Santa Clara County

Climate Variable (and Related Climate Hazard)	Historic Value (1950-2005)	Mid-Century Projected Value (2035-2064)	Mid-Century Change from Historic
Average Annual Days of Rainfall Exceeding 99th Percentile (Flooding)	2 days	2.5 days	+23%
Average Annual Maximum 3-day Rainfall Total (Flooding)	5 inches	5.5 inches	+11%
Sea Level Rise (Flooding)	-	-	+23 inches
Average Annual Maximum Temperature (Extreme Heat)	69 °F	73 °F	+6%
Average Annual Minimum Temperature (Extreme Heat)	47 °F	51 °F	+8%
Average Annual Number of Days with Maximum Temperature Exceeding 95 °F (Extreme Heat)	2 days	7 days	+219%
Average Annual Number of Heat Waves (Extreme Heat)	0.1	0.7	+423%
Average Annual Maximum Length of Heat Waves (Extreme Heat)	0.4 days	2 days	+328%
Average Annual Area Burned (Wildfire)	21 hectares	24 hectares	+14%
Epoch Average Drought Duration (Drought)	15 months	17 months	+15%
Epoch Average Drought Frequency (Drought)	3.6 years	2.9 years	-19%

Notes: °F = degrees Fahrenheit; % = percent.

Source: Compiled by Pathways Climate Institute in 2023.

Summary of Asset Exposure

As mentioned previously, exposure is the "presence of systems in areas that are subject to climate hazards." The purpose of evaluating exposure is to narrow down which assets or populations have the potential to be affected by climate change. This section presents findings for the exposure to four of the six climate change related hazards analyzed (i.e., permanent coastal inundation, temporary coastal flooding, temporary urban/inland flooding, wildfire) for the following physical asset classes: bus and paratransit routes, light rail guideway and routes, and facilities. The two other climate change related hazards analyzed, drought and extreme heat, are not mapped as they applied uniformly over VTA's service region, and therefore, all assets are exposed to the same degree.

For both permanent coastal inundation and temporary coastal flooding, these analyses were conducted for projected exposure by mid-century (2035-2064), while findings for temporary urban/inland flooding and wildfire are based on current conditions. It should be noted that for urban/inland flooding, there was no evaluation of increased riverine flows and stormwater runoff due to a lack of available data, though there are expected increases in urban/inland flooding due to projected increases in extreme rainfall. A full repository of maps and general climate hazard exposure discussions from the vulnerability assessment can be found in **Appendix D**.

Bus and Paratransit Exposure

Figures 4-3 through **4-6** show bus routes currently operated by VTA as of July 2023, along with the average daily boardings at the stations that serve these routes. Ridership data used in the vulnerability assessment were taken from February 2020, after the implementation of the 2019 New Transit Service Plan, and prior to the COVID-19 pandemic. This data is based off the total average daily boardings at each stop for weekdays, Saturdays, and Sundays. Bus routes exposed to permanent coastal inundation are shown in **Figure 4-3**; temporary coastal flooding in **Figure 4-4**, temporary urban/inland flooding in **Figure 4-5**, and wildfire in **Figure 4-6**. VTA's ACCESS Paratransit service are shown in **Figures 4-7** through **4-10**. Paratransit service is provided to eligible individuals with disabilities and operates within the same service area and service times as VTA bus and light rail service. The paratransit service area is within ¾ mile of existing VTA bus routes and light rail stations. This door-to-door service picks up the customer at their door during a scheduled appointment time and drops them off at their preferred destination. Popular paratransit destinations exposed to permanent coastal inundation are shown in **Figure 4-7**; temporary coastal flooding in **Figure 4-8**, temporary urban/inland flooding in **Figure 4-9**, and wildfire in **Figure 4-10**.

Notes: Sea level rise data gathered from BCDC Adapting to Rising Tides Bay Area Sea Level Rise and Shoreline Analysis; this figure is based on projected exposure by mid-century (2050).

Source: Prepared by Pathways Climate Institute in 2023.

Figure 4-3 Bus Route Exposure to Permanent Coastal Inundation

Notes: Sea level rise data gathered from BCDC Adapting to Rising Tides Bay Area Sea Level Rise and Shoreline Analysis; this figure is based on projected exposure by mid-century (2050).

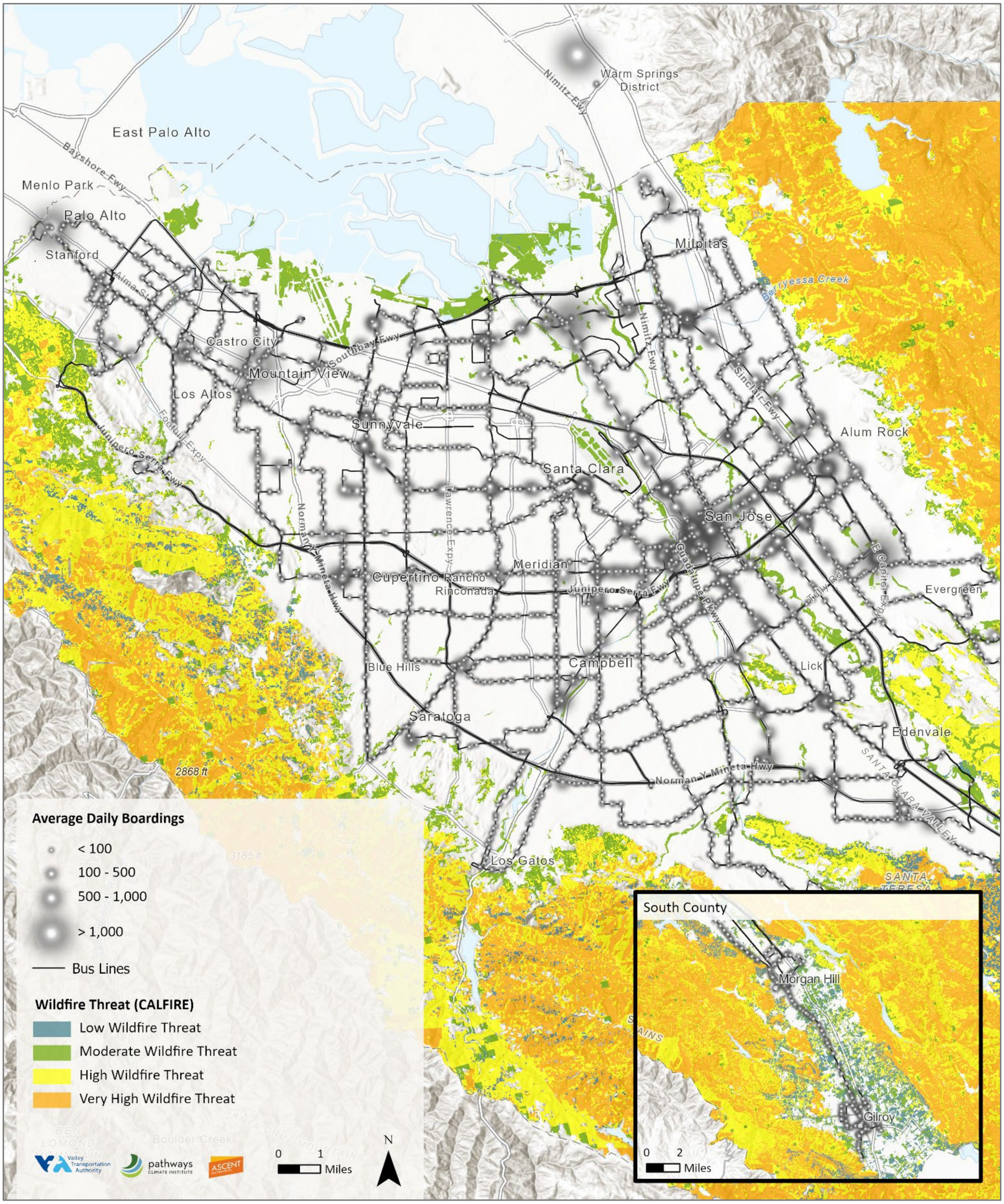
Source: Prepared by Pathways Climate Institute in 2023.

Figure 4-4 Bus Route Exposure to Temporary Coastal Flooding

Notes: Flooding data gathered from FEMA National Flood Hazard Layer; this figure is based on exposure to current conditions.

Source: Prepared by Pathways Climate Institute in 2023.

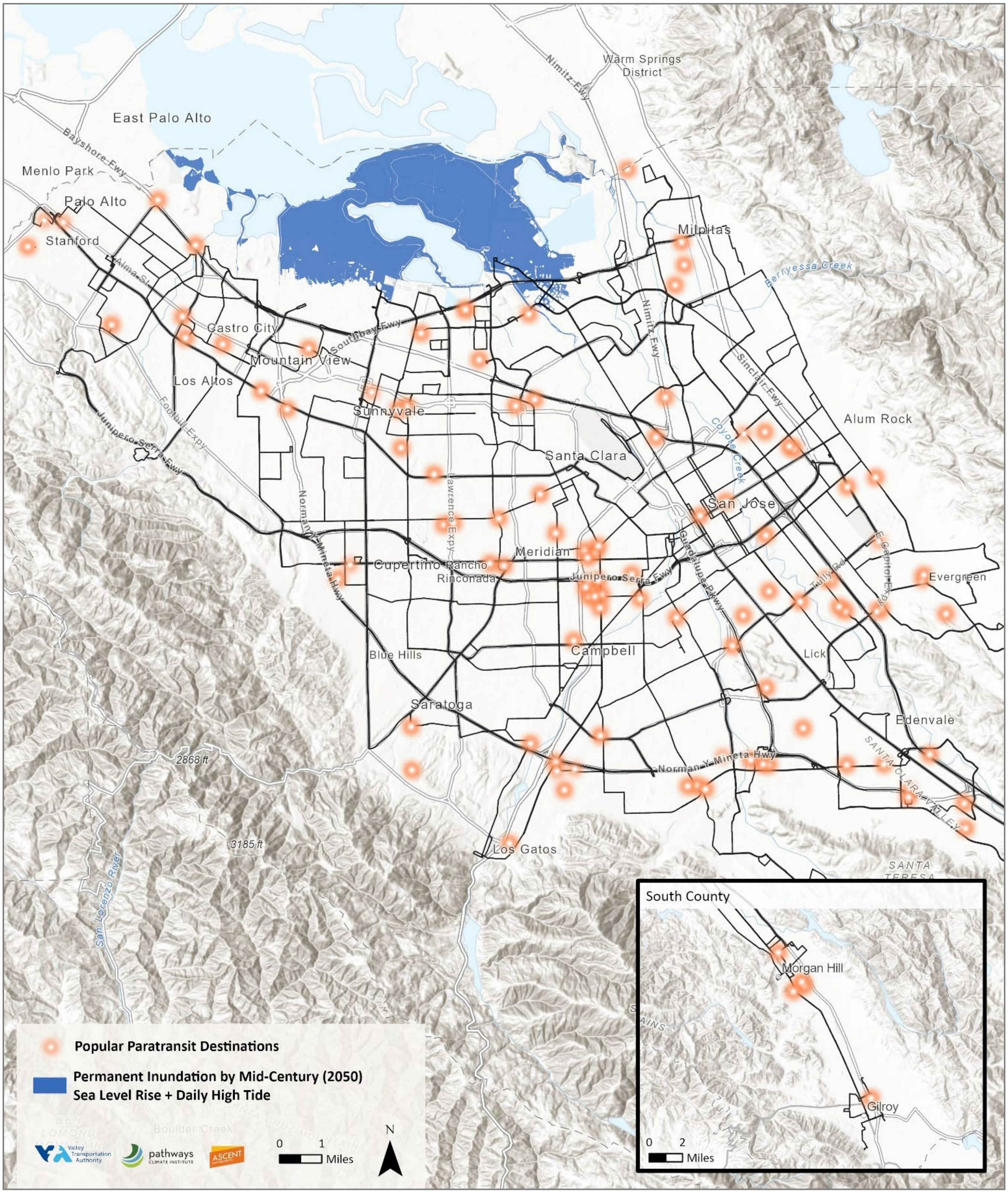
Figure 4-5 Bus Route Exposure to Temporary Urban/Inland Flooding



Notes: Wildfire threat data gathered from CAL FIRE Wildfire Threat Class; this figure is based on exposure to current conditions.

Source: Prepared by Pathways Climate Institute in 2023.

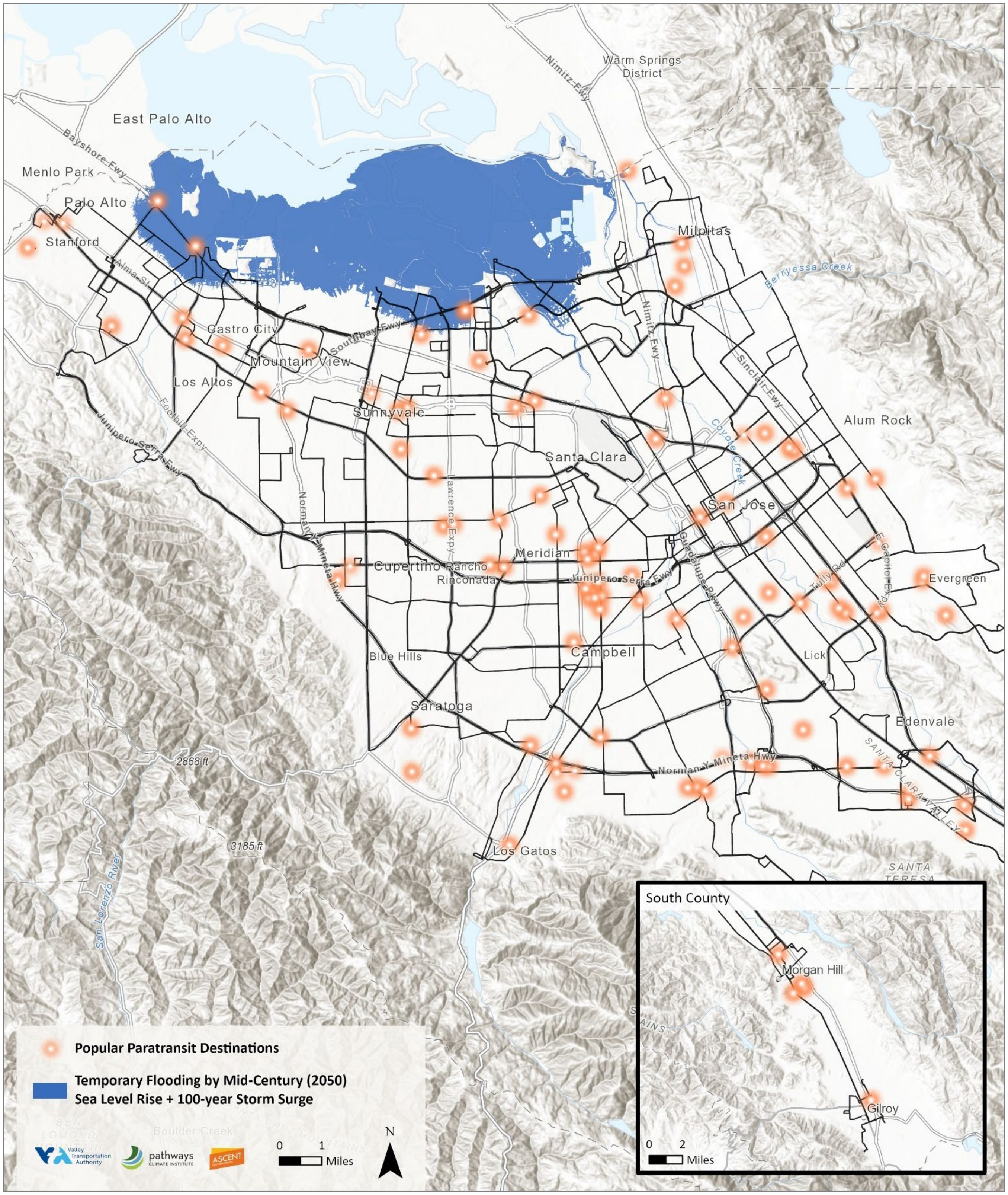
Figure 4-6 Bus Route Exposure to Wildfire



Notes: Sea level rise data gathered from BCDC Adapting to Rising Tides Bay Area Sea Level Rise and Shoreline Analysis; this figure is based on projected exposure by mid-century (2050).

Source: Prepared by Pathways Climate Institute in 2023.

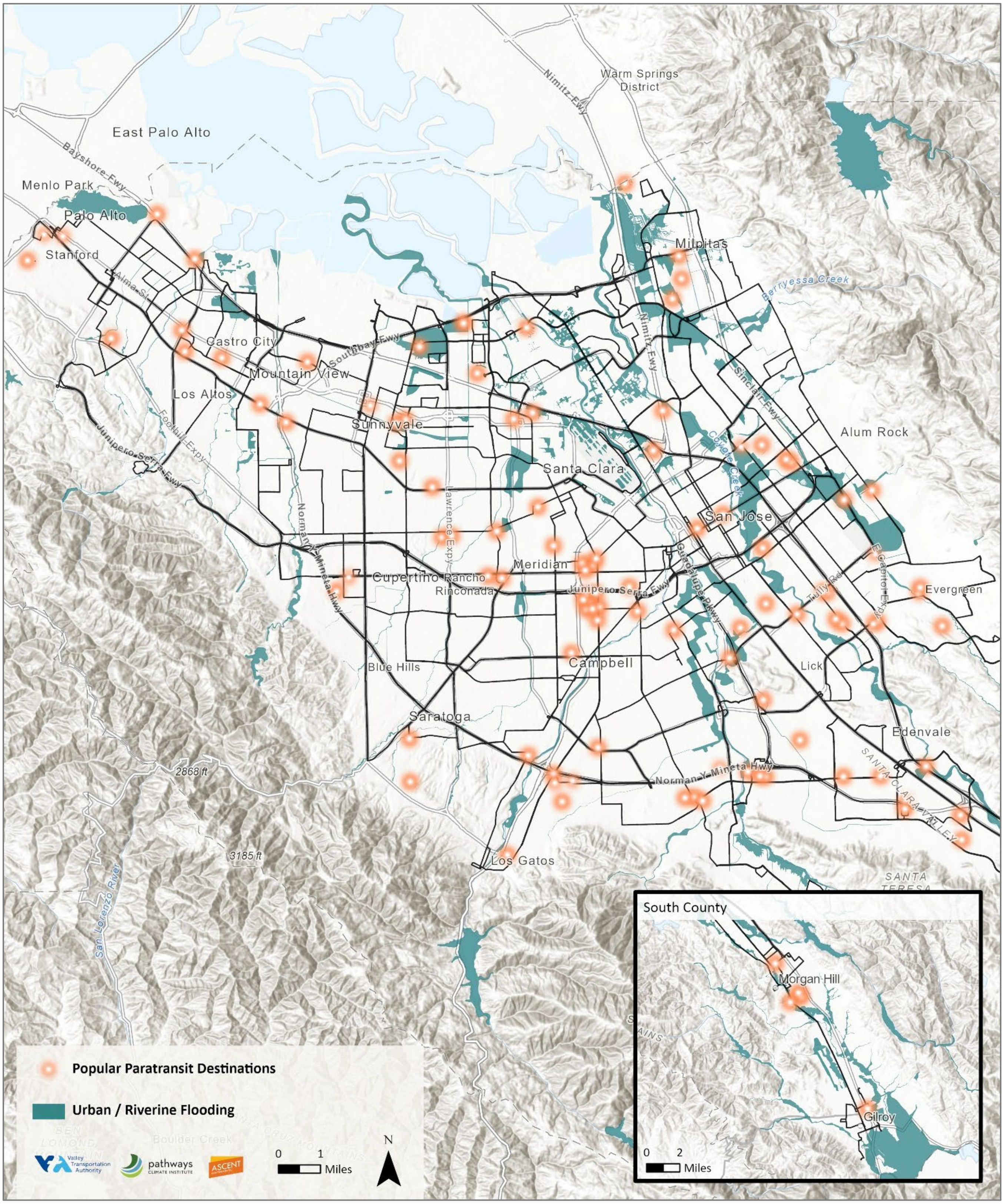
Figure 4-7 Paratransit Exposure to Permanent Coastal Inundation



Notes: Sea level rise data gathered from BCDC Adapting to Rising Tides Bay Area Sea Level Rise and Shoreline Analysis; this figure is based on projected exposure by mid-century (2050).

Source: Prepared by Pathways Climate Institute in 2023.

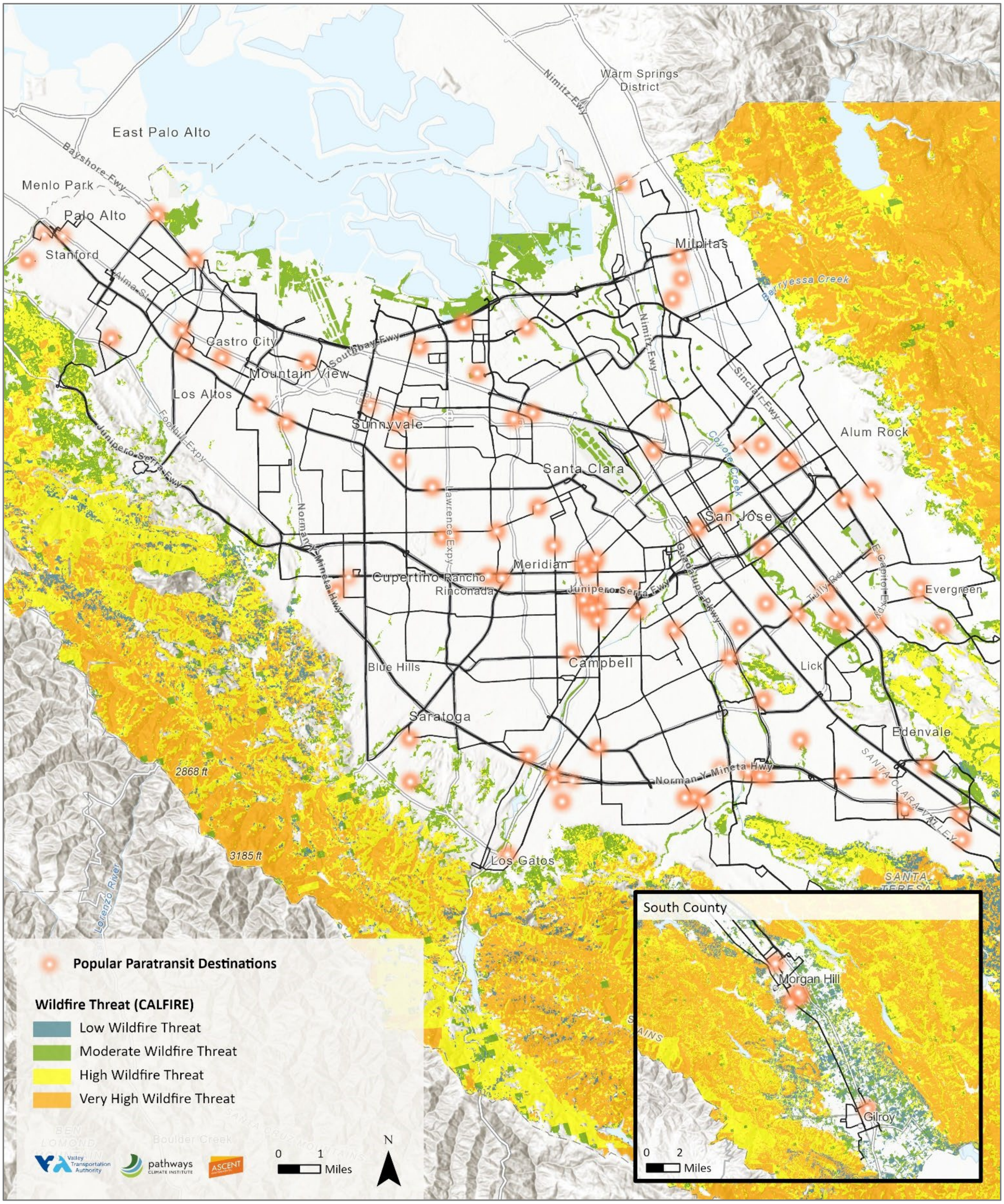
Figure 4-8 Paratransit Exposure to Temporary Coastal Flooding



Notes: Flooding data gathered from FEMA National Flood Hazard Layer; this figure is based on exposure to current conditions.

Source: Prepared by Pathways Climate Institute in 2023.

Figure 4-9 Paratransit Exposure to Temporary Urban/Inland Flooding



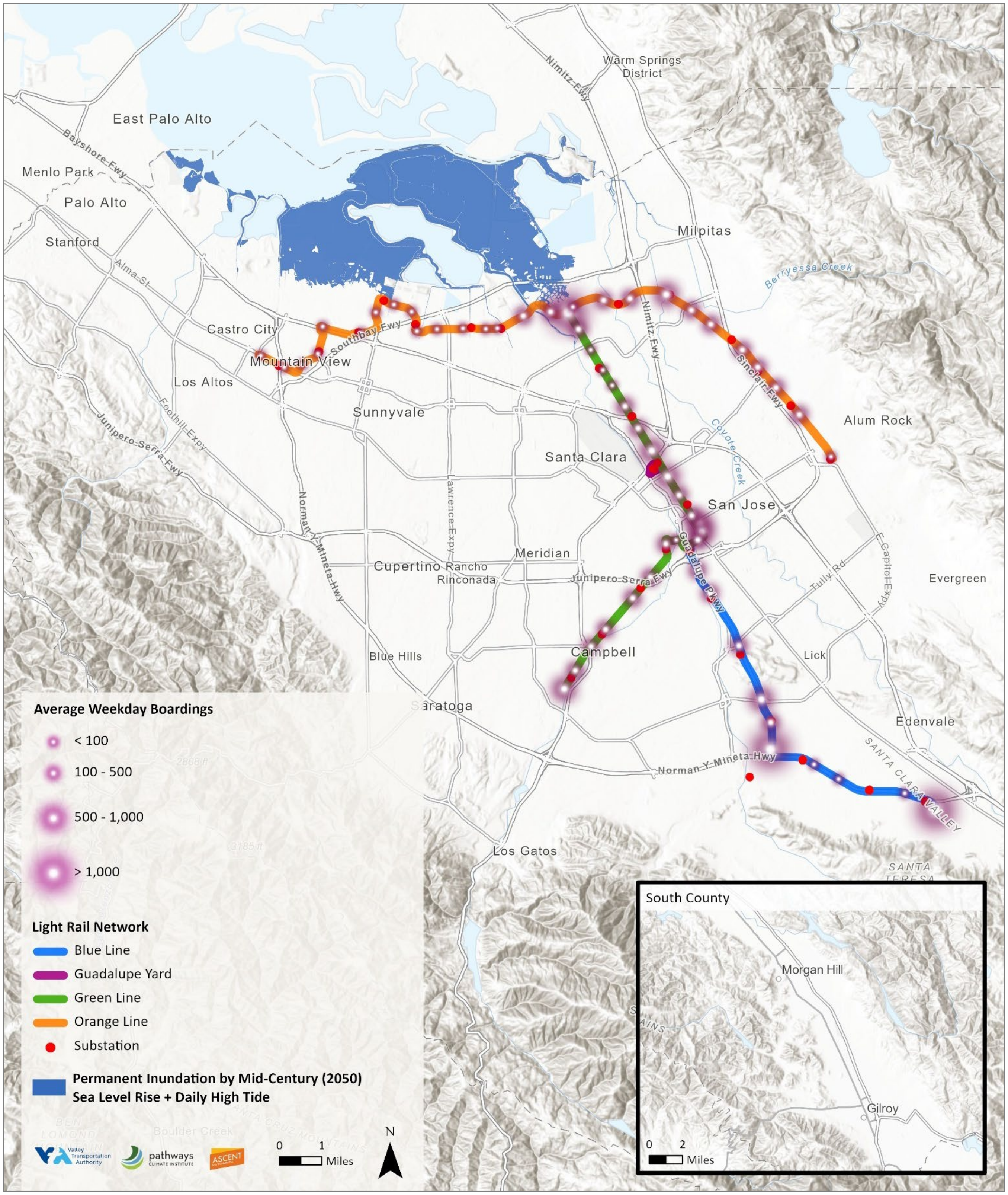
Notes: Wildfire threat data gathered from CAL FIRE Wildfire Threat Class; this figure is based on exposure to current conditions.

Source: Prepared by Pathways Climate Institute in 2023.

Figure 4-10 Paratransit Exposure to Wildfire

Light Rail Exposure

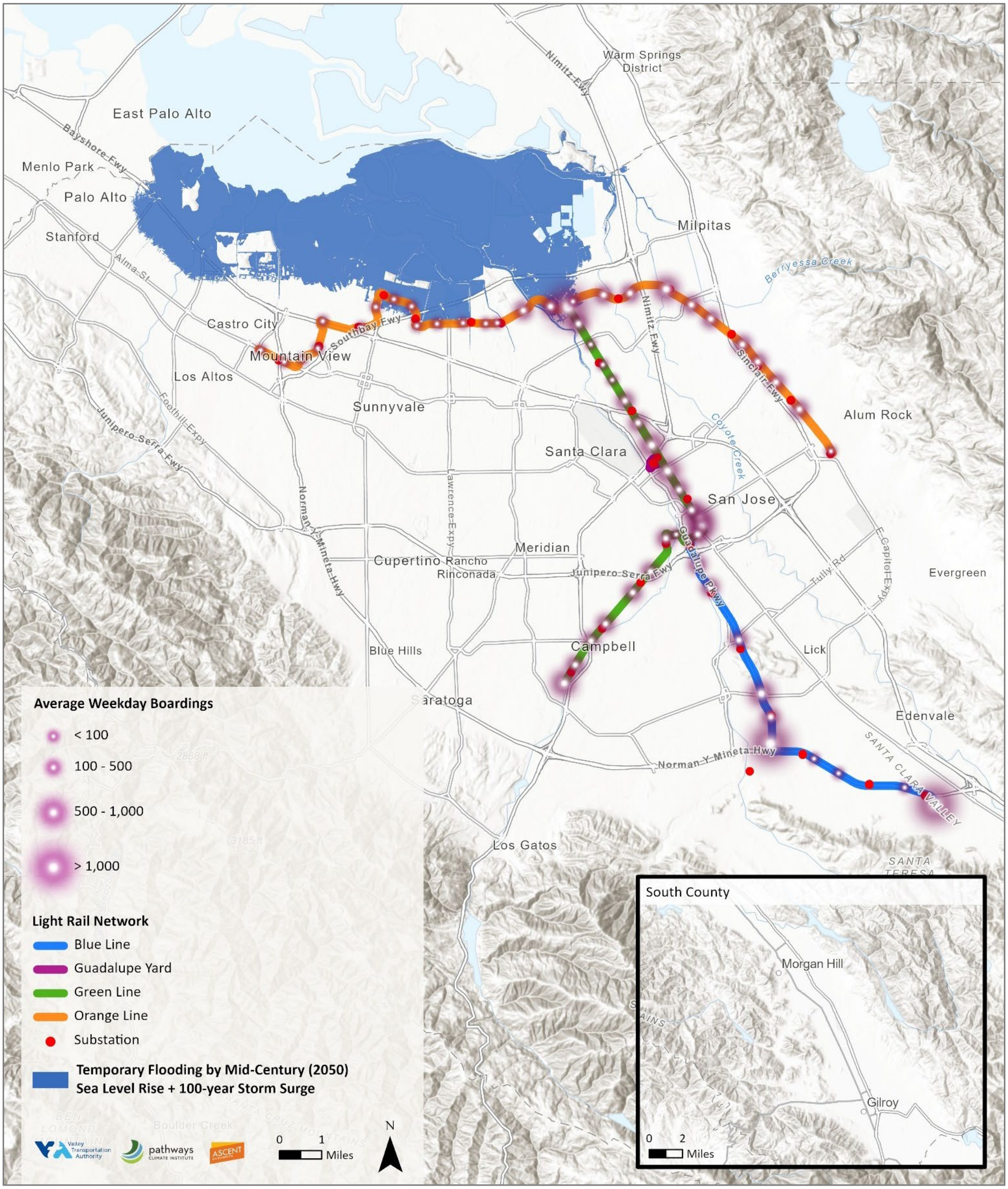
Figures 4-11 through **4-14** show the light rail system, substations, the Guadalupe Light Rail Yard, and the average weekday boardings associated with stations along each line, which includes the Green Line, Orange Line, and Blue Line. Ridership data used in the vulnerability assessment were taken from February 2020, after the implementation of the 2019 New Transit Service Plan, and prior to the COVID-19 pandemic. These data are based off the total average daily boardings at each stop for weekdays, Saturdays, and Sundays. Exposure of the light rail system to permanent coastal inundation is shown in **Figure 4-11**; temporary coastal flooding in **Figure 4-12**, temporary urban/inland flooding in **Figure 4-13**, and wildfire in **Figure 4-14**.



Notes: Sea level rise data gathered from BCDC Adapting to Rising Tides Bay Area Sea Level Rise and Shoreline Analysis; this figure is based on projected exposure by mid-century (2050).

Source: Prepared by Pathways Climate Institute in 2023.

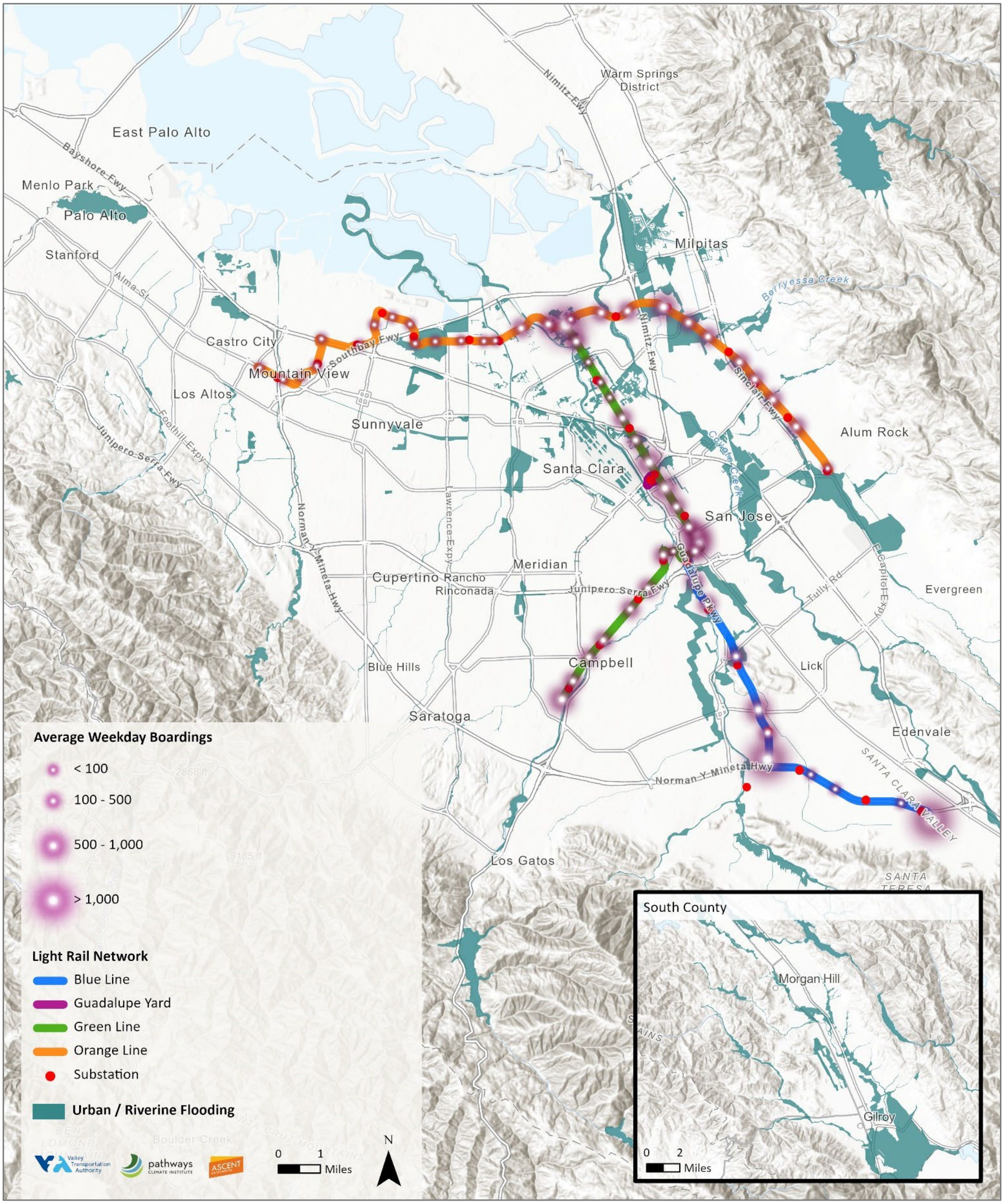
Figure 4-11 Light Rail Exposure to Permanent Coastal Inundation



Notes: Sea level rise data gathered from BCDC Adapting to Rising Tides Bay Area Sea Level Rise and Shoreline Analysis; this figure is based on projected exposure by mid-century (2050).

Source: Prepared by Pathways Climate Institute in 2023.

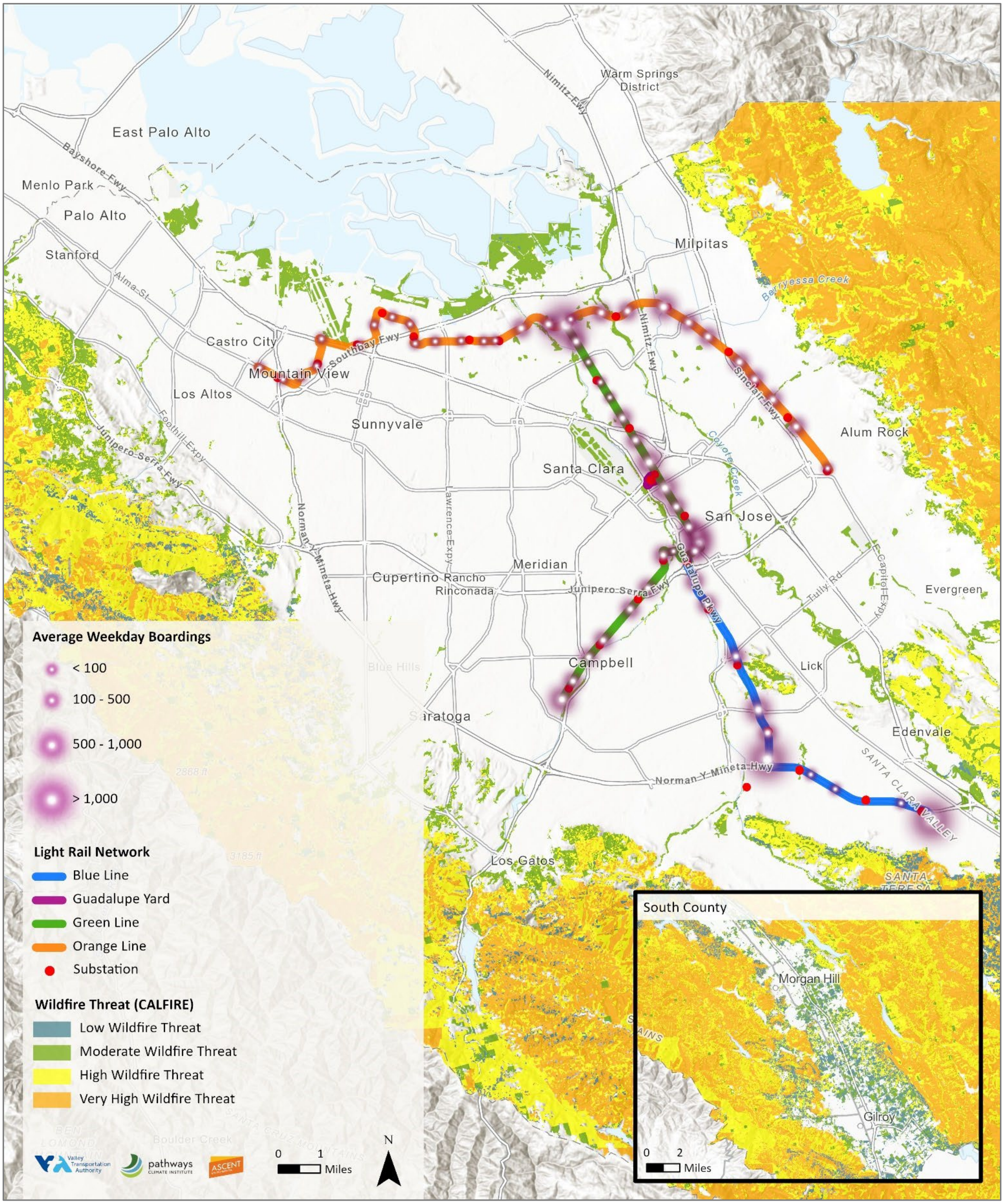
Figure 4-12 Light Rail Exposure to Temporary Coastal Flooding



Notes: Flooding data gathered from FEMA National Flood Hazard Layer; this figure is based on exposure to current conditions.

Source: Prepared by Pathways Climate Institute in 2023.

Figure 4-13 Light Rail Exposure to Temporary Urban/Inland Flooding



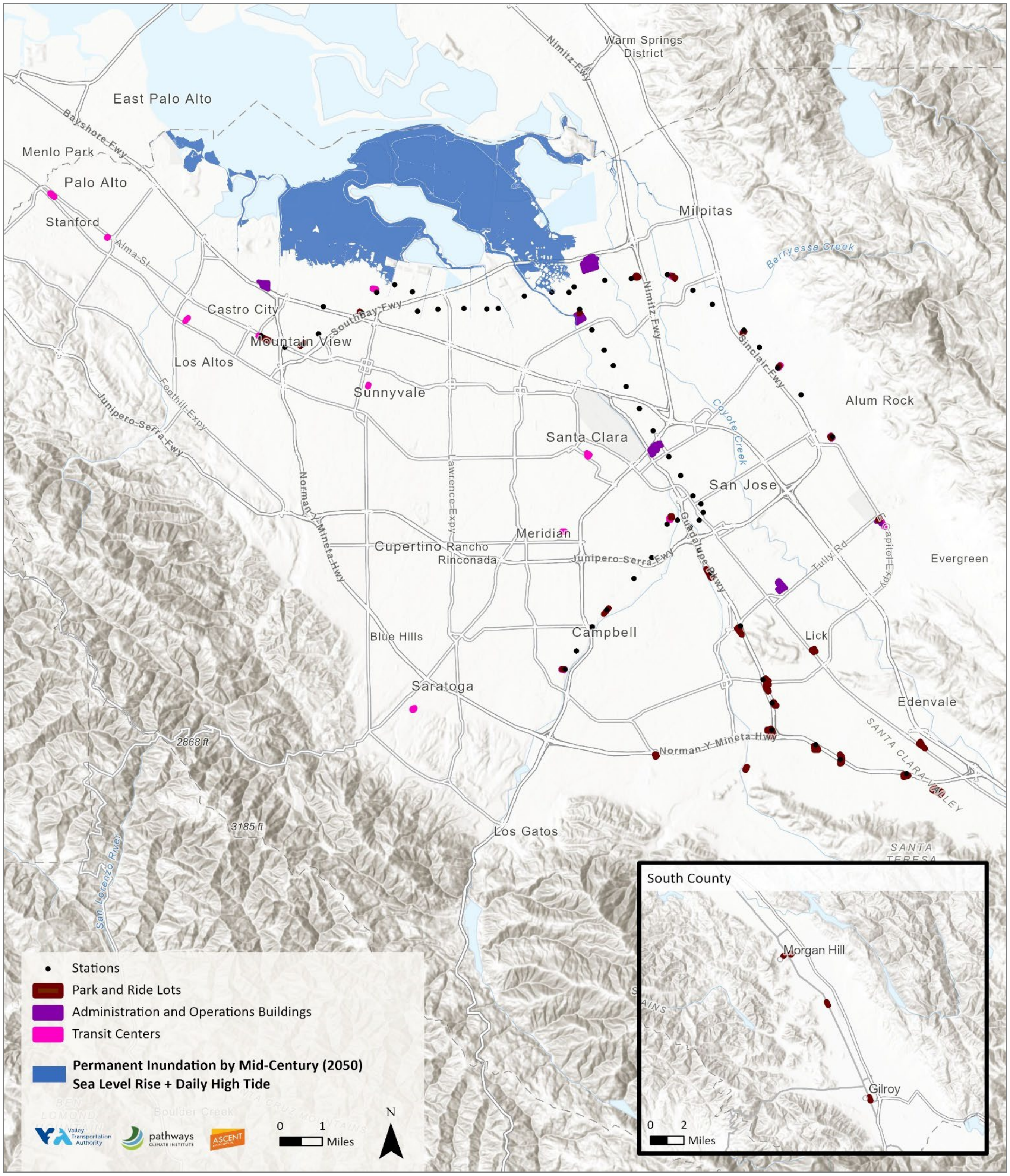
Notes: Wildfire threat data gathered from CAL FIRE Wildfire Threat Class; this figure is based on exposure to current conditions.

Source: Prepared by Pathways Climate Institute in 2023.

Figure 4-14 Light Rail Exposure to Wildfire

Facilities Exposure

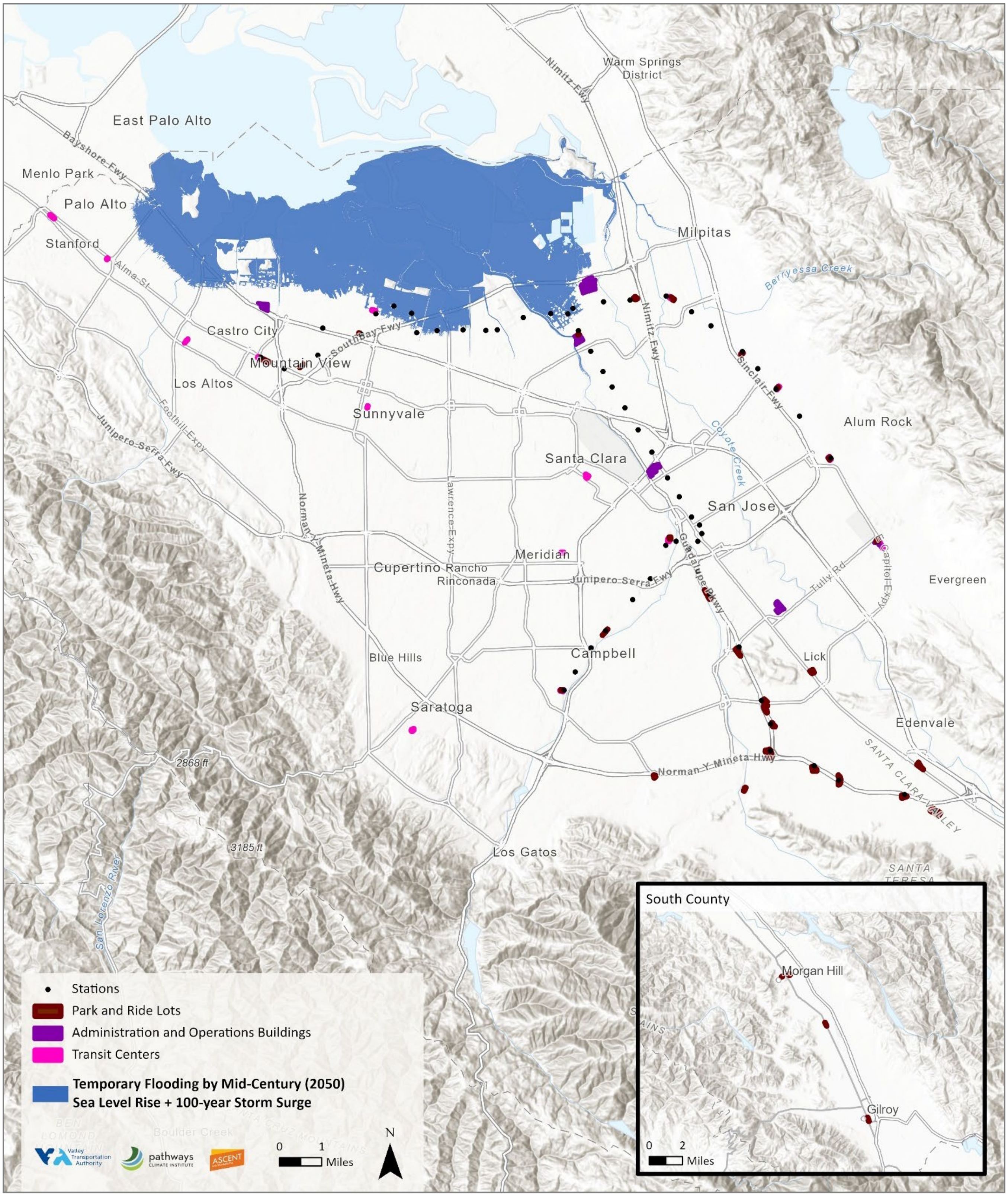
Figures 4-15 through **4-18** show facilities owned and maintained by VTA, including stations, park and ride lots, administration and operations buildings, and transit centers. Exposure of these facilities to permanent coastal inundation is shown in **Figure 4-15**; temporary coastal flooding in **Figure 4-16**; temporary urban/inland flooding in **Figure 4-17**; and wildfire in **Figure 4-18**.



Notes: Sea level rise data gathered from BCDC Adapting to Rising Tides Bay Area Sea Level Rise and Shoreline Analysis; this figure is based on projected exposure by mid-century (2050).

Source: Prepared by Pathways Climate Institute in 2023.

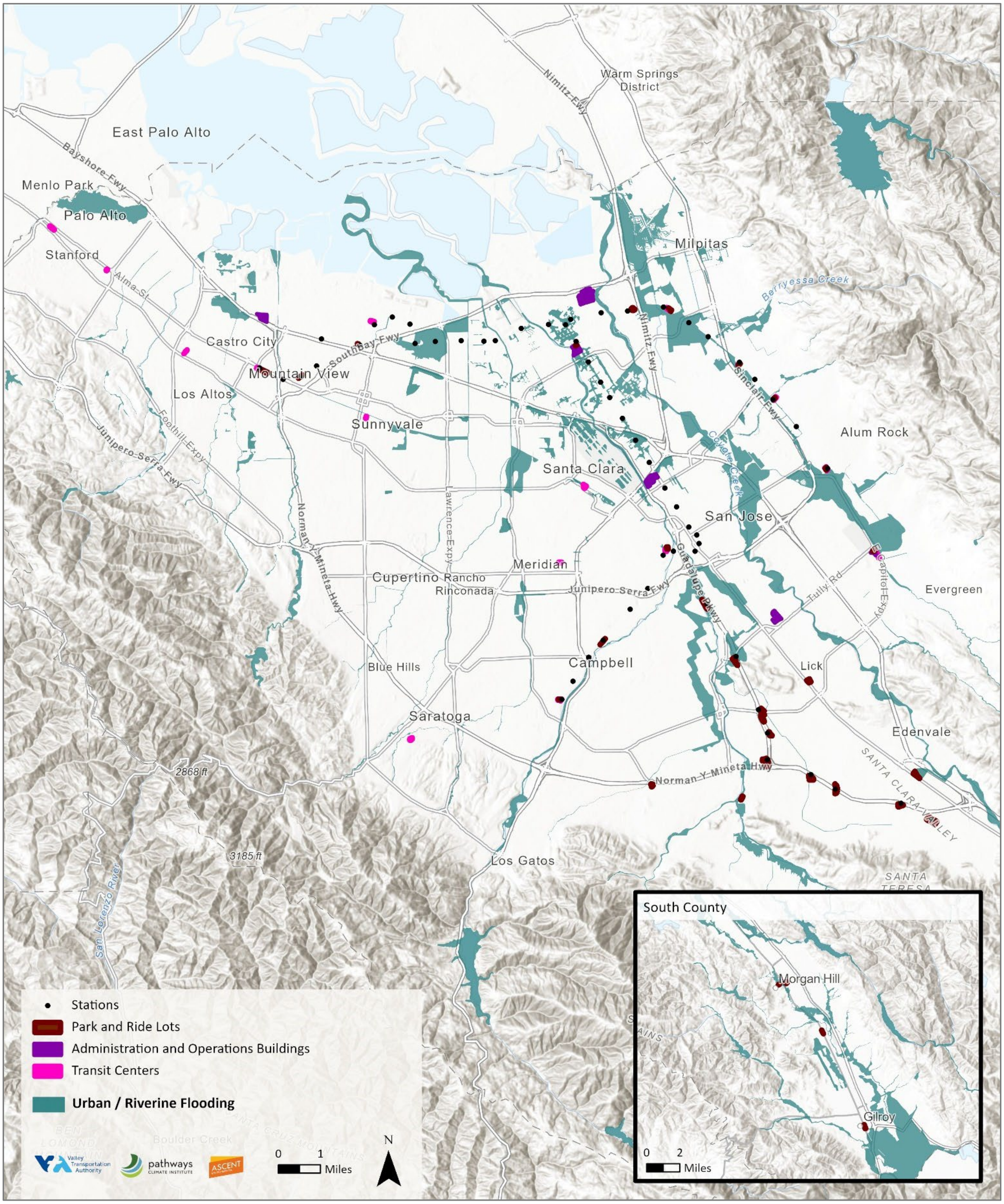
Figure 4-15 Facilities Exposure to Permanent Coastal Inundation



Notes: Sea level rise data gathered from BCDC Adapting to Rising Tides Bay Area Sea Level Rise and Shoreline Analysis; this figure is based on projected exposure by mid-century (2050).

Source: Prepared by Pathways Climate Institute in 2023.

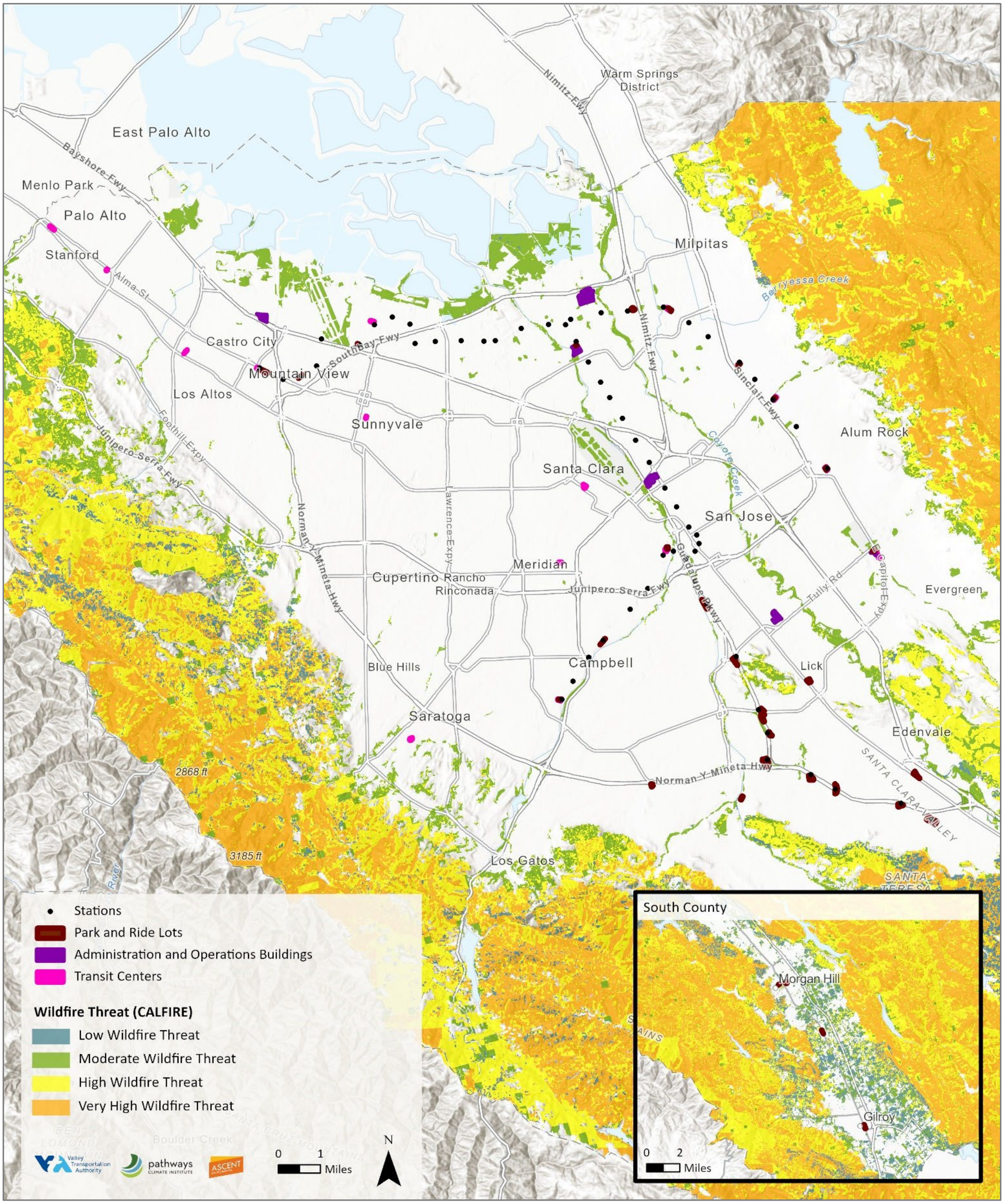
Figure 4-16 Facilities Exposure to Temporary Coastal Flooding



Notes: Flooding data gathered from FEMA National Flood Hazard Layer; this figure is based on exposure to current conditions.

Source: Prepared by Pathways Climate Institute in 2023.

Figure 4-17 Facilities Exposure to Temporary Urban/Inland Flooding



Notes: Wildfire threat data gathered from CAL FIRE Wildfire Threat Class; this figure is based on exposure to current conditions.

Source: Prepared by Pathways Climate Institute in 2023.

Figure 4-18 Facilities Exposure to Wildfire

Key Vulnerability Findings

As noted previously, upon determining the potential impacts and adaptive capacity of each set of assets across the four overarching asset classes (i.e., facilities, light rail, bus and paratransit, operations), vulnerability scores of Low, Medium, or High were assigned to each set of assets, along with a set of related consequence statements. These were prepared as “asset vulnerability profiles,” which can be found in their entirety in **Appendix D**. Some of the key findings from the vulnerability profiles are included below.

Vulnerability Profile – Facilities

Some of the key consequences of climate hazards for VTA’s facilities include physical facility damage, access issues, and electrical impacts. Regarding facility damage, climate hazards may degrade the physical condition of facilities, such as through frequent or permanent flooding. Underground utilities are extremely sensitive to floodwaters, and there is increased potential for contamination from maintenance areas with flood exposure. Additionally, there may be reduced lifespan of equipment, such as HVAC systems from extreme heat, increased costs associated with extreme heat-related damages, and necessary repair for some facilities may take a considerable amount of time. Regarding access issues, climate hazards, such as floods and wildfires, may block access to all facility types, adversely affecting staff and riders and causing riders to rely on private vehicles instead of VTA services. Climate hazards may also delay maintenance or construction-related activities at facilities, such as installing charging stations at the Cerone Bus Division. Regarding electrical impacts, extreme heat and flooding can adversely affect IT and communication systems, degrade electrical assets, and cause electrical equipment to malfunction, leading to system-wide impacts. Some facilities and facility types are listed below with their most pressing climate hazard vulnerabilities:

- **Cerone Bus Division (3990 Zanker Rd, San Jose, CA 95134)** is vulnerable to temporary coastal flooding, temporary urban/inland flooding, and wildfire. The facility has underground and low-lying electrical equipment that are vulnerable to flooding. Both portions of the Cerone Bus Division are vulnerable to temporary coastal and temporary urban/inland flooding and only the Maintenance and Operations portion of the Yard is exposed to wildfire.
- **River Oaks Administrative Campus (3331 N 1st St, San Jose, CA 95134)** is vulnerable to temporary coastal flooding, temporary urban/inland flooding, and wildfire. River Oaks contains IT equipment, which is sensitive to extreme heat, wildfire, or flooding, and damage to the equipment could have widespread consequences to VTA operations.
- **Guadalupe Light Rail Division (101 W Younger Ave, San Jose, CA 95110)** is vulnerable to temporary urban/inland flooding. The Guadalupe Light Rail Division is VTA’s only rail yard providing comprehensive services (e.g., storage, parts, maintenance) for light rail. VTA’s core communications system and dispatching center is also located at this facility. Any disruption to the accessibility of this yard would effectively hinder light rail service as well as communication support for VTA’s Bus service.
- **Stations** have a high vulnerability to flooding, wildfire, and extreme heat. Of all the facility assets, stations have the highest vulnerability to permanent coastal inundation and temporary coastal flooding, with nine stations highly vulnerable to both flood hazards (i.e., Baypointe, Borregas, Champion, Crossman, Fair Oaks, Lockheed Martin, Reamwood, Tasman, and Vienna) and one additional station (i.e., River Oaks) highly vulnerable to only temporary coastal flooding. Over half of the stations have moderate or high vulnerability to urban/inland flooding. Three stations are vulnerable to wildfire (i.e., Bascom, Children’s Discovery Museum, San Fernando). These stations are located in highly urbanized areas where wildfire risk may typically be considered low given the built environment that surrounds them compared to

facilities located in less urban areas. However, these findings are based on "Fire Threat" classification data from CAL FIRE, which shows a moderate degree of fire threat in these areas.[2] Extreme heat events can affect station equipment and systems, causing disruptions to all stations.

- **Transit Centers** – Lockheed Martin Transit Center is the only transit center vulnerable to permanent coastal inundation and temporary coastal flooding, and nine transit centers are vulnerable to temporary urban/inland flooding, with Great Mall Main Transit Center, Hostetter Transit Center, Morgan Hill Transit Center, Penitencia Creek Transit Center, Santa Clara Transit Center, Sunnyvale Transit and Tamien Transit Center having a high vulnerability score.
- **Park and Ride Lots** are highly vulnerable to extreme heat and moderately vulnerable to temporary flooding—River Oaks lot is vulnerable to temporary coastal flooding, and about one-third of lots are vulnerable to temporary urban/inland flooding.

Baypointe Station

Vulnerability Profile – Light Rail

Some of the key consequences of climate hazards for light rail include system damage, loss of power, and reliance on bus service. Regarding system damage, extreme heat is already a major issue for the light rail system, particularly affecting specific components like the overhead catenary system (OCS), brakes, and tracks. OCS sagging, overheating brake systems, and heat-related track kinks can lead to significant and costly damage, resulting in service disruptions until necessary repairs are completed. Regarding loss of power, the light rail system is critically reliant on electricity from external power sources, so power outages during flood, wildfire, and extreme heat events will have significant impacts on service, as they have shown in the past. Regarding reliance on bus service, light rail service disruptions during and after climate hazard events will increase reliance on bus bridges and bus service. However, bus service cannot replace all routes, would require substantial operator resources, and would degrade regular bus service. In these situations, riders may opt for using private vehicles to travel, thereby increasing GHG emissions. Listed below are the most pressing climate hazard vulnerabilities to the light rail system (and **Figure 4-19** displays the light rail system track chart):

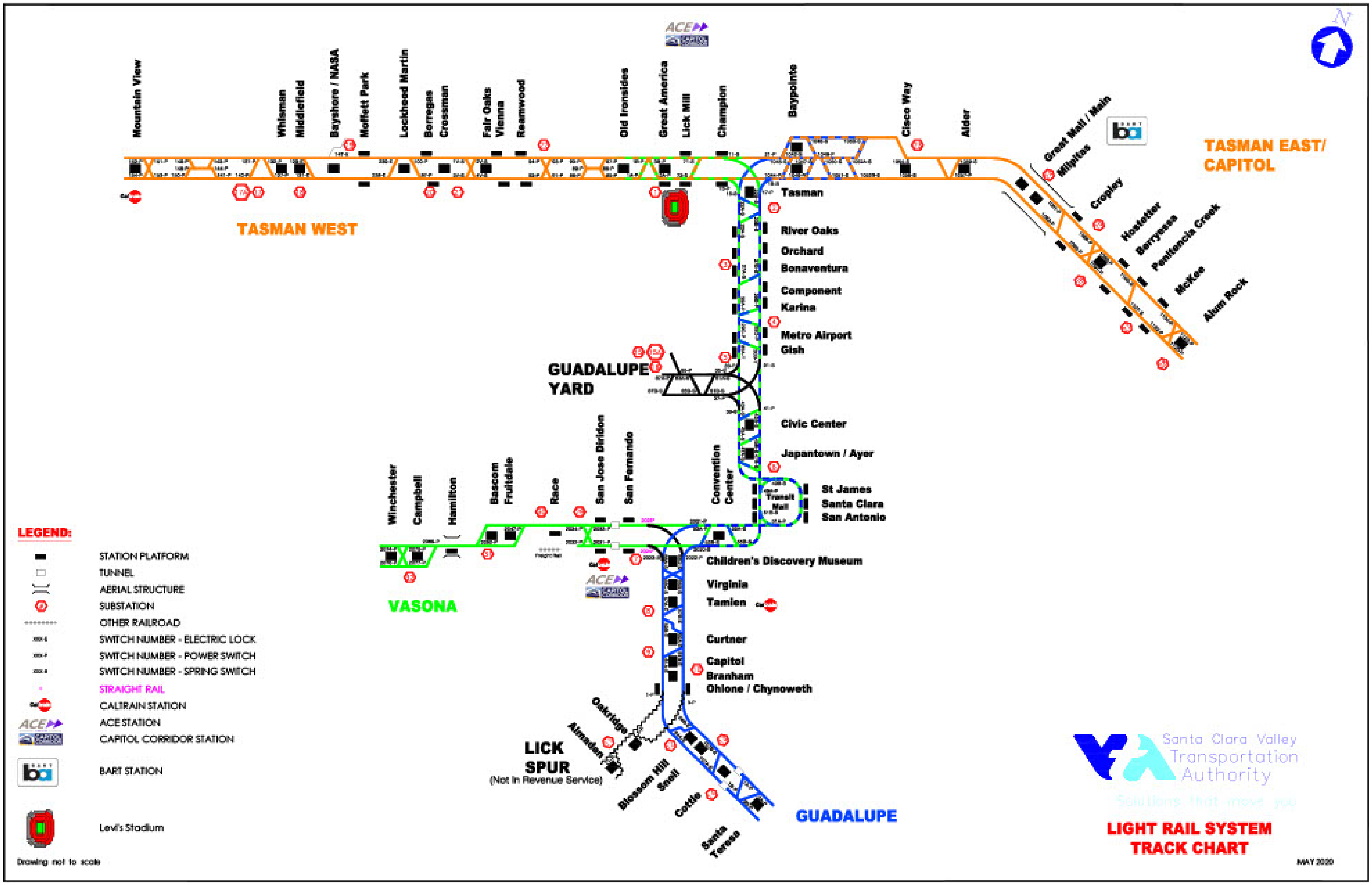
- **Light Rail Route, Green Line** – 5 percent (1,900 feet) of the Guadalupe North track is highly vulnerable to permanent coastal inundation by end of the century, and 3 percent (830 feet) of the Vasona track is highly vulnerable to current wildfire. 3 percent (900 feet) of the Guadalupe North track is moderately vulnerable to temporary coastal flooding by mid-century. 41 percent (2.73 miles) of the Green line on Guadalupe North is at risk from temporary urban/inland flooding by the end of the century.

[2] Fire threat provides a measure of fuel conditions and fire potential in the ecosystem, representing the relative likelihood of "damaging" or difficult to control wildfire occurring for a given area. Fire Threat is not a risk assessment by itself but can be used to assess the potential for impacts on various assets and values susceptible to fire. Fire threat is a combination of two factors: 1) fire probability, or the likelihood of a given area burning, and 2) potential fire behavior (hazard). These two factors are combined to create threat classes ranging from low to extreme.

- **Light Rail Route, Orange Line** – 4 percent (3,910 feet) of the Orange Line on Tasman West is highly vulnerable to permanent coastal inundation by mid-century and 20 percent (3.44 miles) is highly vulnerable to temporary coastal flooding by mid-century. 4 percent (0.75 miles) of the Orange line on Tasman East and West is moderately vulnerable to temporary urban/inland flooding.
- **Light Rail Route, Blue Line** – 0.7 percent (355 feet) of the Blue Line is highly vulnerable to wildfire and moderately vulnerable to temporary urban/inland flooding. 19 percent (1.86 miles) of the Blue line on Guadalupe South is at risk from temporary urban/inland flooding by the end of the century.
- **Substations** #2 (near Tasman Station), #20 (near Lockheed Martin Station), and #21 (Crossman Station) are vulnerable to permanent coastal inundation and temporary coastal flooding with an additional ten substations vulnerable to temporary urban/inland flooding. Additionally, substations are already experiencing impacts from extreme heat, so an increase in extreme heat days as a result of climate change could lead to overheating of equipment and power outages, which could cause significant disruption throughout VTA's service area.
- **Grade Crossings**, intersections at which a roadway crosses a railroad at-grade, are highly vulnerable to permanent coastal inundation (51 total), temporary coastal flooding (31 total), and wildfire (1 total). There are 70 grade crossings moderately vulnerable to temporary urban/inland flooding.
- **Frogs**, or components of track placed where one rail crosses another, are highly vulnerable to permanent coastal inundation (41 total) and temporary coastal flooding (22 total). There are 59 frogs moderately vulnerable to temporary urban/inland flooding.
- **Turnouts**, which enable trains to move from one track to another, are highly vulnerable to permanent coastal inundation (25 total) and temporary coastal flooding (13 total). There are 36 turnouts moderately vulnerable to temporary urban/inland flooding.

Tasman Grade Crossing

- **Utility Poles** that support overhead power lines are moderately vulnerable to temporary urban/inland flooding (2 total).
- **Traction Poles** that bring electricity to light rail trains are highly vulnerable to permanent coastal inundation (270 total), temporary coastal flooding (145 total), and wildfire (10 total). There are 409 traction poles moderately vulnerable to temporary urban/inland flooding.



Source: Developed by VTA

Figure 4-19 Light Rail System Track Chart

Vulnerability Profile – Bus and Paratransit

Riders at Berryessa Transit Center

Some of the key consequences of climate hazards for light rail include climate whiplash, electrical impacts, increased strain, and disproportionate effects on riders with access and functional needs. Regarding climate whiplash, oscillation between extreme heat to colder temperatures, droughts to flooding events, as well as general climate hazard exposure may degrade vehicles and equipment for bus and paratransit operations. Regarding electrical impacts, bus and paratransit operations are highly reliant on external electricity sources for charging the electric fleet and for traffic signals, so any power outages during flooding, wildfire, or extreme heat events will have significant impacts on service and have already proven to impact service in the past. Regarding increased strain, if the light rail system halts service during a climate hazard event, it can lead to strain on bus operations due to additional bus bridges. Additionally, cooling systems in buses can be difficult to maintain during extreme heat events. Lastly, climate hazards may have greater impacts for riders who depend on VTA ACCESS paratransit services. Listed below are the most pressing climate hazard vulnerabilities to bus and paratransit:

- **Bus Routes** – 100 percent of lines 44, 85, 89, 288, 288L, and 288M have potential exposure to temporary urban/inland flooding. Over 50 percent of lines 20, 21, 22, 40, 47, 51, 52, 53, 55, 59, 84, 87, 104, 287, 288, 288L, 288M, 522, ACE Purple, ACE Brown, and ACE Violet have potential exposure to temporary urban/inland flooding.
- **Bus Stops** are highly vulnerable to permanent coastal inundation (88 total), temporary coastal flooding (70 total), and wildfire (27 total). A total of 252 bus stops are moderately vulnerable to temporary urban/inland flooding.
- **Paratransit Destinations** have the highest vulnerability to extreme heat (compared to other climate hazards) because all paratransit destinations are exposed to extreme heat. None of the popular destinations are vulnerable to permanent coastal inundation from sea-level rise, and very few are at risk from temporary coastal flooding (11 total) or temporary urban/inland flooding (13 total).
- **Streets** in VTA's service area are most vulnerable to wildfire (compared to other climate hazards), with 26 percent of streets (1,815 miles) identified with high vulnerability to wildfire. Streets are also highly vulnerable to extreme heat, and moderately vulnerable to temporary/urban inland flooding (14 percent of streets have a moderate vulnerability rating and 28 percent have a low vulnerability rating). Although traffic signals and other related equipment were not included in this analysis, they face the same vulnerability to these hazards.

Vulnerability Profile – Operations

There are three components to operations: **Service and Ridership**, **Maintenance**, and **Rider and Workforce Safety**. Some of the key consequences of climate hazards for operations include service disruption, limited access to maintenance facilities and increased maintenance demand, safety, staffing challenges, and public health impacts. These consequences can vary depending on climate hazard and timescale. For example, all three operations components (i.e., service and ridership, maintenance, and rider and workforce safety) have a high vulnerability to permanent coastal inundation. Permanent coastal inundation would lead to impacts like permanent loss of service and physical assets, which would severely impact riders' mobility and livelihoods, among other impacts. Though the impacts of permanent coastal inundation would be detrimental, these impacts will be longer-term than the acute shocks caused by other climate hazards that are already being experienced today. For example, extreme heat has already proven to slow light rail service speeds, cause maintenance delays, and cause significant health risks to riders and workers, and unless adaptation measures are adopted, extreme heat will continue to be a growing problem within VTA's service region. Overall, each climate hazard presents its own set of consequences to operations. Generally, the key impacts of climate hazards on operations are presented below:

VTA Workers Repairing Overhead Lines

- **Service Disruption** due to permanent or temporary loss of infrastructure and service, which can affect ridership and the local community through secondary impacts to local jobs and mental health for riders and workers.
- **Maintenance Disruptions** caused by limited access during climate hazard events, along with increased efforts to maintain service or repair damages.
- **Safety Concerns** for workers operating in or accessing areas affected by climate hazards (e.g., electrical equipment malfunctioning), along with safety concerns related to poor driving conditions.
- **Staffing Challenges**, such as the inability to report to work or the need for an increased workforce to assess and repair damages while supplying alternative service.
- **Public Health and Safety Impacts**, such as heat stroke or respiratory issues caused by extreme heat and wildfire smoke, or direct threats to public safety during a wildfire or flooding event. It is important to note that extreme heat ranks among the deadliest of all climate hazards in California and projections forecast that there will be two to three times more heat-related deaths by mid-century (CARB 2022a:19).

Riders Boarding Light Rail

5. Adaptation Strategies

CLIMATE ACTION &
ADAPTATION PLAN

Introduction

This chapter includes a set of climate change adaptation strategies and actions that are intended to improve the resilience of VTA's physical assets and operations to climate hazards. The adaptation strategies and actions were developed in response to the findings of the climate vulnerability assessment summarized in **Chapter 4**. The adaptation strategies and actions were also informed by a combination of existing plans for other local or similar transportation agencies and general transportation-focused climate adaptation best practices.

The structure and approach for identifying actionable adaptation strategies included in this CAAP is based on a two-pronged framework that consists of (1) high-level, overarching **strategies,** and (2) a suite of one or more **actions** associated with each strategy. It should be noted that this framework is different than the three-pronged framework of strategies, measures, and implementing actions that was used as the approach for GHG reduction. For each adaptation action, qualitative evaluation criteria were used to assess the feasibility and potential outcomes of each action in addition to the action's specific adaptation benefits. These evaluation criteria include conceptual cost, jurisdictional control, implementation timeframe, and a suite of five co-benefits related to environmental, equity, public health, quality of life, and engagement outcomes. The full set of evaluation criteria and each of their associated scoring rubrics are presented in **Table 5-1** below. The full array of scoring results can be found in **Appendix D**.

Table 5-1 Evaluation Criteria and Scoring Rubric for Adaptation Actions

Evaluation Criteria	Scoring Rubric
Conceptual Cost	▪ Low = This action can be implemented within VTA's current budget or with minimal additional funding. ▪ Medium = This action would require a moderate level of funding beyond VTA's existing budget but may be able to be accommodated with reallocation of resources or obtaining some external funding. ▪ High = This action would involve significant financial investments well beyond VTA's existing budget, as it would necessitate major capital expenditures or require long-term financial commitments or ongoing operational costs. May require substantial external funding.
Jurisdictional Control	▪ Low = For this action, VTA would be the "influencer." VTA would not have any direct control over action implementation, but VTA still has the ability to partner, coordinate with, encourage, or influence the efforts of others. ▪ Medium = For this action, VTA would be the "regulator" or "initiator." VTA would have some degree of jurisdictional control, either directly or indirectly, but is not solely responsible for enacting all efforts required to achieve the full potential of the action. For example, VTA may act as a regulator or initiator for some efforts, but the broader community or other agencies may also need to respond with some degree of action. ▪ High = For this action, VTA would be the "actor." VTA would likely have sole authority and full jurisdictional control over action implementation.
Implementation Timeframe	▪ Near-Term = This action should be initiated and fully implemented or adequately operationalized in the next 1-2 years. ▪ Mid-Term = This action should be initiated and fully implemented or adequately operationalized in the next 2-5 years. ▪ Long-Term = This action should be initiated and fully implemented or adequately operationalized 5+ years from now. ▪ Variable = This action may be an intrinsically ongoing action or may have multiple phases of implementation.
Environmental (Co-Benefit)	▪ No = This action would not result in any environmental (e.g., air, water, habitat, GHG emissions reduction) benefits OR unclear what environmental impact this action may have. ▪ Yes = This action would result in environmental (e.g., air, water, habitat, GHG emissions reduction) benefits.
Equity (Co-Benefit)	▪ No = This action would not directly or indirectly enhance social equity OR unclear what impact this action may have on social equity. ▪ Yes = This action would directly or indirectly enhance social equity by providing benefits to vulnerable or disadvantaged populations.

Evaluation Criteria	Scoring Rubric
Public Health (Co-Benefit)	▪ No = This action would not enhance public health OR unclear what impact this action may have on public health. ▪ Yes = This action would enhance public health.
Quality of Life (Co-Benefit)	▪ No = This action would not influence the quality of life of VTA staff, riders, and/or the broader community OR unclear what impact this action may have on quality of life. ▪ Yes = This action would improve the quality of life of VTA staff, riders, and/or the broader community.
Engagement (Co-Benefit)	▪ No = This action would not require or facilitate engagement with internal staff, the general public, member agencies, and/or other stakeholders OR unclear what impact this action may have on engagement. ▪ Yes = This action would require or likely facilitate engagement with internal staff, the general public, member agencies, and/or other stakeholders.

Notes: GHG = greenhouse gas; VTA = Santa Clara Valley Transportation Authority.

Source: Prepared by Ascent in 2023.

There are a total of 14 adaptation strategies and 64 actions in the CAAP. To better address the inherent multiscale, multifaceted nature of climate change adaptation, the adaptation strategies are distinguished as either **Cross-Cutting Adaptation Strategies** or **Focused Adaptation Strategies**, in which there are eight cross-cutting strategies with 29 associated actions, along with six focused strategies with 35 associated actions. These are discussed further in their corresponding sections below, along with the presentation of all strategies and actions.

Cross-Cutting Strategies and Actions

Cross-cutting adaptation strategies refer to strategies and actions that are inherently broad and that largely address or overlap with all climate hazards analyzed in the vulnerability assessment and are applicable to most or all of VTA's asset classes and operations. Each cross-cutting strategy is classified by a unique combination of letters and numbers. To differentiate from the GHG reduction strategies presented in **Chapter 3**, the cross-cutting adaptation strategies are first denoted with an "AD," which stands for "adaptation," followed by a "CC" for "cross-cutting," and then the strategy number. For example, the first cross-cutting adaptation strategy—"Bolster emergency preparedness and response to protect VTA's assets, minimize disruptions to operations, and foster a sense of community and safety"—is denoted as Strategy AD-CC-1. The actions grouped under each strategy are further distinguished with an additional number (e.g., AD-CC-1.1, AD-CC-1.2, and so forth). Though this classification system is applied to each strategy and action for identification purposes, it should be noted that the order of strategies is random and not related to strategy importance, effectiveness, or otherwise. See **Chapter 6**, Implementation, for more information on determining prioritization. All of the cross-cutting adaptation strategies and actions are presented in **Table 5-2** below.

Table 5-2 Cross-Cutting Adaptation Strategies and Actions

Strategy	Action
AD-CC-1: Bolster emergency preparedness and response to protect VTA's assets, minimize disruptions to operations, and foster a sense of community and safety.	AD-CC-1.1: Engage with Cal OES, Santa Clara County Office of Emergency Management, and Valley Water and participate in planning and response coordination sessions related to climate hazards for the transportation sector. AD-CC-1.2: Develop, update, share, and coordinate emergency management plans with VTA member agencies. Conduct outreach to clarify response elements of plans and to highlight VTA's capabilities to support emergency response efforts within its service area. AD-CC-1.3: Review after-action reports from past evacuation efforts to identify targeted resiliency opportunities for communities in VTA's service areas and improve future evacuation efforts. AD-CC-1.4: Establish and maintain contingency contracts with relevant suppliers who provide prioritized access to resources to enable more reliable and rapid access to services and supplies needed during an emergency response effort. AD-CC-1.5: Maintain the organization, including staff roles and responsibilities, and procedures of the VTA EOC to respond to emergency situations which may require deploying maintenance and repair teams to locations prior to, during, or following a climate hazard event or as indicated in Incident Action Plans. Ensure the EOC is staffed and operated at a level proportionate to the emergency. AD-CC-1.6: Develop climate hazard scenario-specific response plans with consideration of the unique set of circumstances related to each scenario and how they may affect VTA operations, power supply, and other considerations. AD-CC-1.7: Conduct emergency response exercises with both internal and external partners by inviting member agencies and other partners to join emergency management table-tops and full-scale exercises conducted by VTA and have VTA staff participate in drills and exercises being hosted by member agencies and other partners. AD-CC-1.8: Develop training for VTA staff and customer service representatives to better manage concerns of riders and the broader community during climate hazard events. AD-CC-1.9: Improve digital infrastructure to better communicate emergency and service disruption information to riders, which may include a suite of actions, including the installation of electronic signage in trains, buses, and at VTA facilities that displays real-time information, enhancing SMS-based alerting capabilities, further leveraging mobile applications (such as the "VTAlerts" app), and including audible indicators, where feasible.
AD-CC-2: Develop a multi-pronged, community-focused climate resilience communications and informational campaign.	AD-CC-2.1: Develop content for and install multilingual signage at stations to inform riders about VTA climate resilience initiatives and personal climate hazard preparedness. AD-CC-2.2: In collaboration with member agencies, educate community neighbors on how to prepare for and respond to climate hazards. For example, underscoring the importance of shade and hydration during extreme heat events, or the need for vegetation control to reduce risk of wildfire ignition and spread. AD-CC-2.3: Create a web-based dashboard that underscores vulnerability assessment findings and actions that can be taken to improve resilience to better inform riders and the broader community about adaptation-related needs that would be mutually beneficial for all parties that use or otherwise rely on VTA's transportation network. AD-CC-2.4: Leverage and potentially modify existing mobile applications (e.g., "VTAlerts" app), along with social media accounts, to inform the public on climate hazards (e.g., extreme heat, flooding), alternative routes, and climate resilience initiatives, and to provide real-time reports from the public to help VTA respond to a hazard event.

Strategy	Action
AD-CC-3: Ensure redundancy of VTA's transportation network.	AD-CC-3.1: Identify alternative transit routes and modes of transportation and develop protocols for service disruptions or temporary closures during climate hazard events (e.g., wildfire, flooding), ensuring effective communication with riders and VTA staff. AD-CC-3.2: Consider and fully understand all aspects of VTA's transportation network and how they will perform under evacuation scenarios (e.g., locations of chokepoints, expected roadway volumes and timing, potential evacuee characteristics, typical origin-destination numbers and patterns of travelers, capacity of roadways). AD-CC-3.3: Enhance intermodal connectivity between different forms of transportation to provide multiple options for riders and VTA staff, which can include improving transfer facilities, developing multimodal hubs, and optimizing transit schedules to facilitate seamless transfers. AD-CC-3.4: For any scheduled maintenance or repairs to improve safety and reliability within VTA's transportation network, continue to implement and expand efforts to ensure that riders can still efficiently get around. For example, VTA's Rail Rehabilitation and Replacement Program, which includes rehabilitation and replacement projects for overhead power wires, concrete panels, switches, rail, and special track work, also ensures that riders can still get around during these scheduled closures via bus bridges. AD-CC-3.5: Bolster the capacity of VTA ACCESS Paratransit services to be prepared for potentially more frequent requests during future climate hazard events. AD-CC-3.6: Coordinate with member agencies to help identify roadways, bridges, and electrical signal equipment that may be damaged or deteriorating to help expedite repairs and minimize disruptions of VTA's bus and paratransit operations. AD-CC-3.7: Expand bus, paratransit, and light rail staff and fleets to account for enhanced intermodal connectivity and projected future ridership, and to minimize disruptions to VTA's transportation network. Consider resiliency in decisions related to future fleet planning and facility master plans. AD-CC-3.8: Collaborate with member agencies and other regional transportation partners to establish, update, and maintain cooperative agreements and mutual aid protocols, which can facilitate resource sharing, alternative routing, and coordinated response efforts during emergencies.
AD-CC-4: Establish internal and external collaboratives to support climate resilience.	AD-CC-4.1: Create an internal technical advisory group or task force to oversee all climate resilience efforts and support internal and external collaboration, outreach, and implementation of strategies. The group should include a representative from relevant VTA departments and will be responsible for leading implementation of adaptation projects through dedicated budget allocation and applications for grants and other external funding (e.g., FEMA BRIC grants). Additionally, the group will be responsible for data sharing throughout VTA and beyond. AD-CC-4.2: Coordinate with VTA member agencies to explore the establishment of a countywide Climate Resilience District to fund or finance climate adaptation projects and programs, in line with SB 852.
AD-CC-5: Take measures to reduce reliance on external power and ensure a redundant and more reliable power supply.	AD-CC-5.1: Conduct a feasibility study to determine where and how on-site renewable energy generation, battery storage, and/or microgrids could be implemented at VTA facilities and stations to provide more reliable, decentralized, grid-independent energy (Note: this adaptation action is very similar to and should be closely aligned with GHG Reduction Measures BF-1.2 and BF-1.3) AD-CC-5.2: Develop and implement load management strategies to optimize energy usage during peak periods or emergencies and to reduce the risk of power outages, such as rescheduling non-urgent maintenance activities, identifying non-essential loads that can be temporarily reduced (e.g., lighting levels, HVAC systems, other equipment not directly related to critical operations or safety), and analyzing historical energy data to identify trends and make informed load management decisions. AD-CC-5.3: Identify and seek funding to install backup power at VTA facilities and cabinets housing critical communication infrastructure. Ensure that all new and existing backup power sources are hardened and protected from potential hazard events, which may include wall structures to protect from wildfires and high winds or elevating systems out of flood-prone areas. Install redundant or failsafe air

Strategy	Action
	conditioning units in buildings and cabinets containing critical equipment and communication infrastructure where it does not already exist.
AD-CC-6: Integrate climate adaptation and resilience considerations into design standards, criteria, and guidelines.	AD-CC-6.1: Update policies (e.g., Green Building Policy) and design manuals, such as VTA's CDT Manual and the Design Criteria Manual for Stormwater and Landscaping, to further include climate change considerations based on vulnerability assessment findings and other known risks, to ensure that investments made now increase system resilience and sustainability. Consider including climate-resilient design features such as special sealants and other materials on roadways to help prevent roadways from softening during extreme heat and specific pavement options to reduce the heat island effect of parking lots, where applicable and in coordination with Caltrans and others. Improve the building envelope performance by increasing insulation value, glazing performance, window shading, thermal breaks, cool color technology on exterior building finishes, and other voluntary reach codes identified for non-residential projects in CALGreen. Stakeholders should provide feedback so that updated policies and design standards are feasible, have buy-in, and will be implemented by staff and member agencies.
AD-CC-7: Track climate impacts on assets and operations.	AD-CC-7.1: Monitor climate impacts on assets and operations, as well as resulting costs and economic impacts, to justify the need for climate adaptation strategy implementation. Determine data sources and streamlined tracking methods, as appropriate, for different assets, operations, and related departments (e.g., data collection tools, work orders, labor tracking systems, inspection routines) to contribute to regular reporting by monitoring items including, but not limited to: 1) rail temperatures and track alignment to identify patterns related to extreme heat; 2) storm events and related power shutdowns to understand service impacts; 3) ridership complaints related to hazard events and associated costs; 4) impacts of hazardous conditions (e.g., poor air quality from wildfire smoke) on VTA workers through missed work days, compensation claims, etc.
AD-CC-8: Develop adaptation pathways for individual assets and operations.	AD-CC-8.1: Conduct detailed, tailored vulnerability assessments specific to key individual assets and operations and develop a series of adaptation actions that can be taken over time based on changing conditions. This series of actions, also known as "adaptation pathways," establish specific triggers and evaluation metrics that lead into the next appropriate action that should be taken. This approach is intended to be flexible and easily modified as conditions change, climatic or otherwise.

Notes: BRIC = Building Resilient Infrastructure and Communities; Cal OES = California Governor's Office of Emergency Services; CALGreen = California Green Building Standards Code; Caltrans = California Department of Transportation; CDT = Community Design and Transportation; EOC = Emergency Operations Center; FEMA = Federal Emergency Management Agency; HVAC = heating, ventilation, and air conditioning; SB = Senate Bill; SMS = short message service; VTA = Santa Clara Valley Transportation Authority.

Source: Prepared by Ascent in 2023.

Focused Strategies and Actions

Unlike cross-cutting adaptation strategies that are more broad in scope, focused adaptation strategies refer to strategies and potential actions that are more tailored to address a particular asset or operations class, climate hazard, or other specific consideration identified in the vulnerability assessment. Each focused strategy is classified by a unique combination of letters and numbers. To differentiate from the GHG reduction strategies presented in **Chapter 3**, the focused adaptation strategies are first denoted with an "AD," which stands for "adaptation," followed by an "F" for "focused," and then the strategy number. For example, the first focused adaptation strategy—"Implement cooling features to build resilience and ensure adequate access to amenities that help VTA staff and riders cope with extreme heat."—is denoted as Strategy AD-F-1. The actions grouped under each strategy are further distinguished with an additional number (e.g., AD-F-1.1, AD-F-1.2, and so forth). Though this classification system is applied to each strategy and action for identification purposes, it should be noted that the order of strategies is random and not related to strategy importance, effectiveness, or otherwise. See **Chapter 6**, Implementation, for more information on determining prioritization. In addition to the scoring for evaluation criteria and co-benefits, the Adaptation Strategies Workbook in **Appendix D** also includes a tagging system that demonstrates which specific asset or operations class(es) apply to each focused action, along with which climate hazard(s) are addressed. All of the focused adaptation strategies and actions are presented in **Table 5-3** below.

Table 5-3 Focused Adaptation Strategies and Actions

Strategy	Action
AD-F-1: Implement cooling features to build resilience and ensure adequate access to amenities that help VTA staff and riders cope with extreme heat.	AD-F-1.1: Install cooling amenities in areas where they do not yet exist and where feasible, such as: hydration stations on station platforms and in maintenance areas to ensure riders and VTA staff have access to drinking water; additional seating under pre-existing shade platforms; additional shaded areas at park-and-ride lots, bike racks, and platforms; air conditioning in indoor waiting areas; and misters in outdoor waiting areas. AD-F-1.2: Where feasible, increase shading and use heat-mitigating materials around VTA facilities, such as in park-and-ride lots, bus and paratransit stops, stations, transit centers, facility entry areas, pedestrian walkways, and bicycle facilities. For example, build bus shelters or plant trees to provide shaded areas where transit users can wait for transit in more comfortable conditions. Prioritize plantings in high-traffic areas and/or areas identified as lacking canopy tree cover according to local surveys. Planting of trees and landscaping must be consistent with AD-F-5 regarding native, drought tolerant, and fire-resistant species. AD-F-1.3: Reduce wait times for transit service to reduce exposure for passengers during extreme heat events and poor air quality conditions during wildfires. This can be done by providing faster and more frequent service. AD-F-1.4: Consider installing heat-reducing roofs or roof treatments such as green roofs, cool roofs, or using other high-albedo materials for VTA facilities, along with installing awnings on buildings and operator break rooms and ensuring buildings are well insulated, to help reduce cooling needs and costs and the urban heat island effect. AD-F-1.5: Pilot "cool pavement" projects that use lighter materials or lighter colored aggregate in asphalt paving mixes. Monitor progress of achieving potential benefits like reduced ambient air temperatures, reduced maintenance, and increased longevity. Pilot success should help determine the feasibility of this as a solution that could be brought to scale across park-and-ride lots that are not exposed to temporary flooding where permeable pavement should be installed instead. AD-F-1.6: Ensure light rail, bus, and paratransit fleets are equipped with thermal insulation coatings and tinted windows. AD-F-1.7: Increase natural ventilation and passive cooling of facilities through changes in operation and positioning of doors and windows and installing additional vents or louvers.
AD-F-2: Protect and minimize disruptions to the light rail system from the effects of extreme heat.	AD-F-2.1: Establish policies for when to perform zero-stress temperature adjustments based on temperature fluctuations, and stress newly installed and existing rail with a rail zero-stress temperature that is calculated based on projected temperatures for the lifetime of the rail, rather than on current or historic conditions. AD-F-2.2: Develop official protocols for managing and protecting light rail operations during extreme heat events, such as frequent track walking inspections and adopting specific criteria for when to issue rail slow/stop orders to prevent or reduce overheating. AD-F-2.3: Install sensors to indicate potential kinking and rail defects, which may include thermometers that can be remotely monitored (which can reduce operational rail costs associated with rail inspection requirements during hot weather), or motion sensors that can identify a thermal misalignment when it occurs and automatically halt trains. AD-F-2.4: Reduce risk of thermal misalignment through a suite of actions, which may include: replacing wood ties with concrete ties, which are heavier and more resistant to movement; reducing tie spacing, which provides additional weight to the track structure and increased lateral resistance because of increased

Strategy	Action
	exposure to shoulder ballast; re-tamping ballast to increase ballast density, which increases lateral resistance; and/or increasing the width of the ballast shoulder, which will increase lateral resistance.
AD-F-3: Reduce the risk of adverse temporary and permanent flooding-related impacts to VTA's assets and operations.	AD-F-3.1: Prioritize nature-based solutions to address flooding. This may include coordination with other agencies to restore wetland and riparian habitats on floodplains to further slowdown the flow of floodwaters and hold soil in place. Additionally, this may also include drainage improvements, such as bioswales, bioretention basins, retention/detention ponds, incorporation of permeable surfaces, and improvements to culverts, as strategies for reducing peak stormwater flooding in locations where geotechnical conditions are appropriate and/or with adequate foundation/substrate. Choose low maintenance, non-invasive plant species. Improvements to drainage and stormwater infrastructure should be considered at park-and-ride lots, landscaping around VTA facilities, and along track in VTA's right-of-way, and in partnership with the County of Santa Clara and other agencies. AD-F-3.2: Armor subgrade and sub-ballast with riprap or other materials to prevent light rail track structure from weakening because of saturation or washout. This can be done as new substructure is being placed and/or when older ballast is replaced. AD-F-3.3: Where exposure to temporary flooding is prevalent, research and treat light rail system and track components, along with bus/paratransit stops and infrastructure components, with protective coatings or sealants to minimize the risk of potential rusting and promote stronger performance and longevity, where appropriate. AD-F-3.4: Where feasible, explore elevating electrical (e.g., substations), mechanical, and information technology (IT) equipment (including Data Centers, Backup Data Centers, SCADA rooms, and IDF and MDF networking closets) that are vulnerable to current and future flood elevations, such as those at Cerone Bus Division and River Oaks. Some considerations should include accessibility and safety (e.g., ensuring maintenance personnel can access equipment), importance to VTA's operations, elevation techniques and engineering design, and compliance with building codes and regulations. AD-F-3.5: Install permeable pavement to minimize flood risk in park-and-ride lots that are exposed to temporary flooding, but also to reduce peak flows, lessen the strain on drainage systems, and recharge groundwater where it can be filtered naturally by the soil. AD-F-3.6: Develop and practice a suite of post-wildfire debris removal strategies, in collaboration with others, to reduce the severity of flood-after-fire and other debris flow events, including replanting lost vegetation immediately after a wildfire event, establishing and continuing to maintain barriers in areas determined to be susceptible to future debris flows, and employing best-available data to predict future debris flows. AD-F-3.7: Procure additional and appropriate temporary flood protection barriers for different types of assets (e.g., sandbags, Tiger Dam™, AquaFence®) to be better prepared during a temporary flood event. Where feasible and appropriate, explore more permanent forms of wet or dry floodproofing for facilities. AD-F-3.8: Collaborate with member agencies and other partnering organizations to encourage and expedite shoreline protection and restoration projects (e.g., South San Francisco Bay Shoreline Project, led by the Santa Clara Valley Water Agency) to reduce the overall vulnerability of VTA's transportation system to the effects of permanent inundation and coastal flooding. Support community participation in these efforts. AD-F-3.9: Incorporate future sea-level rise, permanent inundation, and precipitation projections into long-term infrastructure planning processes, influencing decisions on expansion, relocation, or retrofitting of assets. For example, many of VTA's facilities and other assets are highly vulnerable to future permanent inundation and coastal flooding, such as Lockheed Martin Transit Center, light rail routes and supporting infrastructure (e.g., grade crossings, frogs, turnouts), express lanes, and bus stops, among others. Potential relocation of these assets should be considered and planned for well in advance of implementation.

Strategy	Action
AD-F-4: Reduce water consumption at VTA facilities and across operations to address drought or other water supply availability issues.	AD-F-4.1: Complete upgrades to vehicle washing facilities (e.g., replace original train wash facility at Guadalupe Yard), wastewater treatment systems, and irrigation equipment, targeting higher usage areas. This may include replacing traditional sprinkler systems with drip irrigation systems, retrofitting water fixtures in yards used for washing trains, buses, or other service/maintenance activities so that water sprays are at higher pressure but lower volume, and replacing water fixtures, toilets, and urinals in station and facility restrooms with low-flow options. AD-F-4.2: Consider maintaining reduced vehicle washing and irrigation schedules imposed during drought emergencies as regular practice. AD-F-4.3: Explore the feasibility of automated data communications and leak detection systems to provide real-time water consumption information and leak alerts to facility managers. AD-F-4.4: Educate and engage relevant staff on ideas for water conservation in the workplace, which may include improvements to cleaners, manual scrubbers, and power washing, and ensuring that leaky hydrants are turned off. AD-F-4.5: Explore opportunities for connecting station and facility irrigation systems to recycled water lines, collaborating with water agencies to determine feasible locations. AD-F-4.6: Further integrate and regularly update water conservation approaches into contractor requirements to better mitigate water use impacts from construction through operations.
AD-F-5: Strategically manage trees and vegetation to maximize site-specific aesthetics, promote resilience, and reduce the risk and potential impacts of climate hazards.	AD-F-5.1: At VTA facilities that require significant irrigation for landscaping and aesthetics (e.g., park and ride lots, stations, and transit centers), identify and install non-invasive plant species that are native or climate appropriate and are more tolerant to climate hazards to reduce water use and improve resilience. AD-F-5.2: Support drought and fire-resistant tree planting in lower wildfire risk, heat vulnerable areas where potential disturbances (e.g., fallen trees) would not greatly impact VTA assets and operations (e.g., not planting in locations directly adjacent to rail track). Ensure trees are properly maintained and watered to survive drought conditions. AD-F-5.3: For VTA assets that are located in higher wildfire risk areas, manage adjacent trees and vegetation in a way that minimizes risk of wildfire ignition and spread. This may include removing and/or replacing trees with other forms of vegetation or hardening features (e.g., fire-resistant materials) that would reduce risk and ensure adequate defensible space. Ensure this work aligns with the Community Wildfire Protection Plan, prepared by the Santa Clara County Fire Safe Council. AD-F-5.4: Install tree wells, where feasible, to promote long-term tree health.
AD-F-6: Take measures to promote rider and workforce safety.	AD-F-6.1: Shift outdoor physical labor hours to earlier in the morning during extreme heat events, and allow for flexible hours and remote work, in general (where possible), to ensure safety during other climate hazard events. AD-F-6.2: Conduct safety audits and inspections across VTA's transportation system (e.g., facilities, buses) to identify and address potential safety risks to riders and VTA staff that would be caused or exacerbated by climate hazards. AD-F-6.3: Develop and update trainings for VTA staff that promote safety during hazard conditions, which may include how to safely operate vehicles and equipment during flood conditions and how to recognize and respond to heat-related illnesses, among others. Provide tips to riders on how to stay safe during floods, heat waves, and other hazard conditions. AD-F-6.4: Ensure indoor facilities, buses, and trains are equipped with air filtration systems to protect public health from wildfire smoke and the harmful effects of particulate matter pollution. AD-F-6.5: Develop and share emergency preparedness tips and safety communications with employees.

Notes: IDF = intermediate distribution frame; IT = information technology; MDF = main distribution frame; SCADA = supervisory control and data acquisition; VTA = Santa Clara Valley Transportation Authority.

Source: Prepared by Ascent in 2023.

CLIMATE ACTION & ADAPTATION PLAN

6. Implementation

Introduction

This chapter outlines what is needed to ensure the CAAP will be successfully implemented over time. As described in **Chapter 1**, this CAAP was designed to meet specific objectives: quantify GHG emissions, identify measures to reduce emissions, and conduct a vulnerability assessment of transportation assets and operations, along with adaptation strategies to protect those assets and operations from climate change impacts. Additional work will be required to further develop and implement the measures and actions identified in this plan.

Summary of the Implementation Process

The implementation process includes identifying what VTA division will take the lead on different measures and actions; what VTA departments, outside organizations and agencies will support this effort; and which measures and actions should be completed first or prioritized over other actions. Priority of the GHG reduction measures could be based on their GHG reduction potential, financial and human resources, and other factors. The GHG reduction measures that were identified as having the highest GHG reduction potential include:

- GHG-TL-3.1: Improve reliability and convenience of existing transit services through increased frequency of service, extended service hours, and improved facilities at stops and stations, prioritizing improvements that serve disadvantaged communities.
- GHG-FE-1.2: Replace VTA diesel trucks and other non-revenue VTA vehicles with ZEVs.

Priority of the adaptation actions could be based on the critical asset, climate hazard, equity considerations, and other factors. **Appendix E** provides a summary table of all measures and actions, along with the VTA division or department assigned to lead the implementation process, and estimated timeframe of implementation. Although a lead division or department will be responsible for spearheading implementation, many of the measures and actions are assumed to need the support of multiple departments. This table is available to VTA staff as an editable spreadsheet that can be sorted and refined during the subsequent implementation process. The community will continue to be engaged during this process by VTA’s Community Outreach and Public Engagement team through the sharing of project updates and coordination with key stakeholders and community members.

Collaboration with Others

Successful implementation of the CAAP will require coordinated climate planning. Regional partnerships are pivotal to share information, tap into and leverage resources, and coordinate efforts to avoid duplication. Several measures and actions identified in this CAAP depend on this coordination. Maintaining VTA’s participation in the Collaborative, established by Santa Clara County and described in **Chapter 1**, as well as other local and regional working groups, must be continued. Public and private partnerships could also be pursued to advance specific measures and actions. For example, the San Francisco Bay Restoration Authority is a regional agency that was created to fund shoreline projects that will protect, restore, and enhance the San Francisco Bay, and is comprised of a Governing Board of local elected officials, an Advisory Committee to represent the community and public agencies, an Oversight Committee, and staff from state and regional agencies. One of the primary projects being funded by the Authority is the South San Francisco Bay Shoreline Project, which will address the need for tidal wetland restoration, flood protection, and improved recreation connections in the South Bay. Additionally, Adapting to Rising

Tides, a regional collaborative consisting of the San Francisco Bay Conservation and Development Commission, non-profit organizations, private associations, and local, regional, state, and federal agencies, leads and supports multi-sector, cross-jurisdictional projects that build local and regional capacity in the San Francisco Bay Area to plan for and implement adaptation responses related to flooding and sea level rise.

Additionally, and most importantly, VTA will continue to engage, build, and maintain relationships with young people and students. VTA recognizes that young people are valuable change agents and contributors to climate action. This generation represents our future leadership and workforce of innovators, entrepreneurs, and planners. VTA will involve youth in the implementation of this CAAP through meaningful outreach efforts, mentoring and professional development, and promoting youth-led initiatives and solutions.

Monitoring, Reporting, and Updating

As with any long-range plan, the CAAP will be reviewed and updated periodically to reflect changing conditions, such as new laws or regulations, emerging technologies, and other situational factors or trends, as well as to incorporate additional climate hazard information as new data becomes available and climate science evolves. GHG inventory updates will be performed annually for GHG emissions associated with VTA's internal operations consistent with VTA's existing Sustainability Plan monitoring and reporting activities, while the Countywide Transportation emissions inventory will be updated every 5-10 years. Reporting on CAAP implementation status will be included in the scope of VTA's annual sustainability reporting process.

7. Conclusion

> ***"The urgency is high, and the time to act is now. Transforming our transportation system, while challenging, is possible with a dedicated, coordinated effort" (DOE 2023).***

Climate change has already had a profound impact on the county's transportation infrastructure and VTA's operations, and will continue to do so in the future. This CAAP outlines strategies and critical actions VTA will take to both reduce GHG emissions on the path to carbon neutrality and adapt and build resilience to impacts of climate change. VTA will engage the community, member agencies, and other interests in reviewing and refining this CAAP. VTA will also continue to partner and collaborate with all of these entities to implement the CAAP and promote sustainability and climate resilience throughout the county and the region.

Leading by example, VTA will take significant actions to reduce GHG emissions with a long-term goal of achieving carbon neutrality in its own internal operations, which is an ambitious but achievable target given VTA's previous sustainability efforts and the measures and actions in this CAAP. Achieving carbon neutrality in the countywide transportation sector will require ongoing partnership to coordinate and accelerate actions across multiple scales and sectors. VTA is committed to leading countywide transportation focused GHG reduction actions in systems and services VTA provides in the county, and aligning with and supporting member agencies and other regional and statewide agencies in carrying out their own actions.

VTA will also begin implementing adaptation strategies and actions that address specific climate hazards. Not all actions can be implemented at the same time. Priorities will need to be developed based on further input from VTA staff and community stakeholders. Continual refinements and evolution of this CAAP are expected. However, any delay in action will result in catastrophic consequences. Therefore, VTA will continue to act with urgency to seize this moment and answer the call to action, in partnership with young people and students.

This CAAP represents VTA's first comprehensive look at the climate crisis, and Santa Clara County's first look at climate change through the transportation lens, specifically. It presents a suite of solutions rooted in equity and science that, when implemented, will improve VTA and the communities it serves for future generations. It does not have all the answers, but it does set forth a path towards action and catalyzes a number of efforts to transform our transportation system.

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8. Acronyms and Abbreviations

°C	degrees Celsius
°F	degrees Fahrenheit
AB	Assembly Bill
ACE	Altamont Corridor Express Rail
APG	*California Adaptation Planning Guide*
BART	Bay Area Rapid Transit District
BAU	business as usual
CAAP	*Climate Action and Adaptation Plan*
Cal OES	California Governor's Office of Emergency Services
CAPCOA	California Air Pollution Control Officers Association
CARB	California Air Resources Board
CBO	community-based organization
CEQA	California Environmental Quality Act
CCUS	carbon capture, utilization, and storage
CH_4	methane
CNRA	California Natural Resources Agency
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
GHG	greenhouse gas
GIS	geographic information system
GWP	global warming potential
$MTCO_2e$	metric tons of carbon dioxide equivalent
NOx	nitrogen oxides
N_2O	nitrous oxide
OAL	Office of Administrative Law

OCS	overhead catenary system
SB	Senate Bill
SJSU	San Jose State University
SVI	Social Vulnerability Index
SVYCA	Silicon Valley Youth Climate Action
TOD	transit-oriented development
UNFCC	United Nations Framework Convention on Climate Change
VMT	vehicle miles traveled
VTA	Santa Clara Valley Transportation Authority
ZEB	Zero Emissions Bus
ZEV	Zero Emission Vehicle

9. Glossary

Adaptation: An action or set of actions that reduce physical climate risk. In the context of this CAAP, climate change adaptation refers to building resilience of VTA's assets and operations in response to the current or expected effects of climate change.

Adaptive Capacity: A system's current ability to cope with or adjust to the impacts of climate hazards.

Adaptation Pathways: A series of actions that can be taken over time based on changing conditions to effectively adapt to climate change, which may establish specific triggers and evaluation metrics that lead into the next appropriate action that should be taken.

Albedo: A fraction of light that is reflected by a body or surface.

Anaerobic Decay: A process through which bacteria break down organic matter—such as animal manure, wastewater biosolids, and food wastes—in the absence of oxygen.

Anthropogenic: Originating from human activities.

Asset Classes: High-level groupings of physical assets or operations that were evaluated in the CAAP's vulnerability assessment. The four asset classes include: (1) facilities; (2) light rail; (3) bus and paratransit; and (4) operations.

Asset Vulnerability Profiles: Profiles of the four asset classes identified in the CAAP's vulnerability assessment that provide an overview of vulnerabilities and consequences from the impacts of climate hazards.

Business As Usual (BAU): Regarding GHG emissions forecasts, a BAU scenario is based on a continuation of current trends in activity and does not account for GHG emissions reductions resulting from laws and regulations adopted by local, regional, state, or federal agencies.

California Environmental Quality Act (CEQA): A statute that generally requires state and local government agencies to inform decision makers and the public about the potential environmental impacts of proposed projects, and to mitigate significant environmental impacts to the extent feasible.

California Green Building Standards Code (CALGreen): A first-in-the-nation mandatory green building standards code that aims to improve public health, safety, and general welfare through enhance design and construction of buildings which reduce negative impacts and promote those principles which have positive environmental impact and encourage sustainable construction practices.

Carbon Capture, Utilization, and Storage (CCUS): A process that captures GHG emissions for reuse or storage and that prevents them from entering the atmosphere.

Carbon Dioxide Equivalent (CO_2e): A way to measure and equalize the different warming potencies of the six internationally recognized GHGs. Measuring emissions in terms of CO_2e helps to normalize all GHG emissions to CO_2, which is the most prevalent GHG emitted by human activities and has a global warming potential (GWP) value of 1.

Carbon Neutrality: All GHG emissions emitted into the atmosphere balanced in equal measure by GHGs that are removed from the atmosphere, either through carbon sinks (i.e., natural or anthropogenic systems that absorb or hold more carbon than they emit) or CCUS. (See also "Net Zero GHG Emissions").

Cascading Impacts: A sequence of secondary events in natural and human systems caused by climate hazard events that result in physical, natural, social, or economic disruption, whereby the resulting impact is significantly greater than the initial impact.

Climate Change Scoping Plan: The State of California's climate action plan, which is designed to provide a statewide strategy for achieving the GHG reduction targets established in AB 32 and subsequent laws.

Equity: In the context of this CAAP, the term equity means the just distribution of the benefits of climate protection efforts and the alleviation of unequal burdens created by climate change.

Climate Hazard: A natural hazard exacerbated by climate change. The six climate hazards evaluated in this CAAP include permanent coastal inundation, temporary coastal flooding, temporary urban/inland flooding, wildfire, extreme heat, and drought.

Climate Resilience District: A special type of financing district that allows cities, counties or special districts—either alone or in combination— to undertake and finance projects and programs to address climate hazards. The districts allow participating agencies to raise revenue through tax increment funding, voter-approved supplemental property taxes, or property benefit assessments or fees. Climate resilience districts were established in California under SB 852 (Dodd, 2022).

Climate Variable: Critical attributes of atmospheric, oceanic, and terrestrial systems tracked over time (e.g., temperature, rainfall).

Climate Whiplash: Quick oscillation between two weather extremes, such as extreme heat and cold, or drought and extreme rainfall.

Cool Pavement: Higher albedo paving materials that reflect more solar energy, enhance water evaporation, or have been otherwise modified to reduce both surface and ambient air temperatures.

Demand-Based Parking Pricing: A pricing model that periodically adjusts meter and garage costs to match parking demand. This encourages people to park in underutilized blocks and garages, helping to open spaces in busy areas and at busy times.

Diesel Particulate Matter: Diesel engines emit a complex mixture of air pollutants, including both gaseous and solid material. The solid material in diesel exhaust is known as diesel particulate matter. It is identified as carcinogenic but can also contribute to non-carcinogenic health effects.

Disadvantaged Communities: Communities that have suffered from historical disinvestment and environmental injustice and are among the most vulnerable to the impacts of climate change. According to state law, definitional criteria may include either of the following: (a) areas that are disproportionately affected by environmental pollution and other hazards that can lead to negative health effects, exposure, or environmental degradation, or (b) areas with concentrations of people that are of low income, high unemployment, low levels of homeownership, high rent burden, sensitive populations, or low levels of educational attainment (CA Health and Safety Code, Section 39711).

Downscaled Climate Projection Data: Large-scale Global Climate Model (GCM) data that is translated to a smaller spatial scale, allowing for the data to be more useful in local and regional contexts.

Drought: A deficiency of precipitation over an extended period of time, typically resulting in issues with water supply and/or quality.

Electrification: The process of replacing systems that use fossil fuels (e.g., coal, oil, natural gas) with ones that use electricity as a source of power.

Energy Storage: The capture of energy produced at one time (e.g., high production with low demand) so that it can be used at another time (e.g., low production with high demand). Building more energy storage allows renewable energy sources to power more of the electric grid.

Environmental Justice: The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.

Federal Emergency Management Agency (FEMA) "Building Resilient Infrastructure and Communities" (BRIC) Program: Grant program that aims to categorically shift the federal focus away from reactive disaster spending and toward research-supported, proactive investment in community resilience.

Fine Particulate Matter: A mixture of solid and aerosol particles that are 2.5 microns or less in diameter, typically resulting from the combustion of gasoline, oil, diesel fuel, or wood.

Fluorocarbons (F-gases): The most potent and longest lasting greenhouse gases emitted by human activities.

Focused Adaptation Strategies: The adaptation strategies in the CAAP that are more tailored to address a particular asset or operations class, climate hazard, or other specific considerations identified in the vulnerability assessment.

Frogs: Components of track placed where one rail crosses another.

General Plan: A mandatory local government plan in California that serves as a blueprint for local land use and meeting the community's long-term vision for the future.

GHG Reduction Target: A goal of reducing GHG emissions a certain amount by a specified point in time; typically reflected as a percent reduction from a historic baseline by a certain year.

Global Warming Potential (GWP): The relative potency of various GHGs when compared to carbon dioxide.

Greenhouse Effect: A warming of Earth's surface and atmosphere caused by the presence of greenhouse gases. This greenhouse effect has been enhanced by human activities.

Light-Emitting Diode (LED): A highly energy-efficient lighting technology that uses a semiconductor device to emit light when current flows through it.

Leadership in Energy and Environmental Design (LEED®): The most widely used green building rating system in the world; LEED® certification is a globally recognized symbol of sustainability achievement and leadership; it provides a framework for healthy, efficient, and cost-saving green buildings.

Microgrid: A local electrical grid with defined electrical boundaries, acting as a single and controllable entity, and with the ability to operate both grid-connected and independently.

Mitigation: Reduction or removal of GHG emissions from the atmosphere to prevent the planet from warming to more extreme temperatures.

Mobility-As-A-Service: A consumer-centric model of mobility that enables users to plan, book, and pay for transportation services; describes a shift away from personally owned modes of transportation (e.g., personal vehicles).

Nature-Based Solutions: Nature-based solutions are sustainable planning, design, environmental management, and engineering practices that weave natural features or processes into the built environment to promote carbon neutrality as well as climate adaptation and resilience.

Natural and Working Lands: Lands consisting of natural lands, which include forests, grasslands, deserts, freshwater and riparian systems, wetlands, coastal and estuarine areas, watersheds, wildlands, or wildlife habitats; lands used for recreational purposes such as parks (i.e., areas that provide public green space), urban and community forests, greenbelts, trails, and other similar open-space lands; and working lands which include lands used for farming, grazing, or the production of forest products.

Net Zero GHG Emissions: Removing an equal amount of GHGs from the atmosphere as are released into it. AB 1279 set California on a path to net zero GHG emissions by 2045. While similar to carbon neutrality, net zero GHG emissions applies to all GHGs emitted into the atmosphere.

Nitrogen Oxides (NOx): A family of poisonous, highly reactive gases that form when fuel is burned at high temperatures; are commonly emitted by automobiles, trucks, off-road vehicles, and industrial sources, like power plants. Includes nitric oxide, nitrogen dioxide, and other nitrogen-based oxides.

Off-Road Equipment: Any non-stationary device powered by an internal combustion engine or electric motor used primarily off roadways, such as those used for agricultural, landscaping or construction purposes.

Organic Waste: Solid waste containing material originated from living organisms and their metabolic waste products, including but not limited to food, green waste, landscape and pruning waste, applicable textiles and carpets, wood, lumber, fiber, manure, biosolids, digestate and sludges.

Paratransit: A door-to-door transportation service intended for persons who are unable to independently use other forms of transit (e.g., bus, light rail) due to physical, visual, or cognitive disabilities.

Passive Cooling: A design approach that focuses on heat gain control and heat dissipation in a building to improve indoor thermal comfort with low or no energy consumption.

Permanent Coastal Inundation: A climate hazard that refers to the permanent flooding of coastal areas due to sea level rise.

Potential Impacts: How a system may be affected by exposure to climate hazards.

Renewable Natural Gas (RNG): Biogas or natural gas from renewable sources that has been upgraded for use in place of natural gas. The biogas used to produce RNG comes from a variety of sources, including municipal solid waste landfills, digesters at water resource recovery facilities, livestock farms, food production facilities and organic waste management operations.

Resilience: The ability to anticipate, prepare for, respond to, and recover from hazardous events, trends, or disturbances related to climate; describes a state of climate readiness.

Revenue Fleet: Public transit vehicles, such as buses or trains, that provide revenue service for passengers. Non-revenue fleet includes vehicles operated by VTA employees not used to carry passengers.

Senate Bill (SB) 1000: A bill that requires local jurisdictions to add an Environmental Justice element to their general plans, which will help meet the needs of their most vulnerable residents and create healthier communities.

Sensitivity: The degree to which a system would be affected by exposure to climate hazards.

Smart Mobility: Refers to using modes of transportation alongside or instead of personal vehicles that combust gasoline or diesel, which can take on many forms, including ride sharing, public transit, walking, and biking, among others.

Social Vulnerability Index (SVI): Social vulnerability refers to the potential negative effects on communities caused by external stresses on human health. The SVI uses 16 census variables to help local officials identify communities with heightened levels of social vulnerability that may need support before, during, or after disasters.

Transit Signal Priority: Providing special treatment to prioritize throughput of transit vehicles at signalized intersections.

Transportation Demand Management (TDM): Also known as travel demand management, TDM is the application of strategies and policies to reduce travel demand of single-occupancy private vehicles, traffic congestion, or to redistribute this demand in space or in time.

Transportation Management Association (TMA): A membership organization formed to provide a forum for employers, developers, building owners, local government representatives, and others to work together to collectively establish policies, programs, and services to address local transportation needs and air quality issues within a specific geographic area.

Transit-Oriented Development (TOD): The development of housing, commercial space, services, and job opportunities near public transit nodes.

Turnout: A mechanical installation enabling trains to move from one track to another; also known as a railroad switch.

Unbundling: Separating parking costs from commercial leasing or residential rental rates.

Urban Heat Island Effect: A phenomenon whereby urban areas experience higher air temperatures than surrounding non-urban areas due to dense concentrations of pavement, buildings, and other surfaces that absorb and retain heat. Trees, green roofs, and vegetation can help reduce the urban heat island effect by shading building surfaces, deflecting radiation from the sun, and releasing moisture into the atmosphere.

Vehicle Miles Traveled (VMT): VMT is a measure of how much motor vehicle activity occurs on the roadway network in total miles traveled over a given period of time, and it is a key input into measuring GHG emissions from motor vehicles broadly at various scales.

Vulnerability: The degree to which natural, built, and human systems are susceptible to harm from exposure to stresses associated with climate change and from the absence of adaptive capacity.

Vulnerability Assessment: A comprehensive analysis of exposure, sensitivity, potential impacts, and adaptive capacity to determine the vulnerability of natural, built, and human systems to climate change. In the context of this CAAP, a vulnerability assessment was conducted to evaluate the vulnerabilities of VTA's physical assets and operations to various climate hazards.

Zero-Emission Bus (ZEB): Any bus that produces zero GHG emissions in its day-to-day operations, which includes full battery electric buses, hydrogen fuel cell electric buses, and overhead wire electric buses.

Zero-Emission Vehicle (ZEV): Any vehicle that produces zero GHG emissions in its day-to-day operations.

Zero-Stress Temperature: Temperature at which the residual stress in a concrete element reaches zero, and one of the critical factors affecting the behavior and performance of concrete.

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