



PENINSULA RESILIENCE PLANNING PROJECT

BRISBANE VULNERABILITY ASSESSMENT SUMMARY

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Prepared for:

City of Brisbane
50 Park Place
Brisbane, CA 94005
415.508.2100

Prepared by:

PlaceWorks
2040 Bancroft Way, Suite 400
Berkeley, CA 94704
510.848.3815

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Introduction

There are nine jurisdictions in San Mateo County working collaboratively on the Peninsula Resilience Planning (PREP) project: San Mateo County; the Town of Atherton; and the cities of Belmont, Brisbane, Burlingame, East Palo Alto, Half Moon Bay, Pacifica, and San Bruno. The PREP project is a coordinated effort to identify the hazards facing Brisbane and other communities across San Mateo County, evaluate how these hazards may change with the changing climate, recognize the communities and community features that are most vulnerable, and develop strategies for improving community safety and resilience. As a participant in the project, Brisbane is conducting technical work that will be used to support a comprehensive update of its Safety Element.

As part of this work, the PREP team prepared an updated Climate Change Vulnerability Assessment to analyze how climate-related hazards may harm the community. California law^{*} requires that safety elements analyze climate vulnerability, which is the degree to which people, nature, the built environment, and other systems are susceptible to harm from climate change and associated hazards. This includes physical and mental injuries, property damage or destruction, environmental harm, economic damage, and other factors.

The Vulnerability Assessment helps community members, City staff, and decision makers understand how climate change hazards may alter community conditions and what parts of the community (people and places) should be prioritized for adaptation and resilience. The Vulnerability Assessment identifies how City and community resources help to improve resiliency in Brisbane in an integrated, thorough, and tailored way. The findings from the Vulnerability Assessment process will support future updates to the Safety Element, working in combination with the San Mateo County Multijurisdictional Local Hazard Mitigation Plan to help safeguard Brisbane against both current and future hazard conditions, including the changes in hazard events from climate change.

What Is a General Plan?

A general plan is each local government's blueprint for meeting the community's long-term vision for the future, with goals, policies, and actions for achieving the vision. All cities and counties in California are required to have general plans. These general plans must cover eight mandatory topics: land use, circulation, housing, conservation, open space, noise, safety, and environmental justice (if applicable). General plans typically organize one or more of these topics into dedicated chapters, known as elements.

Source: Governor's Office of Planning and Research. 2017. *State of California General Plan Guidelines*

^{*} California Government Code Section 65302(g)(4), established by Senate Bill 379 in 2015.

Community Profile

The City of Brisbane is a small community of approximately 4,800 people located along the shores of San Francisco Bay in northern San Mateo County, just south of San Francisco. Brisbane's southern and western borders back up against the ridges and canyons of San Bruno Mountain, which are home to grasslands, chapparal scrub, and woodlands. Brisbane is divided from north to south by Bayshore Boulevard and the Caltrain rail line, with Highway 101 running along the bay shore. Brisbane has a diverse economy, with several major employers from the building and construction, life sciences, and warehousing and logistics industries.

City of Stars

Brisbane is known as the "City of Stars" due to the wooden five-pointed stars wrapped in lights that community members install on the sides and roofs of homes and businesses, especially around the December holidays. The tradition began in 1939. Today, the Brisbane Chamber of Commerce still makes free stars available to community members.

Downtown Brisbane, concentrated along Visitacion Avenue, is home to several small shops and other local businesses, surrounded by residential neighborhoods that rise up into the hills. North of Downtown are the warehouses in the Crocker Park neighborhood, and beyond that the Northeast Ridge area, home to larger residential developments of single-family homes and townhomes. East of Downtown, across Bayshore Boulevard, is the Brisbane Lagoon, a section of the San Francisco Bay that was largely cut off when Highway 101 was constructed. North of Brisbane Lagoon is the Baylands, which is a mix of vacant land and heavy industrial operations, including waste management and a large petroleum products depot that serves San Francisco International Airport and is operated by Kinder Morgan. At the northern end of the Baylands, along the border with San Francisco, is the Bayshore Caltrain station. Approximately 640 acres of



the Baylands have been proposed for redevelopment. At the far southeast end of Brisbane, east of Highway 101, is the Sierra Point neighborhood, which includes several large business complexes (particularly for the biotechnology and pharmaceutical industries), hotels, and the Brisbane Marina.

In many respects, Brisbane's demographics are similar to San Mateo County at large. Most significantly, although Brisbane's median income is lower than that of the County, Brisbane has a higher rate of home ownership, fewer people without lifelines such as access to the Internet and a private vehicle, and slightly lower rates of

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overcrowded households. Despite this, more than a third of Brisbane residents are paying more than 30 percent of their income on housing, mirroring regional and statewide patterns. **Table 1** shows key demographics for Brisbane compared to all of San Mateo County.

Table 1: Brisbane and San Mateo County Demographics

Demographic	Brisbane		San Mateo County	
	Number	Percentage	Number	Percentage
Population	4,756		754,520	
Children (under 18 years old)	959	20.20%	150,187	19.90%
Linguistically isolated persons	687	15.30%	116,306	16.30%
Older adults (65 years and older)	748	15.70%	127,520	16.90%
Persons with disabilities	501	10.50%	65,466	8.70%
Persons working outdoors	286	6.09%	41,748	5.44%
Persons in poverty	234	5.00%	48,137	6.40%
Unhoused persons	11	-	1,145	-
Number of households	1,902		264,323	
Median household income	\$137,583	-	\$175,000	-
Cost-burdened households	705	37.36%	94,625	36.55%
Households without access to the Internet	68	3.60%	14,371	5.40%
Households without a vehicle	31	1.60%	14,752	5.58%
Overcrowded households	114	5.99%	19,366	7.33%
Rental households	633	33.28%	106,955	40.46%

Note: The 2024 demographic estimates from the California Department of Finance put Brisbane's 2022 population at 4,678 people, and its 2024 population at 4,661. ¹

Source: American Community Survey, 2022, ACS 5-Year Estimates.

Climate Hazards

Climate change is the long-term shift in the average weather patterns, including significant alterations in temperature, precipitation, and wind patterns over an extended period—typically decades or longer. Rising global temperatures are causing more frequent and intense heatwaves, storms, floods, droughts, wildfires, and other hazards. These events are frequently concurrent, resulting in cascading impacts that are progressively more difficult to manage, such as droughts amplifying wildfire risk or extreme heat exacerbating water scarcity. This section lays out the major hazards that are affected by climate change in Brisbane, and how these hazards are expected to change in the coming years and decades.

Cascading and Compounding Effects

Cascading Effects: When an extreme event causes a series of secondary events that are larger than the initial impact.

Compounding Effects: When multiple hazards or drivers occur simultaneously, amplifying their collective impact.

Source: IPCC. 2019. *Extremes, Abrupt Changes and Managing Risk*.

The vulnerability assessment considers ten climate-related hazards and their effects on the community: air quality and smoke, drought, ecosystem pests, extreme heat and warm nights, flooding, human health hazards, landslides and debris flows, sea level rise and emergent groundwater, severe weather, and wildfire.

Air Quality and Smoke

Poor air quality and smoke affects the health and quality of life for Brisbane community members. The health risks associated with these types of air pollutants are particularly severe for vulnerable populations, including children, older adults, individuals with pre-existing respiratory or cardiovascular conditions, and low-resourced residents, who may experience more severe acute and chronic health effects.² Exposure to air pollutants such as ozone and particulate matter (PM) can lead to respiratory conditions, exacerbate asthma, and increase the risks of heart attacks, strokes, and certain types of cancer.

The increased frequency of wildfires in northern California is exacerbating these hazards.³ Air pollutants come from mobile sources such as cars and trucks, dust from construction sites, smoke from wildfires, and other sources. Climate change directly impacts and exacerbates air quality through increased temperatures, severe weather, wildfires, changes in precipitation patterns, and other mechanisms. Warmer temperatures lengthen the growing seasons of plants and trees, increasing allergen production. Poor air quality leads to more health issues, strains healthcare systems, and restricts outdoor activities.

The financial burden of poor air quality in the Bay Area region is estimated at \$32 billion annually, which includes costs associated with premature deaths, healthcare expenses, reduced productivity, and other related issues.⁴ The Bay Area Air Quality Management District has played

a key role in monitoring and improving air quality throughout the region, resulting in notable progress even as population, traffic, and industrial activities have grown.⁵

Brisbane ranks well below California averages for levels of ozone and PM_{2.5} (fine particulate matter, which forms the greatest health risk), according to the California Office of Environmental Health Hazard Assessment. Levels of particulate matter from diesel engines are similar to California averages in much of the community, although they are likely higher along Brisbane's northern and southeastern borders where Brisbane abuts areas with much higher pollution levels.

Bay Area Air Quality Management District Programs

The Bay Area Air Quality Management District has several programs to reduce air pollution from multiple sources.

The **Spare the Air Program** issues alerts on days when air quality is expected to be poor due to high levels of ozone or particulate matter. On Spare the Air days, residents are encouraged to limit activities that contribute to air pollution, such as driving, using gas-powered equipment, or wood burning.

Employers with 50 or more full-time employees in the Bay Area are required to provide **Commuter Benefits Programs** to encourage the use of alternative modes of transportation, such as public transit, vanpool, or biking, in order to reduce emissions from commuting.

Drought

A drought is when conditions are drier than normal for an extended period, making less water available for people and ecosystems. While drought is a normal occurrence in California, prolonged drought conditions can harm ecosystems and the regional economy. Droughts do not typically cause direct loss of life or structural damage, but they can lead to critical environmental and economic harm, including agricultural losses, increased water costs, habitat degradation, and heightened wildfire risks. During a drought, groundwater reserves deplete faster because of less precipitation for replenishment, which can negatively impact creek flows, particularly in summer. Water demands, such as population growth, exacerbate these impacts, complicating water allocation and potentially leading to restrictions and quality issues.

The City supplies water to the Brisbane community through two separate water districts, although like most of the communities along San Mateo County's bayside, it purchases this water from the San Francisco Public Utilities Commission (SFPUC). Most of this water (approximately 85 percent) comes from San Francisco's Hetch Hetchy Reservoir, fed by rainfall and snowmelt in the Tuolumne River watershed in the Sierra Nevada. The remaining 15 percent comes from lakes and reservoirs in Alameda and San Mateo Counties. In emergencies, Brisbane can obtain water from its existing interconnections with water systems in Daly City and South San Francisco.

Scientists predict climate change will result in more frequent and severe droughts across the state. Overall, precipitation levels are expected to increase slightly in Brisbane, with more years with extreme levels of precipitation, both high and low, because of climate change. Locally, more intense droughts are expected to harden soil and cause groundwater levels to drop due to reduced groundwater recharge. When rains return, more water will run off rather than infiltrate into soils, potentially causing downstream flooding. Higher temperatures will further increase evaporation, worsening drought conditions.

Of greater concern to Brisbane's water supply are projections of reduced winter precipitation levels and warmer temperatures in the Sierra Nevada. These changes decrease the size of the Sierra Nevada snowpack (the volume of accumulated snow), which in turn makes less fresh water available for communities throughout California, including those that receive water from the Hetch Hetchy system. The Cal-Adapt database reports that climate scientists project a decline of over 60 percent in the snowpack immediately around Hetch Hetchy in the second half of the century.

Ecosystem Pests

Ecosystems pests are the plant and animal species that threaten Brisbane's natural environments. Climate change is expected to worsen these problems by increasing the abundance and range of both native and nonnative pests. Invasive plant species threaten local ecosystems by outcompeting native flora, disrupting habitats, and reducing biodiversity.

Warmer temperatures and shifting precipitation patterns can weaken trees and plant life, making them more susceptible to infestations and infections. It also creates favorable conditions for invasive species to establish themselves, as extreme weather events disrupt native communities. This includes sudden oak death, an invasive pathogen that can kill multiple oak species common to the region's oak woodlands. Sudden oak death benefits from warmer temperatures, such as those brought on by climate change. A 2020 study estimated that sudden oak death has killed 48 million trees in coastal California and southwestern Oregon, infected a further 150 million, and threatens about 1.8 billion in the region.⁶

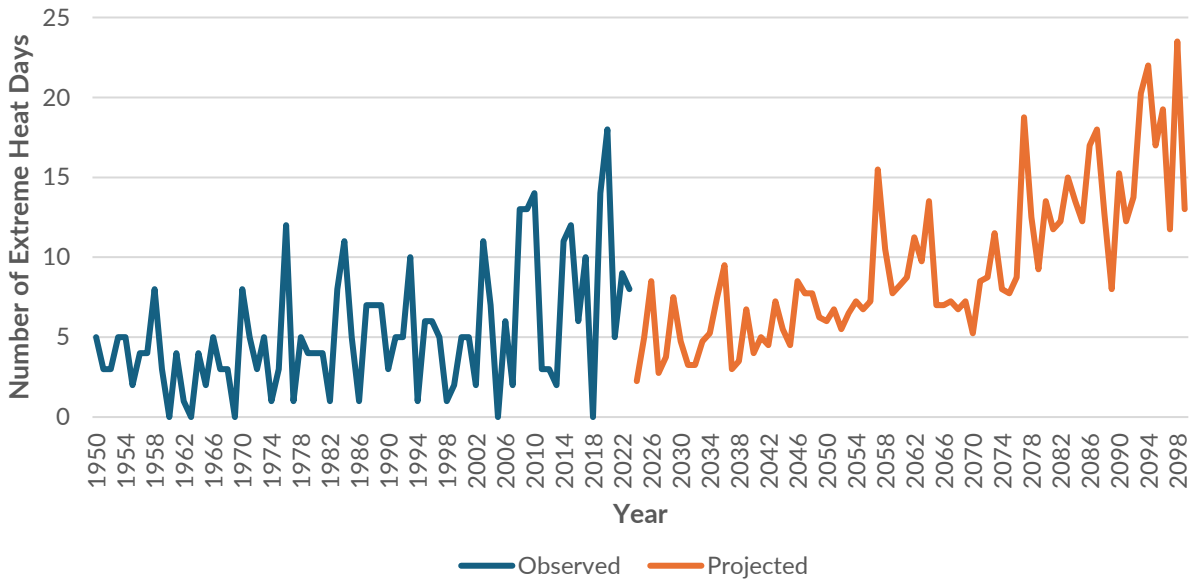
In aquatic environments such as Brisbane Lagoon, rising temperatures and drought conditions decrease dissolved oxygen levels, causing harmful algal blooms and allowing invasive species to thrive, complicating management efforts. This could also harm the productive fishing environments along the Brisbane Lagoon and the Brisbane Fishing Pier near the community marina.

Extreme Heat and Warm Nights

Extreme heat is a growing issue of concern for Brisbane. Extreme heat days, or those with temperatures exceeding 98 percent of historical highs, are becoming more frequent and intense due to climate change. They pose significant health risks, can result in loss of power and high energy bills, and can increase the risk of wildfires.

According to the Cal-Adapt database, an extreme heat day in Brisbane is one where the temperature exceeds 86.5 degrees Fahrenheit. **Figure 1*** shows that climate change is expected to increase extreme heat days in the city from a historic annual average (1961 to 1990) of 3 days per year, to an average of 7 days per year by mid-century (2035 to 2064) and an average of 13 days per year by late century (2070 to 2099).^{7, †}

Figure 1. Observed and Projected Extreme Heat Days in Brisbane

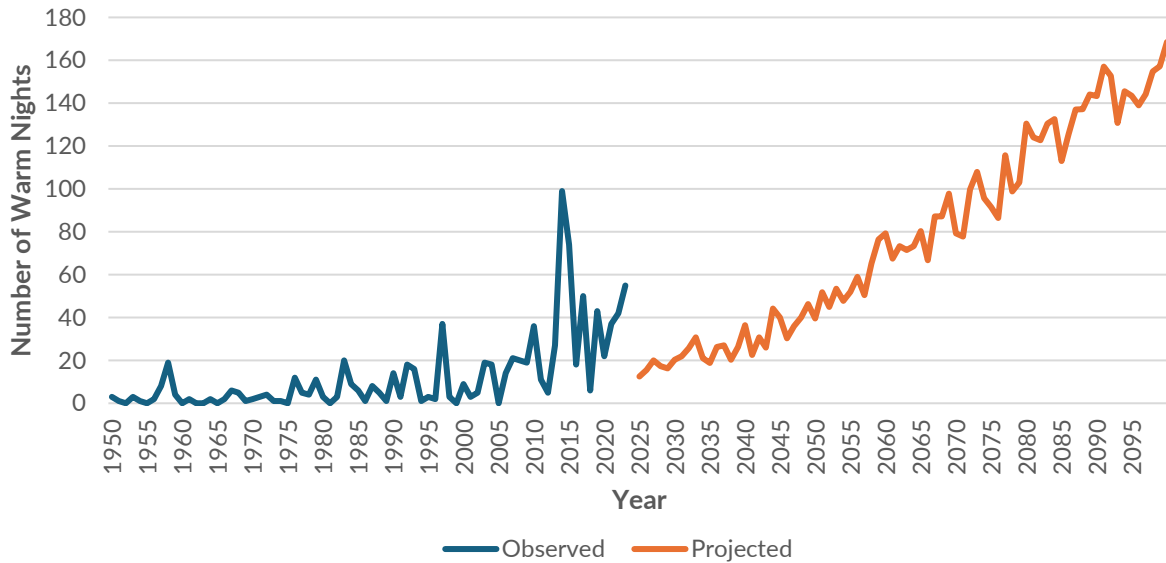


The harm of extreme heat is often compounded when nighttime temperatures do not cool to more normal levels, which means that the community gets little or no relief from the heat of the day. A warm night in Brisbane is when temperatures remain above 58.9 degrees. As shown in **Figure 2**, warm nights are projected to increase from a historical 7 nights per year to 48 nights per year by mid-century and 127 nights per year by late century.⁸

* The Cal-Adapt database at time of writing uses Representative Concentration Pathways (RCPs) to project future conditions. The projections listed in this report use RCP 8.5, which assumes global emissions continue to increase at least until the end of century, which is consistent with the International Panel on Climate Change Sixth Assessment Report.

† Figures 1 and 2 use observed data from the Cal-Adapt database, which provides data from 1950 to 2005, the nearest National Weather Service weather stations, which provides data from 2006 to 2023, and projected data from the Cal-adapt database, which provides data from 2024 to 2099. Due to the different database sources, the observed and projected data may not match.

Figure 2. Observed and Projected Warm Nights in Brisbane



Extreme heat is one of the deadliest climate-related hazards nationwide, and the Center for Disease Control and Prevention noted a rise in heat-related deaths—from 297 in 2004 to over 2,300 in 2023.^{9, 10} These numbers are likely a significant undercount because they do not include deaths caused by other factors that are exacerbated by extreme heat. The rising frequency and intensity of extreme heat and warm night events pose significant public health concerns. Although temperatures during extreme heat events in Brisbane are not as high as in other parts of California, this can be more dangerous, since community members and local systems are not used to extreme heat, and so face greater harm from them compared to more heat-adapted regions. Extreme heat leads to heightened risks of dehydration, heat-related illnesses, and respiratory issues, disrupting daily life and economic activity.¹¹ Extreme heat also stresses infrastructure because as more residents install air conditioning units, electricity demand increases and risks overloading the power grid and causing outages. Additionally, rising temperatures harm local ecosystems by increasing water temperatures in the Brisbane Lagoon and other aquatic areas.

Flooding

Flooding occurs when normally dry land is covered by water. This can include creeks and other water bodies overtopping their banks, heavy rainfall that surpasses the capacity of drains to carry the water away, and very high tides. It can also occur because of dam failure, water or wastewater infrastructure failure, or tsunamis.

Floods are among the costliest natural disasters in terms of human hardship and economic loss nationwide, significantly threatening the health and life of community members and causing substantial damage to structures, landscapes, and utilities serving the city. Flooding can lead to long-term public health problems if mold and mildew grow in buildings, displace residents if homes are destroyed or become uninhabitable, and increase economic burdens, such as rising home insurance costs. Floods can also contribute to other natural hazards, especially landslides.

Climate change is expected to increase the risk of flooding across much of California. Even though overall precipitation levels may not change substantially, climate change is expected to shift precipitation to more extreme highs and lows, increasing the frequency and intensity of strong storms such as those associated with atmospheric rivers. For example, storms that have a 1 in 200 (0.5 percent) chance of occurring in any given year (known as a 200-year storm) could increase in frequency and become storms with a 1 in 150 chance of occurring in a year. Areas at risk of flooding are likely to increase. Climate change is also likely to increase the frequency and severity of droughts that cause soil to dry out and harden. When rainfall does return, more water runs off the surface than is absorbed into the ground, which can increase flooding downstream.

As shown on **Figure 3** and on the online [PREP Map Viewer](#), the mapped 100-year flood-prone areas in Brisbane include Valley Drive and surrounding properties, the Visitacion Creek Marsh and surrounding areas near Main Street, several of the Baylands industrial properties along Bayshore Boulevard, and the wetlands at the southern end of the Brisbane Lagoon. A large section of the Baylands west of the Caltrain tracks are in the mapped 500-year floodplain.

Atmospheric Rivers

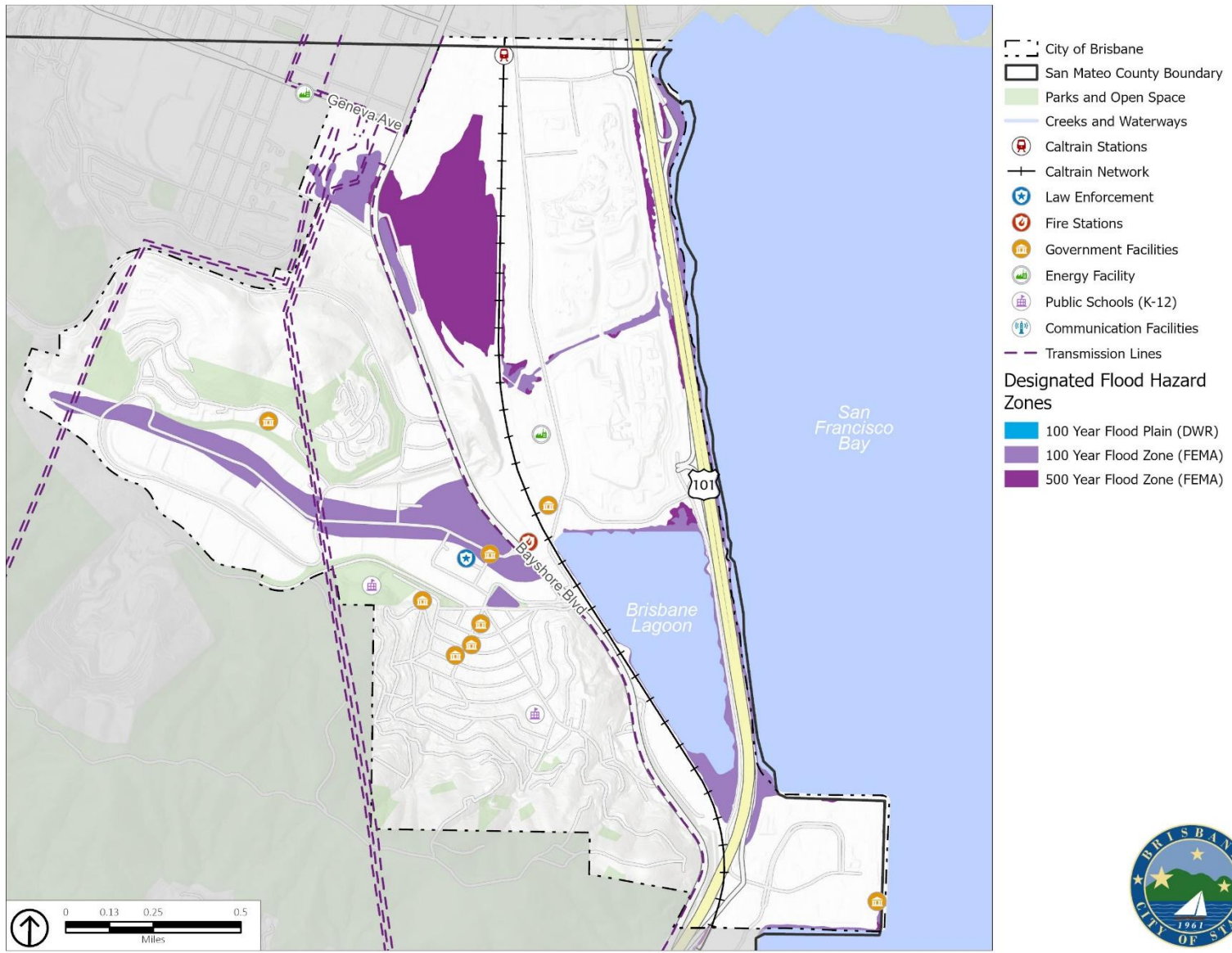
In California, flooding is usually caused by strong storms. Many of these storms are associated with atmospheric rivers. These are long, narrow bands of moisture in the atmosphere moving from the tropics that can cause heavy rain or snow when they move over land. These storms are responsible for over half of California's water supply, but also the majority of the flooding and mudslide events across the state.

Sources: Emily Mendez. 2024. *A Climate Expert Explains Why Atmospheric Rivers Are Causing Historic Rainfall in California*. Lamont-Doherty Earth Observatory: Columbia Climate School.

Floodplains and Flood Recurrence

According to the Federal Emergency Management Agency (FEMA), a floodplain is any area of land that could be flooded by water from any source, but are often next to creeks, lakes, oceans, and ponds. The 100-year floodplain is the area that has a 1 percent (1 in 100) chance of being flooded in any given year. This would also be the area that would flood during a 100-year storm. The 500-year floodplain is the area that has a 0.2 percent (1 in 500) chance of being flooded in any given year due to a 500-year storm.

Figure 3: Flood Hazard Zones in Brisbane



Source: ESRI, 2023; County of San Mateo, 2023; PlaceWorks, 2023; FEMA; DWR, 2021



Human Health Hazards

Human health hazards, including bacteria, viruses, parasites, and other pathogens, pose significant concerns in Brisbane. These conditions can result in physical injuries, fatalities, mental health issues, and exacerbate pre-existing conditions like asthma and allergies. Rats, mice, ticks, and mosquitos are common vectors, meaning that they often spread the pathogens that can cause illness. Rising temperatures and changing precipitation patterns due to climate change promote the proliferation of disease-carrying vectors. Warmer, wetter conditions allow for increased populations of mosquitoes and ticks, extending their geographic range and spreading diseases like West Nile virus, dengue fever, and Lyme disease.¹² According to the California Office of Health Hazard Assessment, as temperatures rise and extreme weather events, such as heavy rainfall, become more frequent, these vectors can spread more broadly, transmitting diseases that threaten public health.¹³

Heat waves, another increasing hazard due to climate change, can directly impact human health by causing heat-related illnesses and deaths, while also worsening respiratory conditions due to increased air pollution (as discussed above in the Air Quality and Extreme Heat sections). The combination of these factors suggests that human health hazards will become more widespread and severe as climate change progresses, making proactive public health measures even more critical, especially in areas that have limited healthcare services. The implications of these health hazards extend beyond individual well-being, placing strain on healthcare systems, increasing economic burdens, and affecting mental health.

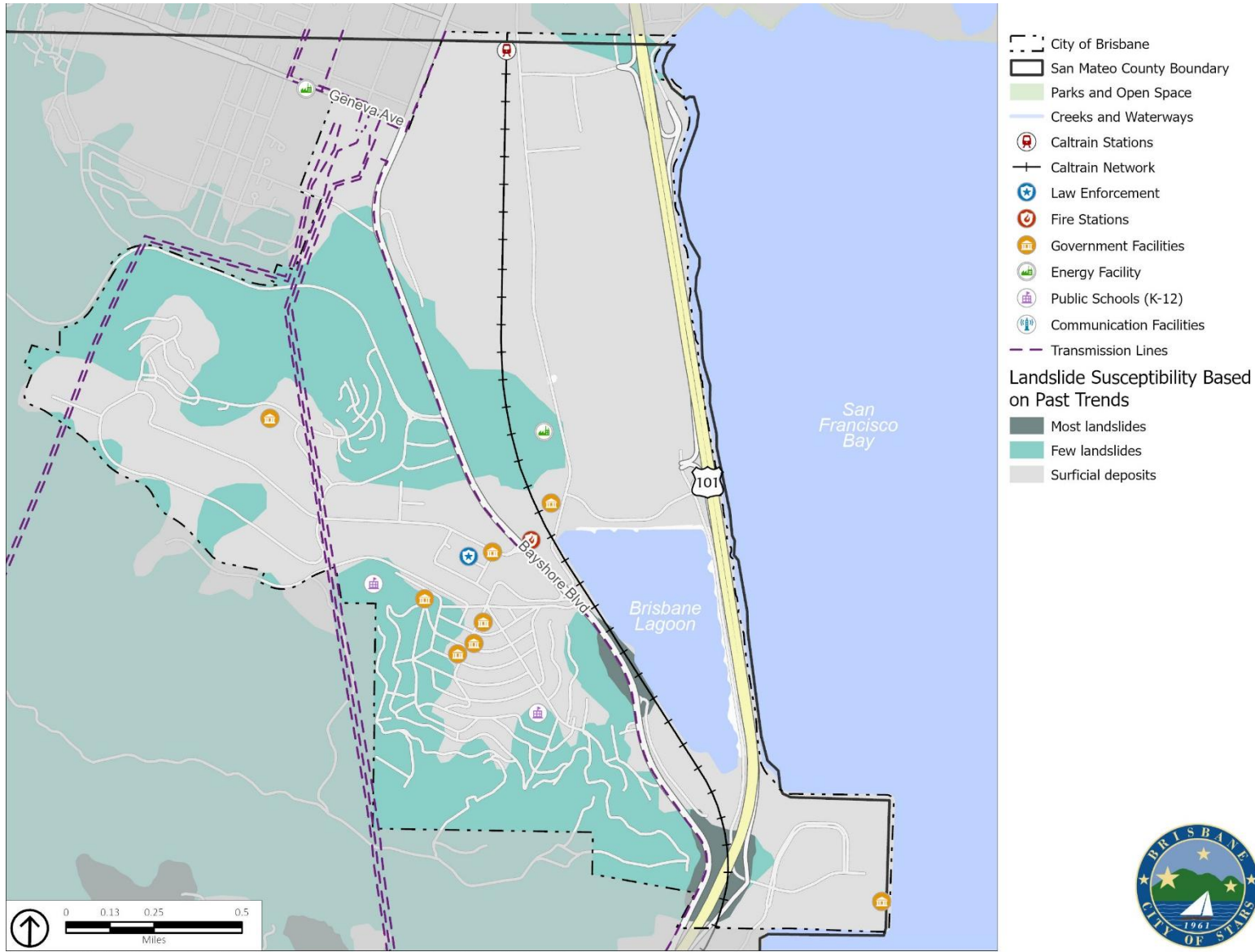
Landslides and Debris Flows

Landslides are the movement of rock, soil, or debris down a hill or mountain. They are often triggered by natural events such as heavy rainfall, floods, or earthquakes. Wildfires can indirectly cause landslides by burning away vegetation that helps stabilize the slope, making it more susceptible to sliding.

As shown on **Figure 4** and the online PREP [Map Viewer](#), the highest risks of landslides in Brisbane are around the southern end of Bayshore Boulevard and where Sierra Point Parkway crosses under Highway 101. Several areas of the community face a lower but still elevated risk of landslides, including the residential neighborhoods in the hills around Downtown and the Northeast Ridge neighborhoods. Although not directly in Brisbane, most of San Bruno Mountain is a landslide-prone area, and landslides in the unincorporated area could have impacts within Brisbane itself.

Climate change is expected to exacerbate landslide hazards by increasing frequency of wildfires and severe storms that can elevate the risk of landslides, particularly fast-moving debris flows. Landslides can displace residents, block key transportation routes such as Bayshore Boulevard and Highway 101, and damage critical infrastructure such as electricity, water, and sewer pipelines. Such impacts can disrupt daily life in Brisbane, deprive community members of key services, and require costly repairs.

Figure 4: Landslide Susceptibility Based on Past Trends in Brisbane



Source: ESRI, 2023; County of San Mateo, 2023; PlaceWorks, 2023; USGS, 1997



Sea Level Rise and Emergent Groundwater

As global temperatures rise, glaciers and other polar ice melt, causing sea levels to rise. High average temperatures can also cause ocean water to expand, causing further rising of sea levels. According to the 2024 California Ocean Protection Council's *State of California Sea Level Rise Guidance*, sea levels in Brisbane are projected to increase by as much as 0.4 feet (5 inches) by 2030, 1.3 feet (16 inches) by 2050, and 6.5 feet (78 inches) by 2100, from a year 2000 baseline.



However, sea levels could also rise faster than these projections, with storm surge and king tides events adding an additional 24 to 36 inches of temporary flooding.¹⁴

The sea level rise risk in Brisbane is mostly associated with temporary flooding. Even 6.5 feet of sea level rise is not likely to cause permanent inundation, except around the Highway 101 on- and off-ramps at the end of Harney Way. However, by 2100, a 20-year storm could cause temporary sea level rise at properties east of Bayshore Boulevard immediately adjacent to the Brisbane Lagoon, areas along the shore of Sierra Point, and overtop sections of Highway 101. **Figure 5** and the online PREP [Map Viewer](#) show these areas at risk of temporary flooding.

Another consequence of sea level rise is that it causes dense, saline water to infiltrate soils near shoreline areas. These waters can push fresh groundwater upwards, raising the water table. Rising groundwater can infiltrate storm drains, destabilize and corrode buried infrastructure, spread soil or groundwater contamination, undermine building foundations, and increase liquefaction hazards.¹⁵ In some cases, sea level rise can push freshwater high enough that it can emerge on the surface in low-lying areas and cause flooding, an effect known as “emergent groundwater.” Groundwater is expected to rise at the same rate as sea level rise in Brisbane, causing groundwater to emerge at the surface in low-lying areas.¹⁶

While the depth of emergent groundwater is not currently known, this hazard could cause widespread flooding throughout Brisbane, as shown on **Figure 6** and on the online PREP [Map Viewer](#). Areas potentially at risk include commercial areas between San Francisco Avenue and Valley Drive, the commercial and industrial developments next to Brisbane Lagoon east of

Liquefaction

Liquefaction occurs when water-saturated soils are shaken so violently that the individual grains lose contact with one another and float freely in the water, turning the ground into a puddinglike liquid. Building and foundations lose strength and may sink into what was previously solid ground. Unless properly secured, hazardous materials can be released, causing significant damage to the environment and people.

Bayshore Boulevard, and most of the Baylands north of the Kinder Morgan terminal and east of the Caltrain station. Parts of PG&E's Martin Substation-West in northern Brisbane are also at risk.

Though the exact level of future sea level rise is uncertain, it is expected to increase the frequency, duration, and magnitude of flood events and push groundwater to emergent levels further inland. Sea level rise and emergent groundwater are likely to interact directly with stormwater from inland sources, causing more severe flooding near creeks and at the outlets of drainage systems.

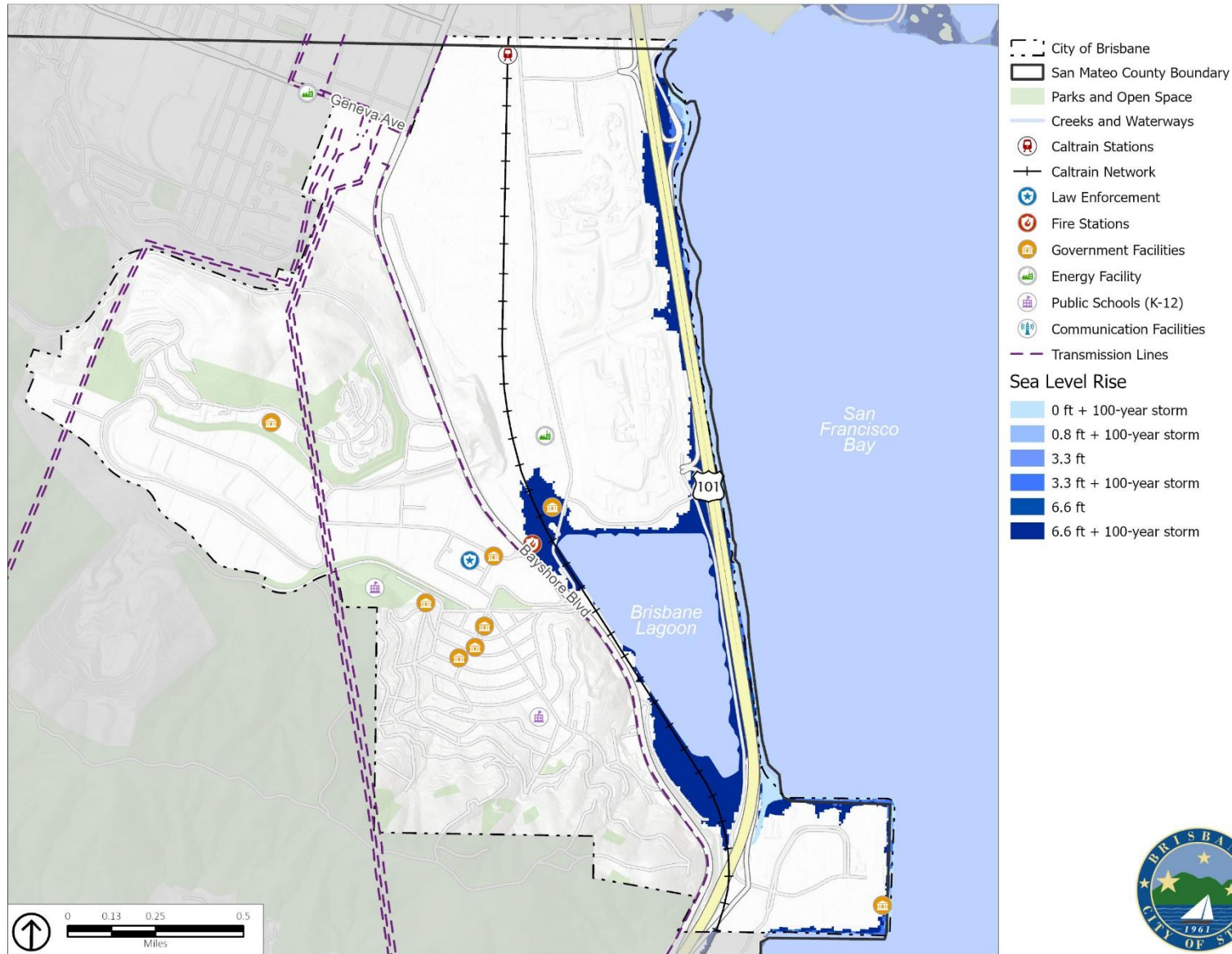
Severe Weather

Severe weather, such as high winds and thunderstorms, poses a significant threat to Brisbane. It is usually caused by intense storms, although some types of strong winds can occur separately from storm systems. The types of dangers posed by severe weather include injuries or deaths, damage to buildings and structures, fallen trees and roads blocked by debris, and fires sparked by lightning. Severe weather often produces high winds and lightning that can damage structures and cause power outages. Lightning from these storms can ignite wildfires and structure fires that can cause damage to buildings and endanger people. Objects such as vehicles, unprotected structures like bus stops or carports, fences, telephone poles, or trees can also be struck directly by lightning, which may cause an explosion or fire.

The most common severe weather events that have historically impacted Brisbane are heavy rains (usually a result of atmospheric rivers), thunderstorms, and windstorms. As mentioned above, though average annual rainfall may increase only slightly in Brisbane, climate change is expected to cause an increase in the number of years with intense levels of precipitation. Heavy rainfall can increase the frequency and severity of other hazards, including flooding and landslides.

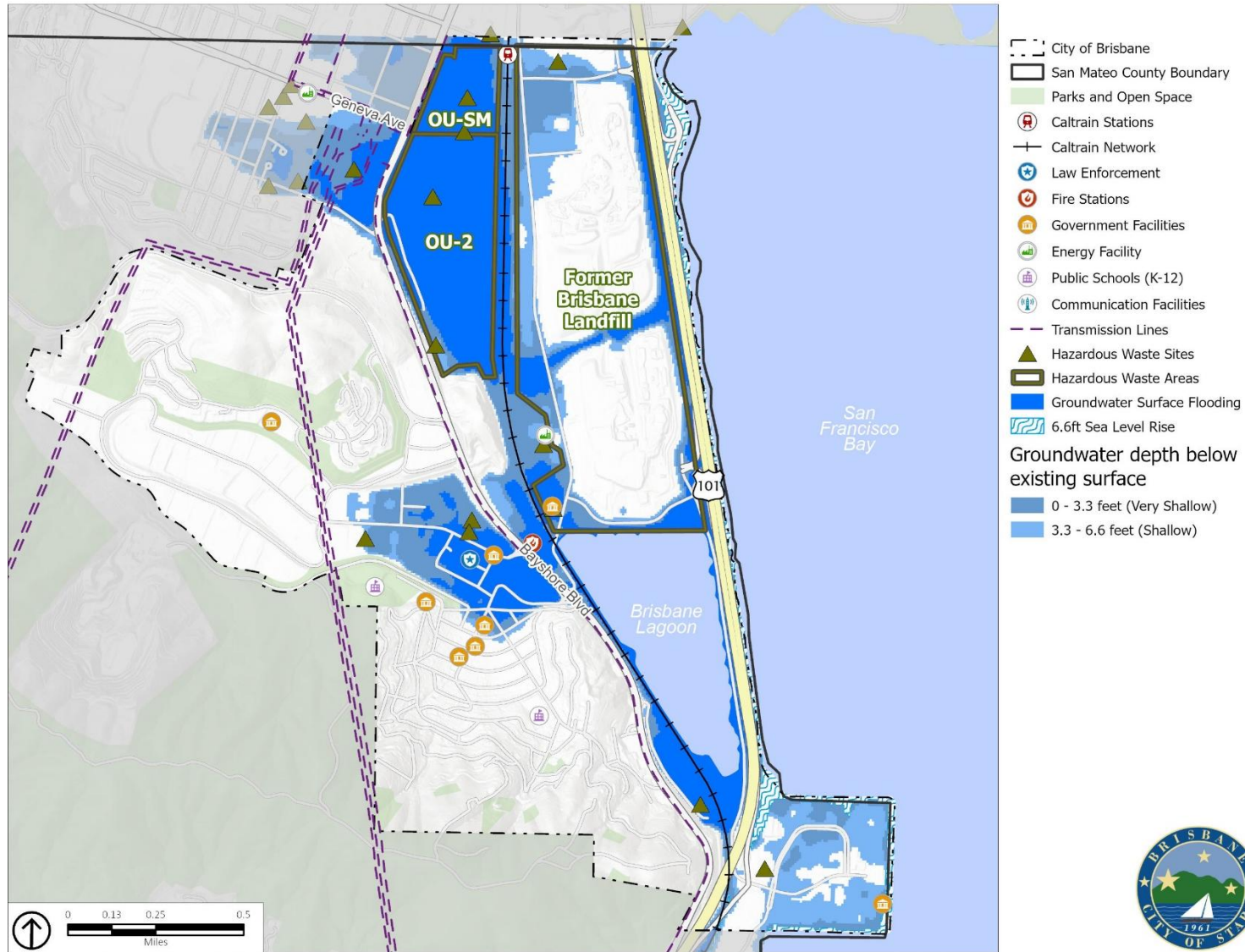
Public Safety Power Shutoff (PSPS) events are used as a preventive strategy to reduce wildfire risk during severe weather, especially during high winds and dry conditions. PG&E may shut off power lines during severe weather to prevent them from sparking fires, causing power outages that may last for extended periods. Though Brisbane has not been affected by PSPS events in the past, it may be in the future. Loss of power, whether intentionally caused by a PSPS or as an unscheduled impact of severe weather, can disrupt communication networks, harm people dependent on medical devices, and result in a loss of goods that need to be kept in specific conditions (refrigerated, for example). A loss of power can also interrupt heating or cooling services, which can be dangerous if occurs at the same time as extreme temperatures.

Figure 5: Projected Sea Level Rise in Brisbane



Source: ESRI, 2023; County of San Mateo, 2023; PlaceWorks, 2023; USGS CoSMoS

Figure 6: Emergent Groundwater in Brisbane



Source: ESRI, 2023; County of San Mateo, 2023; PlaceWorks, 2023; California Office of Environmental Health Hazard Assessment, 2021; USGS, 2020

*Depth of emergent groundwater not known

Wildfire

Wildfires pose a growing threat to Brisbane. The community's Mediterranean climate, steep topography, and diverse plant communities create ideal conditions for wildfire development. Historically, the fire season extended from early summer through late fall of each year during the hotter, dryer months, although it is increasingly a hazard that can occur year-round due to higher temperatures, lower moisture content in air and plant matter, accumulation of vegetation, and high winds. Rising temperatures and prolonged droughts dry out vegetation, creating abundant fuel for fires. Pest outbreaks, such as sudden oak death, leave weakened and dead trees as additional fuel, and extreme heat, less fog, and erratic wind conditions make wildfires more unpredictable and harder to control.

Human activities are the leading cause of wildfires, and increased development near these wildland areas has amplified the likelihood and risk of wildfire events.¹⁷ Wildfires not only destroy homes and infrastructure but can also displace entire communities and degrade critical wildlife habitats. The economic consequences are significant, ranging from property damage and fire suppression costs to long-term business disruptions. Climate change is expected to make wildfires worse throughout California by raising temperatures, increasing the frequency and severity of drought events that can dry out vegetation and make it more likely to burn, and increasing pest and disease activity that can kill vegetation and add fuel for fires.

The California Department of Forestry and Fire Prevention (CAL FIRE) designates fire hazard severity zones as Moderate, High, and Very High zones. Parts of Brisbane are designated Moderate, including the Northeast Ridge neighborhood, most of the Brisbane Acres area, and parts of Central Brisbane and Crocker Park. Unincorporated San Bruno Mountain is also area of Moderate fire. Figure 7 shows the fire hazard severity zones in Brisbane.

It should be remembered that wildfires can extend from wildland areas into development that is far from any mapped hazard zone. For example, the 2017 Tubbs Fire in Santa Rosa burned large sections of the city that were not in officially designated wildfire hazard zones, including the estimated 1,300 homes burned in the Coffey Park neighborhood.

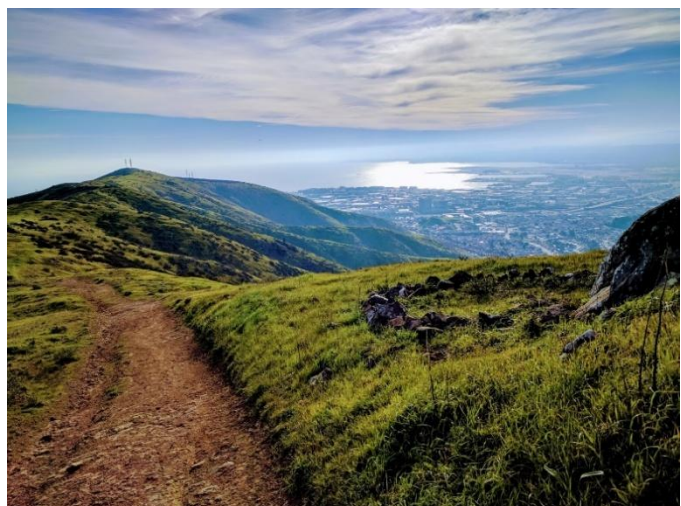
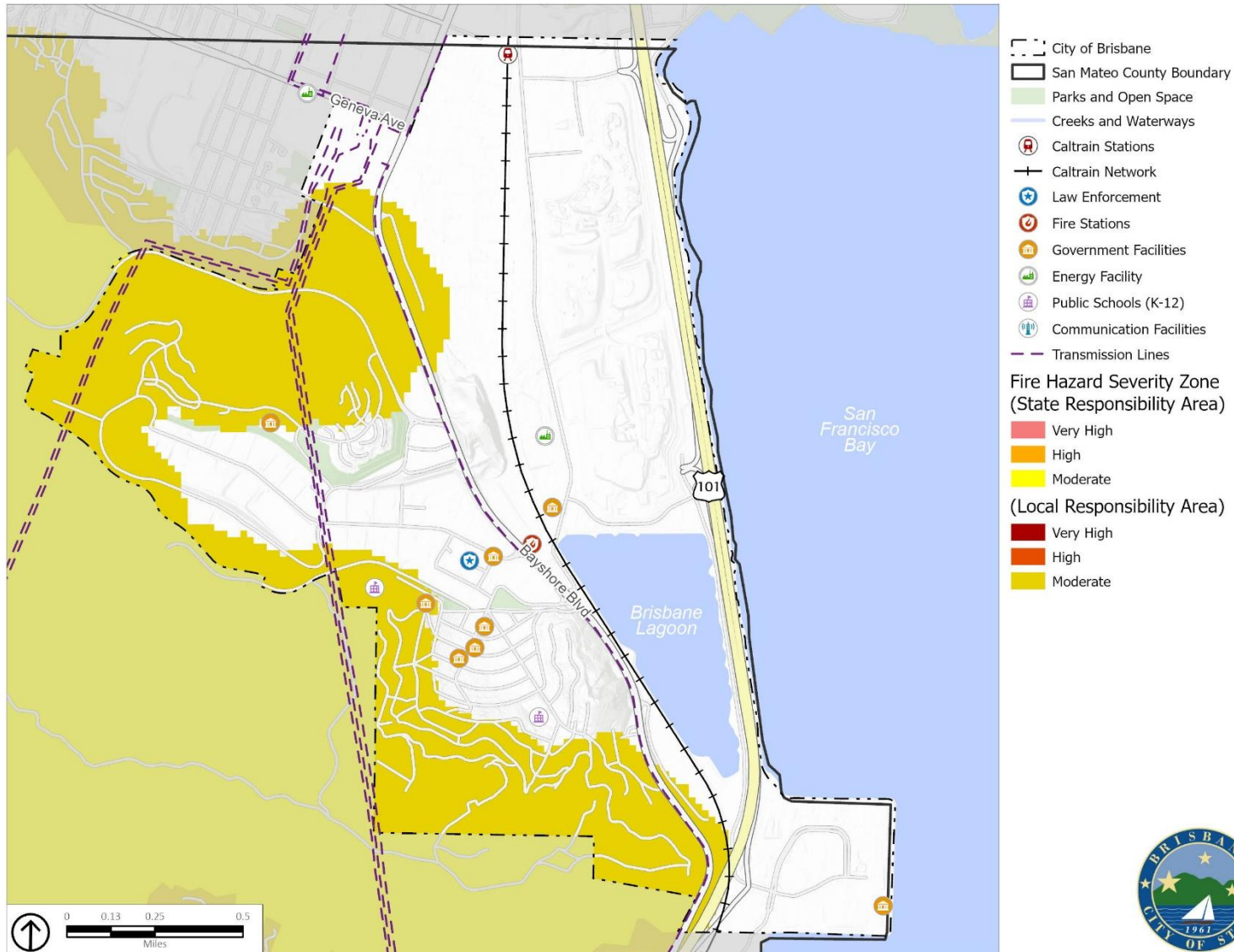


Figure 7: Fire Hazard Severity Zones in Brisbane



Source: ESRI, 2023; County of San Mateo, 2023; PlaceWorks, 2023; CAL FIRE 2024 and 2025



Key Findings

The following section presents the key findings of the Vulnerability Assessment for Brisbane, highlighting the people and community features that were identified as priority vulnerabilities. Priority vulnerabilities are the people, buildings, infrastructure, economic drivers, ecosystems and natural resources, and key services that should be considered the City's priorities in adaptation and resilience planning. Identifying a population or a community asset as a priority vulnerability reflects the severity of climate change impacts and level of harm, but also considers several other factors.

All ten hazards discussed in this report are of concern to Brisbane, although severe weather creates the most priority vulnerabilities, followed by extreme heat and warm nights, flooding, and wildfires. Climate change is expected to affect all population and assets in Brisbane to some degree. This section does not describe all potential harm in Brisbane but focuses on the most substantial findings from the vulnerability assessment. Other populations and assets that are not designated as priority vulnerabilities may also face substantial impacts from climate change.

Priority Vulnerabilities

In addition to the severity of impacts from climate change and related hazards, other factors that affect whether a population or asset is considered a priority vulnerability include:

- Size of the population or the importance of the asset.
- Equity considerations and history of marginalization.
- Role in supporting community well-being.
- Community values and concerns.
- Ability to resist and recover from hazards.
- Potential for cascading and compounding impacts.

Older Adults and Persons with Limiting Health and Wellness Factors

Most Vulnerable To:

			
Air quality and smoke	Drought	Extreme heat	Flooding
			
Human health hazards	Landslides	Severe weather	Wildfire

Older adults and persons with limiting health and wellness factors (including persons with disabilities, other access and functional needs, and chronic illnesses) are priority vulnerabilities for eight of the ten climate change hazards in Brisbane (all except ecosystem pests and sea level rise), more than any other population or asset in the community. These populations often face difficulty preparing for natural hazards, which can include hardening or retrofitting their homes (filling sandbags or maintaining defensible space, for example) or securing emergency supplies. Similarly, these persons often face challenges evacuating. Even if they have reliable access to a vehicle, they may have difficulty driving, especially during a sudden evacuation or one that occurs at night. Reduced mobility, impaired vision or hearing, and cognitive challenges are among the health factors that can complicate emergency preparation and response. The risk is especially high for individuals in this category who live alone.

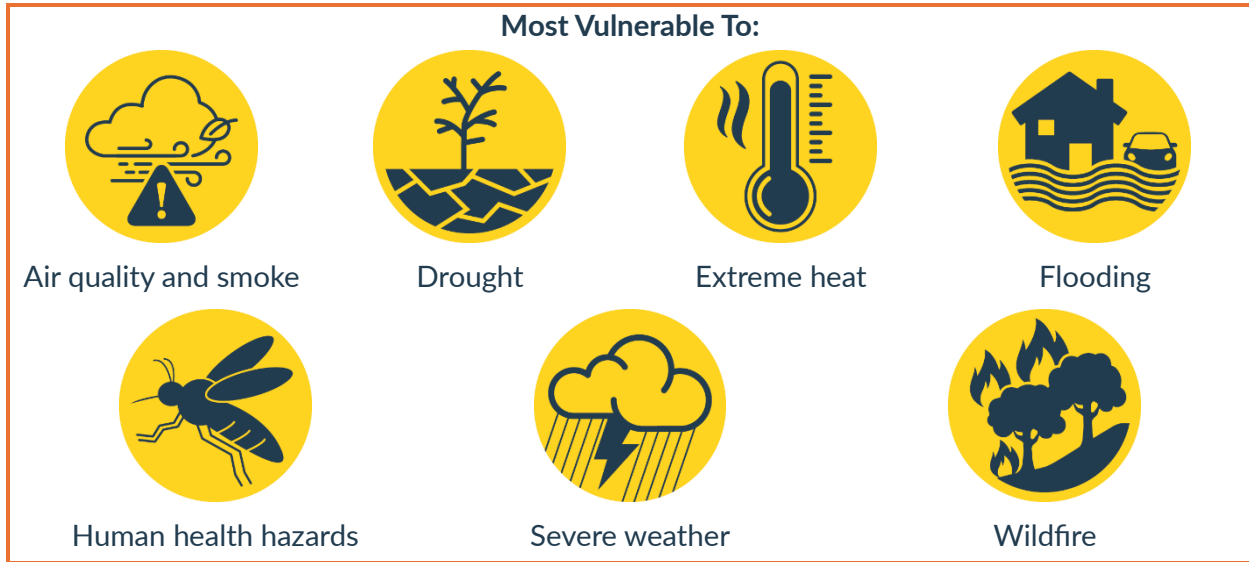
Supportive Programs

Brisbane has several programs and organizations to increase the resilience of these population groups, such as a cooling center at the Mission Blue Center, Brisbane Village Helping Hands, the Institute on Aging, the Center for Independence for Individuals with Disabilities and the County's Office of Sustainability, Office of Emergency Management, and Department of Public Health. While these organizations and services help reduce overall vulnerability, many of the populations they support are heavily impacted by several different hazards and require additional resources to increase resilience.

Older adults and persons with limiting health and wellness factors are also more directly susceptible to harm from some hazards, particularly air quality, extreme heat, and vector-borne human health hazards. Many of these individuals have conditions such as heart diseases, respiratory illnesses, or diabetes. Poor air quality, extreme heat, and some diseases can exacerbate these underlying issues, causing more serious health impacts than they would for other Brisbane community members. Many people in this group are also dependent on medication that may increase their risk. For example, several antihistamine medicines increase the risk of heat-related illnesses.

Compounding this, older persons and many persons with underlying health issues have lower or fixed income levels that can make emergency preparation and recovery more challenging. In Brisbane, the average person with a disability earns approximately \$53,600 annually, compared to average annual earnings of approximately \$77,400 for people without disabilities.¹⁸ These income disparities can prevent these people from taking necessary steps to reduce their risk of hazards or securing home insurance that can make post-disaster recovery easier. The digital divide is another factor, especially for older adults or those whose health issues may prevent them from using modern technology. These individuals often have more difficulty receiving timely alerts and critical information through smartphone alerts, social media, or text messaging. The relationship of physical limitations, chronic health issues, economic constraints, and limited access to information can converge to place their lives at considerable risk.

Persons with a Lack of Access to Resources



People must have access to sufficient financial resources to prepare for emergencies or recover effectively from them, but there are many in Brisbane who do not. In addition to low-income households and those in poverty, this also includes households who are overcrowded (e.g., there are not enough rooms in their homes to comfortably accommodate everyone) or those that are housing cost-burdened (spending at least 30 percent of their income on housing costs). In San Mateo County, a family of four earning less than \$156,650 is considered low-income, and even those that earn more may have limited financial resources due to high housing costs. Approximately 54 percent of households (of all sizes) in Brisbane reported annual incomes of less than \$150,000 in 2022.¹⁹ It is important to remember that the “low resourced” population is broader than the traditional conception of “low-income”.

Low-resourced households often lack sufficient resources to invest in steps that help them prepare for hazards, including home repairs and maintenance, and weatherization or landscaping improvements, energy-efficient appliances, healthcare, and others. Low-resourced households are also more likely to be renters, which limits the types of steps they can take to prepare for hazardous conditions. Evacuation concerns are significant for these households because they may lack access to reliable transportation or the financial means to leave during emergencies, which can make it more difficult to comply with evacuation orders.²⁰

Low-resourced households are less likely to have air conditioning (or be able to afford to run it, especially during extreme heat) or air filtration systems, increasing the risk from poor air quality and heat waves. These households are less likely to have effective homeowners’ insurance, which can make it harder for them to recover. Limited financial resources may prevent these households from affording safe and secure housing, increasing the likelihood that they live in older buildings with poor maintenance, structural damage, or inadequate sanitation.²¹ These conditions create an ideal environment for pests, which can carry harmful pathogens. These households may be financially strained by medical costs and inability to work due to illness, injury from a hazard, or if

emergency conditions prevent them from getting to work (for example, if a vital roadway is flooded).

Persons of Color and Persons with Linguistic Isolation



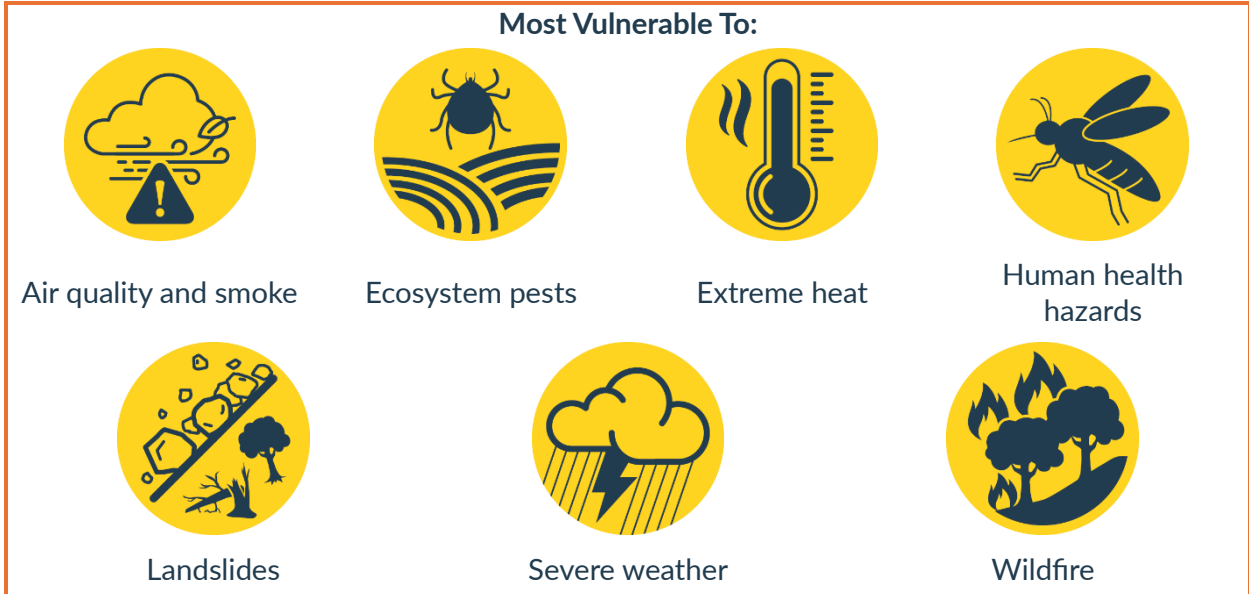
Brisbane is a community with high racial and ethnic diversity. Approximately 40 percent of the community identifies as white (not Hispanic or Latino), 34 percent identify as Asian, 23 percent as Hispanic or Latino, and approximately 3 percent as multiple races or another race/ethnicity. Persons of color often face systemic discrimination and marginalization that makes them more susceptible to harm, even when controlling for other factors such as income and educational attainment.

When persons of color seek out cooling centers, health services, and other resiliency programs, they are more likely to encounter questions about citizenship status, racial discrimination, and language barriers that make them feel unsafe or unwelcome.²² Many individuals in these communities work in outdoor occupations, exposing them to poor air quality, extreme heat, and vector-borne illnesses (discussed under “Persons with Increased Hazard Exposure,” below).

Linguistic isolation often significantly compounds these challenges. Persons who are linguistically isolated are those who are not proficient in English, particularly if there is not anyone in their household who is. They are much less likely to receive information about hazards, including time-sensitive information such as emergency alerts or evacuation notices. Linguistic barriers also make it more difficult for them to receive information about resilience programs and other support systems. Approximately 15 percent of Brisbane’s population is linguistically isolated, as shown in **Table 1**, and approximately 12 percent of households do not have any household member who is proficient in English. The Census Bureau estimates that linguistic isolation in

Brisbane is highest for households that speak Mandarin, Cantonese, or “other Asian and Pacific Island languages”.*

Persons with Increased Hazard Exposure



Some people are more likely to be exposed to hazards due to where they live or work. This is especially true for outdoor workers and unhoused persons. Approximately 6 percent of Brisbane residents work outdoors, which includes persons in construction, stone and aggregate mining,[†] and landscaping industries. Their jobs often require wearing heavy gear and performing manual labor, which increases their susceptibility to heat-related illnesses during periods of extreme heat. Outdoor workers are often from low-resourced households and more likely to be people of color. These jobs often have fewer educational requirements, making them accessible to those facing challenges such as a lack of legal status, language barriers, or the need to support their families. Additionally, systemic barriers limit access for many people of color to higher-paying, safer jobs, leading to a concentration in low-wage, physically demanding work. These positions are often seasonal or temporary, which further contributes to their economic insecurity. Natural disasters, such as wildfires or severe weather, can disrupt their ability to work, leading to economic instability. This financial strain can limit access to timely medical care, creating a cycle of vulnerability that is difficult to break.

Unhoused persons may face even greater challenges from these hazards. Without consistent access to adequate shelter, they are left exposed to poor air quality, extreme heat events, vector-borne illnesses, and other hazardous conditions, putting their health and safety at significant risk.

* It is unclear exactly what language or languages are spoken in these households, but based on an analysis of census data, these languages may be Burmese, Khmer, and/or Malay.

[†] The Guadalupe Quarry, which provides the stone and aggregate mining jobs in Brisbane, may close in the near term if a proposed redevelopment project is approved. This would likely decrease the percent of Brisbane residents who work in outdoor occupations.

In some parts of Brisbane, they also face a risk of injury from landslides. Even if they are not harmed directly by hazardous events, their belongings can be damaged, destroyed, or lost due to flooding from heavy rainfall events or storm surge that moves farther inland due to sea level rise. This can further diminish their already-reduced ability to adequately respond to and recover from hazards. Although Brisbane has a small number of unhoused persons (11, according to the most recent point-of-time count), these individuals have extremely limited financial resources and are often unable to seek any kind of shelter, which contributes to them being highly vulnerable to hazardous conditions.

Transportation Infrastructure



Brisbane's transportation infrastructure includes Highway 101, all local roadways, and the Caltrain commuter rail line. It provides community members with the means to go about their day-to-day lives, allows for the movement of vital goods and services, and supports numerous important community services. However, this complex infrastructure network faces harm from several hazards.

Flooding is a substantial hazard of concern for transportation networks in Brisbane. Highway 101 runs through flood-prone areas at a few locations in the community, and sea level rise may exacerbate this flooding. This is particularly an issue for Bayshore Boulevard, the largest surface street in Brisbane, which runs through a mapped floodplain at the northern end of the city. Bayshore Boulevard and other roads in flood-prone areas may be damaged by floods or blocked by standing water, creating traffic delays, or making them impassable. Blocked or damaged roads can interfere with people getting to work, school, or critical appointments. Services such as public transit and emergency response may be interrupted if these roads are blocked or damaged.

The Caltrain commuter rail line passes through mapped floodplains at points in the Baylands and the southern end of Brisbane Lagoon, and is therefore subject to disruption from flooding. The San Mateo County Climate Ready program noted that during extreme heat events, Caltrain will reduce the speed of trains to prevent damage to tracks.²³ Interruptions to the Caltrain line can cause regional disruptions, preventing Brisbane community members from reaching major job centers in other communities. If Caltrain service is interrupted or significantly delayed, people are likely to drive as a backup, which can lead to increased congestion on Highway 101 and Bayshore Boulevard.

Energy and Communication Infrastructure and Services



Energy and communication infrastructure is necessary to maintain quality of life and support much of the economic activity in Brisbane, including warehouse/logistics and life sciences operations. In emergencies or other hazardous conditions, this infrastructure helps people receive potentially life-saving information and can maintain critical services such as air conditioning during extreme heat events or air filtration during poor air quality events. However, this infrastructure network is also vulnerable to disruption from numerous hazards.

Extreme heat events can regularly cause power outages due to a combination of mechanical failure of electrical grid equipment, heat damage to the wires themselves, and high demand for electricity because of cooling equipment, all of which cause stress on the grid. Similarly, extreme heat can harm communication infrastructure and disrupt service in Brisbane. Landslides and severe weather can knock over power lines, damage communication hubs, and in some cases may also disrupt underground natural gas lines. According to PG&E, a major natural gas line runs along Bayshore Boulevard and another under PG&E's electrical transmission lines in western Brisbane (both areas have elevated landslide risks) Many major electrical transmission lines that serve Brisbane and connect to the Martin Substation run through areas of elevated landslide risk, including parts of San Bruno Mountain south of the community. Part of the Martin Substation is

also within a mapped floodplain, and while this in itself is not considered a priority vulnerability, it could potentially result in impacts to the facility during an extreme flood event.

Retrofitting or undergrounding this infrastructure can be expensive and requires coordination with PG&E. The Martin Substation does provide some degree of protection against a loss of power because it is a centralized piece of infrastructure in PG&E's energy network, so there is greater redundancy in Brisbane's electricity connections than in more remote parts of San Mateo County. However, there is still a high potential for power loss, especially in the hillside residential neighborhoods where there is less redundancy.

Water and Wastewater Infrastructure and Services



Brisbane's water and wastewater system is another critical piece of infrastructure for the community, given the importance of the services that these systems provide. The City maintains both the water and wastewater infrastructure in Brisbane, although the SFPUC supplies water to Brisbane and treats the community's wastewater under contract.

Drought does not significantly affect water and wastewater infrastructure in Brisbane, although the reduced water flow through wastewater pipes during drought conditions can cause some damage to the infrastructure. However, water and wastewater *services* are a priority vulnerability for drought. Studies conducted by the SFPUC note that while the system's water supply is generally resilient to climate change at current water demand levels, an increase in water demand could exceed supplies. A recent study estimated that if water demand on the system increased by 15 percent, SFPUC would not be able to meet water demand while maintaining rationing targets.²⁴

Extreme heat is not likely to significantly affect water supplies in Brisbane, but it can affect the community's water infrastructure. City staff report that extreme heat raises the temperature of stored water, resulting in reactions that increase the level of nitrates in the water and can affect

disinfection activities. Flooding, landslides, and severe weather can damage pipelines and treatment/processing facilities, interrupting water and wastewater services and resulting in expensive repairs. One of Brisbane’s wastewater pump stations is vulnerable to sea level rise, particularly from saltwater that can corrode pipelines over time and compromise the station’s electrical system. If wastewater pipes or other infrastructure are damaged, this could spill untreated or partially treated wastewater, creating a human and environmental health hazard. This is of particular concern if wastewater reaches San Francisco Bay or the Brisbane Lagoon without being fully treated. There are also concerns that wildfires near SFPUC’s reservoirs, including those in the Sierra Nevada, Alameda County, and the more local San Andreas or Crystal Springs reservoirs, could lead to fire retardants contaminating the water supplies. Such contamination could be filtered out, but treatment plants would need the necessary treatment resources to ensure that the water supply remains safe.

Oak Woodland Habitat



Oak woodland is common along the side of San Bruno Mountain behind Brisbane, including in places such as Costaños Canyon, Firth Canyon, and Buckeye Canyon just outside of the city limits. This ecosystem, made up of coast live oak trees and associated species such as California bay laurel trees and toyon shrubs, serves as habitat for many important species and is a key part of the regional community character. However, it is among the habitats in Brisbane that is most susceptible to climate change and is identified as a priority vulnerability for more hazards than any other natural resource or ecosystem in the community.

Growing on the hillside, Brisbane’s oak woodland habitats are exposed to landslides and severe weather. Severe weather can blow down branches, and significant landslide and severe weather events can topple entire trees. Although these hazards are not often widespread to pose significant danger to the ecosystem at large, they are expected to occur more frequently in the future, and so over time Brisbane could see a gradual loss of oak woodlands.

Oak woodlands throughout California, including in Brisbane, are regularly exposed to drought and wildfire conditions. Overall, these ecosystems are typically well adapted to these hazards, as oak trees are usually able to recover well from drought, and most oak trees (especially established adults) can survive wildfires.²⁵ However, a significant increase in drought and wildfire frequency and severity can stress oak trees beyond their normal capabilities, weakening them and causing long-term damage to the ecosystem.



The risk of pests and diseases, particularly sudden oak death, compounds the hazards for oak woodlands. Oak trees that face increased stress from conditions such as drought are more susceptible to diseases. Pests and diseases can also make post-disaster recovery more difficult by infecting and killing younger trees before they have a chance to establish themselves.

Emergency Services

Most Vulnerable To:

 Air quality	 Extreme heat	 Flooding	 Human health hazards
 Landslides	 Severe weather	 Wildfire	

Brisbane's emergency services include fire, emergency medical, and law enforcement response. Such services are critical to the health and safety of the community but face a risk of significant disruption from climate change. There are two main challenges to Brisbane's emergency services caused by natural hazards: disruptions to community roadways and stress on local service capacities.

PENINSULA RESILIENCE PLANNING PROJECT
CITY OF BRISBANE | VULNERABILITY ASSESSEMENT SUMMARY

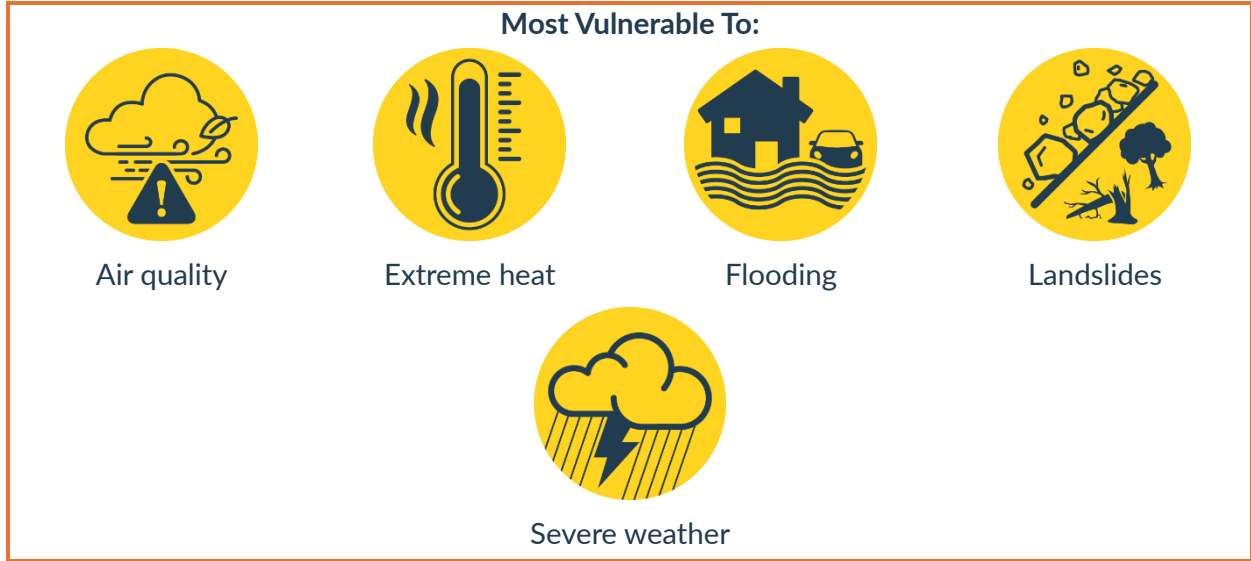
As mentioned above in the “Transportation Infrastructure” discussion, Brisbane’s road network is vulnerable to disruption from flooding, landslides, severe weather, and wildfire. Such hazards may directly damage the road surface or can prevent access (for example, flooding that is too deep to drive through, or a downed power line on a roadway). This can affect both Highway 101 and local roadways. If roadways in Brisbane are closed, emergency responders can be delayed. Responders may have a particularly difficult time reaching homes and businesses on roadways with a single or limited access points, including some of the roads at the top of the residential neighborhoods around Downtown.

Several hazards can increase the demand for emergency response services, which can stress responder staff even if there is no impact to local infrastructure. Significant, one-time events like floods, landslides, and wildfires can tax Brisbane’s emergency response capabilities. However other types of events, like poor air quality, extreme heat days, or widespread human health issues can also create challenges. There is likely to be a significant increase in demand for emergency medical response services on these days, and Brisbane may not have the capabilities to meet community demand. Response staff themselves may be unable to come into work, further restricting local capacity. While Brisbane can request assistance from neighboring jurisdictions, regional hazard events can create similar stresses for emergency responders in other communities and leave little or no surplus capacity to support Brisbane.



Community members may have difficulty accessing fire and other emergency response services during extreme events. Photo by the City of Brisbane.

Public Transit Services



Brisbane’s primary public transit provider is SamTrans, which operates two local bus routes that connect Brisbane to neighboring communities, plus a regional express bus route between San Francisco and San Mateo that stops in Brisbane. The regional Commute.org program also runs two commuter shuttles that connect Brisbane with Daly City and San Francisco, and the Bayshore Caltrain station just north of Brisbane provides regional rail service. Climate change threatens the safety and reliability of these services.

The primary risk to public transit services is damage to the community road and highway network that prevents bus access. Flooding, landslides, and severe weather may block roadways by damaging the roadbed itself or by causing the road to be impassable (for example, from debris or standing water). In these cases, bus routes may reroute, terminate early, or not run at all. Such impacts can leave some neighborhoods in Brisbane entirely without access to transit. Additionally, poor air quality can reduce visibility, forcing buses to drive more slowly, creating delays and potentially reducing the usefulness of transit services. As mentioned above in the “transportation infrastructure” discussion, extreme heat can cause delays on the Caltrain commuter rail line, further affecting transit services in Brisbane.

Public transit is a vital equity consideration in the community. Although people of all ages and income levels ride transit, it is particularly important for households without access to a reliable vehicle (who are usually lower-income households) or persons with disabilities and access/functional needs who may be unable to drive in some conditions or at all. Maintaining a safe and reliable transit system in Brisbane, and between Brisbane and neighboring communities, is critical in moving to a more equitable future.

Other Priority Vulnerabilities

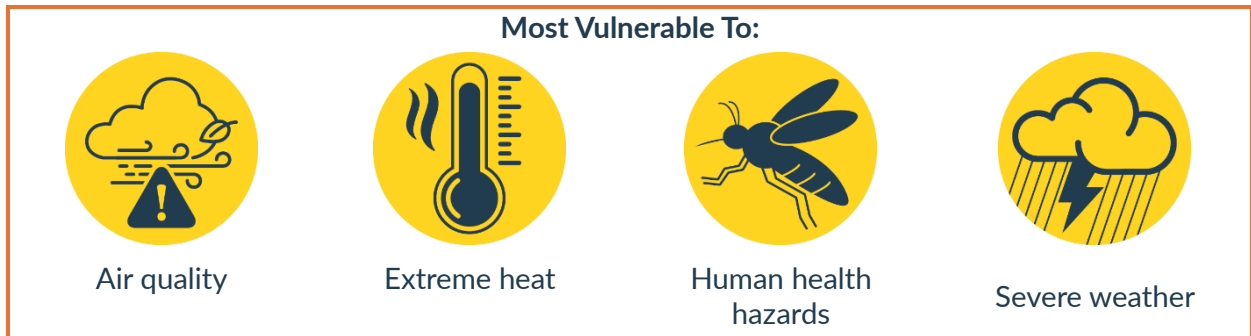
Although the following populations and assets are not identified as priority vulnerabilities for as many hazards as discussed above, they are still significant and important to Brisbane and represent critical concerns to community members. It is essential that this report recognize these other priority vulnerabilities for the purpose of community planning and risk assessment efforts. Addressing these vulnerabilities proactively can help to mitigate their impacts and support Brisbane’s overall resilience.

Persons without access to lifelines



In this vulnerability assessment, “lifelines” refers to private vehicles and electronic communication services such as television, phone, and Internet access. Without these lifelines, community members are likely to be highly isolated. They are often unable to receive information about imminent or ongoing emergencies, including evacuation orders. They also face difficulties in improving their resilience, even during “normal” conditions, because the lack of access to a vehicle can prevent people from accessing necessary goods and services if they do not live in a transit-accessible area and do not have a social network of friends and family who they can rely on for transportation.

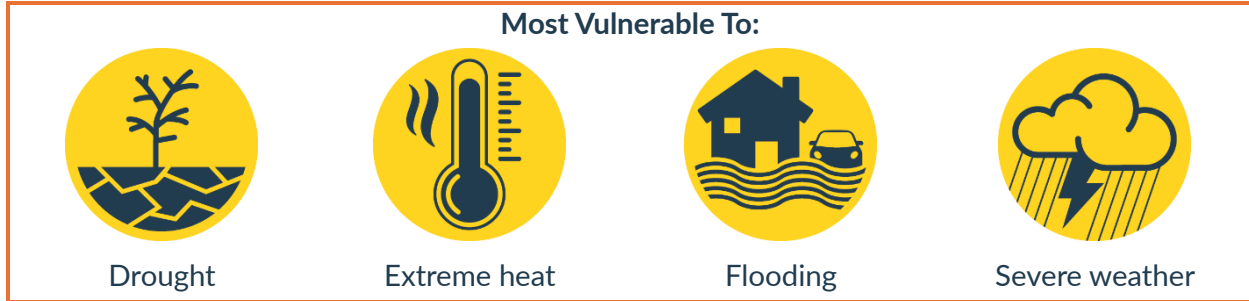
Hospitality and tourism



Hospitality and tourism is an important driver of the regional economy, and includes the hotels at Sierra Point. If air quality is poor or if there is a significant human health hazard outbreak, the number of visitors to the region can drop and affect Brisbane’s economy. While extreme heat can drive tourism to San Mateo County since it is usually cooler than inland California, it could also

result in power outages that may harm the local hospitality sector. Severe weather can also damage hotels and other visitor-serving buildings.

Riparian forests



Brisbane has a few patches of riparian forest ecosystem in the southern part of the Crocker Park neighborhood and in parts of the Baylands east of the Caltrain tracks. This ecosystem is made up of small trees and shrubs that prefer moist soils, especially the Arroyo willow. Drought and extreme heat can dry out these soils, depriving plants of necessary moisture and harming the viability of the ecosystem. Floods can wash harmful debris or pollutants into riparian areas, and severe weather can create debris in the ecosystem that may affect water flow. Since the riparian forest ecosystem in Brisbane is highly fragmented, the ecosystem is likely to have a harder time recovering than a more integrated environment.

Salt marshes



Brisbane's salt marshes are clustered at the southern and northwestern ends of the Brisbane Lagoon, at the northeastern corner of Sierra Point, and around the Harney Way on- and off-ramps. These are the remaining fragments of much larger salt marshes that were once common across the Bay Area, and they are vulnerable to a number of hazards. Extreme heat can raise water temperatures and result in the growth of harmful algae in the marshes, and flooding and severe weather can cause significant runoff of freshwater into the marsh that may carry harmful pollutants or debris. Also, sea level rise can cause the marshes to be regularly inundated, eroding the vegetation and causing the marshes to transition to open water.

Next Steps

The vulnerability assessment is a key technical study that can inform a future update of Brisbane's General Plan Safety Element. The vulnerability assessment helps community members, agency staff, and decision makers understand how climate change hazards may alter community conditions and what parts of the community (people and places) should be prioritized for adaptation and resilience. The findings from the climate change vulnerability assessment process can be used to inform the goals, policies, and actions to be included in the Safety Element, helping to build a stronger and more resilient community.



A blue heron at Brisbane Lagoon. Photo by the City of Brisbane.

Glossary

Adaptation: Making changes in response to current or future conditions (such as the increased frequency and intensity of climate-related hazards), usually to reduce harm and to take advantage of new opportunities. ^{26 27}

Adaptive Capacity: The combination of the strengths, attributes, and resources available to an individual, community, society, or organization that can be used to prepare for and undertake actions to reduce adverse impacts, moderate harm, or exploit beneficial opportunities. ²⁸

Cascading or Compounding Effects: Extreme events that link together hazards over days, weeks, or months, resulting in multiplied effects that cause secondary and sometimes tertiary damage, exceeding the damage of the initial hazard event.

Climate Change: A change in the state of the climate that can be identified by changes in the mean, and/or the variability, of its properties, and that persists for an extended period, typically decades or longer.

Community Asset: A valued feature of a community that may be harmed by climate change. Community assets may include buildings, infrastructure, community services, ecosystems, and economic drivers.

Exposure: The presence of people; infrastructure; natural systems; and economic, cultural, and social resources in areas that are subject to harm. ²⁹

Goal: An ideal future end state related to public health, safety, or general welfare.

Hazard: An event or physical condition that has the potential to cause fatalities, injuries, property damage, infrastructure damage, damage to the environment, interruption of business, or other types of harm or loss. ³⁰

Impact: The effects (especially the negative effects) of a hazard or other conditions associated with climate change.

Policy: A specific statement that guides decision-making, indicating a commitment of the local legislative body to a particular course of action.

Program: An action, procedure, program, or technique that carries out a general plan policy.

Resilience: The capacity of any entity—an individual, a community, an organization, or a natural system—to prepare for disruptions, to recover from shocks and stresses, and to adapt and change from a disruptive experience. Community resilience is the ability of communities to withstand, recover, and to learn from past disasters to strengthen future response and recovery efforts.

Risk: The potential for damage or loss created by the interaction of hazards with assets such as buildings, infrastructure, or natural and cultural resources.

Vulnerability: The degree to which natural, built, and human systems are susceptible to harm from exposure to stresses associated with environmental and social change and from the absence of capacity to adapt. ³¹

Vulnerability Assessment: An analysis of how a changing climate may harm a community and which elements—people, buildings and structures, resources, and other assets—are most vulnerable to its effects based on an assessment of exposure, sensitivity, potential impact(s), and the community’s adaptive capacity.

Appendix A: Methods

The Vulnerability Assessment considers the threats from all relevant natural *hazards*, which are events or physical conditions that have the potential to cause harm or loss and will emphasize changes to hazard frequency and severity due to climate change. When Brisbane updates its Safety Element, the update will address natural and human caused hazards, such as seismic hazards and hazardous materials. However, these hazards are not included in the Vulnerability Assessment, as climate change does not substantially change their frequency or severity. The Vulnerability Assessment also assesses *populations* and *assets* facing potential harm from the hazards. This includes the risk of physical damage to buildings and infrastructure, social vulnerability of persons likely to be disproportionately harmed by hazards, potential disruption to the city's economic engines, and loss of important services.

The Vulnerability Assessment is based on accurate and up-to-date information, including the Cal-Adapt database, the *California Adaptation Planning Guide (2020)*, and the *San Mateo County Multijurisdictional Local Hazard Mitigation Plan (2021)*. As outlined in the *California Adaptation Planning Guide*, the Vulnerability Assessment follows a four-step process:

1. **Identify Exposure.** In a vulnerability assessment, *exposure* is the presence of people, infrastructure, natural systems, and resources (economic, cultural, and social) in areas subject to harm. A *hazard*, in this context also called a climate change hazard, is an event or physical condition that has the potential to cause types of harm or loss. This step includes confirming applicable hazards in the county, describing historical hazards, describing how hazards are expected to change, and mapping the hazard-prone areas. The creation and review of this memo is part of this step of the Vulnerability Assessment.
2. **Analyze Sensitivity and Potential Impacts.** *Sensitivity* is the level to which changing climate conditions affect a population or community, species, natural system, government, asset, or resource. Potential *impacts* are the effects of a climate change hazard, the combination of exposure to the hazard and sensitivity of the population or asset to it. For example, suppose an increase in extreme heat events is the hazard. In that case, the greater risk of heat-related illness in susceptible persons is the exposure, and the sensitivity is the degree of the impact from the exposure. Each population and asset in Brisbane is likely to experience different impacts. The project team will assess the sensitivities and potential impacts to each population or asset from each applicable climate change hazard.
3. **Evaluate Adaptive Capacity.** *Adaptive capacity* is the ability of people and assets to adjust to potential damage from climate change hazards, to take advantage of existing resources and opportunities such as funding or tools, and to respond to the impacts of climate change. The project team will assess the adaptive capacity of each population and asset for each applicable identified hazard. The City is already implementing several measures to increase adaptive capacity including the Municipal Code requirements, Capital Improvement Program, Climate Action Plan, and others listed in the Adaptive Capacity Resources section, below.

4. **Conduct Vulnerability Scoring.** *Vulnerability* is defined as the combination of impact and adaptive capacity as affected by the level of exposure to changing climate conditions. Following the process in the *California Adaptation Planning Guide*, the project team will score impact and adaptive capacity for each population and asset affected by each hazard on a scale of low, medium, and high, which informs determination of the priority vulnerabilities among the populations and assets in Brisbane.

Appendix B: Populations and Assets

Populations

1. Children and youth (under 18).
2. Cost-burdened/low-income/overcrowded households: Cost-burdened households are those paying 30% or more of their income towards housing expenses.³² The State identifies \$149,100 as the low-income threshold for a household of four people in San Mateo County in 2023.³³ Approximately 5 percent of Brisbane residents earn incomes at or below poverty level.³⁴ Overcrowded households include housing units that have more than 1.0 person per room (excluding bathrooms and kitchens). Approximately 6 percent of Brisbane homes are overcrowded.³⁵
3. Households in poverty: The federal poverty line for a household of four is \$31,200 a year.³⁶ However, in San Mateo County, the poverty line (15 percent of area median income) is even lower. at \$26,250 for a household of four.³⁷ Approximately 5 percent of Brisbane residents earn incomes at or below poverty level.³⁸
4. Immigrant communities/linguistically isolated persons: Communities consisting of foreign-born populations, including immigrants, refugees, and undocumented persons. Linguistically isolated persons include households without a member who is fluent in English. Chinese, Spanish, and Tagalog are the primary languages in Brisbane among households that are not fluent in English.³⁹
5. Low-resourced people of color: Persons identifying as a member of a racial and/or ethnic group and facing limited access to resources, such as financial, social, healthcare, or educational assistance.^{40,41}
6. Outdoor workers: workers in landscaping, construction, outdoor recreation, etc.
7. Persons experiencing homelessness: 2022 Point In Time count reported six total persons experiencing homelessness (all unsheltered) within the City of Brisbane.⁴²
8. Persons living on single access roads (roads with only a single entry or exit point): Single access roads are generally located in the western and southwestern portions of Brisbane.
9. Persons with chronic illnesses and/or disabilities: Approximately 9 percent of Brisbane's population identifies as having a disability.⁴³
10. Persons without a high school degree. Approximately 10 percent of Brisbane's adult population has not obtained a high school degree or equivalent.⁴⁴
11. Persons without access to lifelines: Persons without reliable access to a car, transit, or communication systems. Approximately 1 percent of Brisbane households do not have access to a personal vehicle.⁴⁵ Approximately 7 percent of Brisbane households do not have an internet subscription.⁴⁶
12. Renters. Approximately 37 percent of Brisbane housing units are renter occupied.⁴⁷
13. Seniors (65+). Seniors constitute 15 percent of Brisbane's population.⁴⁸ Approximately 6 percent of Brisbane households consist of seniors living alone.⁴⁹
14. College students.

15. Unemployed persons. Brisbane's civilian labor force unemployment rate is approximately 8 percent.⁵⁰

Infrastructure

1. Energy and communication infrastructure:
 - Transmission Lines: Pacific Gas & Electric (PG&E).
 - Natural gas pipelines and structures: PG&E.
 - Cell towers, radio sites, fiber optic lines, and internet lines.
2. Flood control and stormwater infrastructure: Brisbane Public Works Department.
3. Vehicle fuel stations:
 - Electric vehicle charging stations: 40 public charging stations.⁵¹
 - Gas stations
4. Hazardous materials sites: 34 cleanup sites (three with ongoing verification or assessment activities) identified via the State Water Control Board's GeoTracker database;⁵² seven toxic substance sites (one with active cleanup activities) identified via the State Department of Toxic Substance Control's EnviroStor database.⁵³
5. Transportation infrastructure:
 - State Highway: Highway 101.
 - Local roads: Bayshore Boulevard, Guadalupe Canyon Parkway, Visitacion Avenue, San Bruno Avenue, Old County Road, Tunnel Avenue, Lagoon Way, Sierra Point Parkway, Valley Drive, North Hill Drive, Mission Blue Drive.
 - Transit facilities stops and other facilities provided by SamTrans, San Mateo County Transit District.
 - Railway: Caltrain.
 - Airports: San Francisco International Airport.
6. Parks, recreational facilities, and open space:⁵⁴
 - City Owned Parks: Marina par course/ picnic area, Community Center Park, Plug Preserve. Marsili Field, Sierra Point public access trail, Community Park (Old County Road), Northeast Ridge school/park site, Brisbane Dog Park, Fisherman's Park, Mission Blue Complex, Tot Lot Playground/Park, Marina Park, Firth Park.
 - Brisbane School District facilities: Lipman School/courts, Kids & Things/court, Brisbane Elementary.
 - Open Space and Trail Areas:
 - City Owned: Sierra Point Canyon, Costanos Canyon, Firth Canyon, Quarry Road Park and Trail, Crocker Park Recreational Trail.
 - State/County Owned Parks: San Bruno Mountain State and County Park.
 - San Francisco Bay Trail
 - Recreational Facilities:
 - City Owned: Brisbane Community Pool, Childcare Modular, Community Center/Library, Mission Blue Center, and Silverspot Cooperative.

7. Water and wastewater infrastructure:
 - City operated and maintained: Gravity sewers, lower laterals, force mains, sewage lift stations, water pump stations, and water storage tanks.
 - Operated and maintained by others serving Brisbane: Wastewater treatment facility (SFPUC's Southeast Treatment Plant) and reservoirs including Hetch Hetchy, Calaveras, San Antonio, Crystal Springs, Pilarcitos, and San Andreas reservoirs.

Buildings

1. Government and community facilities: Brisbane City Hall, Brisbane Administrative Annex, Brisbane Public Library, Brisbane Community Center, Brisbane Corporation Yard (leased asset), Mission Blue Center, and Brisbane Senior Center.
2. Commercial centers: Brisbane Village Shopping Center.
3. Homes and residential structures: Multi-family and single-family residences.
4. Public safety buildings: North County Fire Authority Fire Station 81 and Brisbane Police Department. North County Fire Authority Fire Stations 91, 92, 93, 94, and 95 (located in Daly City) and North County Fire Authority Fire Stations 71 and 72 (located in Pacifica) share resources and provide support.
5. Schools
 - Preschools: Silverspot Co-operative Nursery School (City owned and leased out), Brisbane Preschool.
 - Elementary Schools: Brisbane Elementary School
 - Junior High Schools: Lipman Middle School
 - High Schools: Jefferson Union High School District (located in Daly City), Summit Shasta Public Charter High School (located in Daly City).

Economic Drivers

1. Biotechnology and life sciences.
2. Commercial and retail centers.
3. Education services.
4. Industrial and warehouse centers.
5. Major employers: Bi-Rite Foodservice Distributors, Expeditors International Inc., LeeMAH Electronics Inc., Cutera Inc., Greenleaf, Ultragenyx Pharmaceutical Inc., Amazon Fresh, Transdev Services Inc., Hensley Event Resources, Norman S. Wright Mechanical Equipment Corporation.
6. Hospitality and tourism.

Ecosystems and Natural resources

1. Oak Woodland: Woodland communities dominated by coast live oak (*Quercus agrifolia*) typically occur on steeper, north- to east-facing slopes in Buckeye and Owl Canyons and above the City of Brisbane. Associated shrub species include California coffeeberry (*Rhamnus californica*), poison oak (*Toxicodendron diversilobum*), toyon (*Heteromeles*

arbutifolia), and California bay (*Umbellularia californica*). The growth-form of these trees is typically low and shrubby due to the maritime influence.

2. Shrubland:

- Northern Coastal Scrub. This shrub community is common in many locations on San Bruno Mountain and is dominated by stands of coyote brush (*Baccharis pilularis*) and California sagebrush (*Artemisia californica*). Subdominants include sticky monkeyflower (*Mimulus aurantiacus*) and poison oak. Associated shrub species include pearly everlasting (*Anaphalis margaritacea*), hazelnut (*Corylus cornuta*), oceanspray (*Holodiscus discolor*), seaside woolly sunflower (*Eriophyllum staechadifolium*), and California blackberry (*Rubus ursinus*).
- Blue Blossom Chaparral. This shrub community is dominated by blue blossoms (*Ceanothus thyrsiflorus*). Associated shrub species include black huckleberry (*Vaccinium ovatum*), coyote brush, toyon, and poison oak. Large stands of this community occur on the northeast-facing slopes below the upper parking lot at the head of the Ridge Trail (Devil's Arroyo). Before the last hot fire that occurred in this area in 1964, the north-facing slope below the summit contained only small patches and remnants of blue blossom. A component of this chaparral type includes stands of maritime chaparral dominated by manzanita species such as San Bruno Mountain Manzanita (*Arctostaphylos imbricata imbricata*), Montara Manzanita (*A. montaraensis*), and bearberry (*A. uva-ursi*).

3. Riparian Forest:

- Central Coast Riparian Scrub. This riparian scrub and forest community occurs along creeks and wet ravines and is dominated by stands of arroyo willow (*Salix lasiolepis*), Sitka willow (*Salix sitchensis*) and California wax myrtle (*Myrica californica*). Associated species include American dogwood (*Cornus sericea* ssp. *sericea*), red elderberry (*Sambucus racemosa*), California blackberry, water parsnip (*Oenanthe sarmentosa*), lady fern (*Athyrium filix-femina*), and cow parsnip (*Heracleum lanatum*).
- Freshwater Marsh and Seeps. Wetland marshes and seeps dominated by sedge and/or rush species make up this herbaceous plant community. Dominant rush species include Pacific bog rush (*Juncus effusus*), Baltic rush (*Juncus balticus*), and brown-headed rush (*Juncus phaeocephalus*); dominant sedge species include slough sedge (*Carex obnupta*), dense sedge (*Carex densa*), and Santa Barbara sedge (*Carex barbarae*). Associated species include fringe cup (*Tellima grandiflora*) and monkeyflower (*Mimulus guttatus*)

4. Grassland:

- Valley Needlegrass Grassland. Creeping ryegrass (*Leymus triticoides*) dominates in riparian grasslands and mesic grassland slopes. Examples of this community include localities on the Northeast Ridge, Southeast Ridge Preservation Parcel, and the base of Wax Myrtle Ravine. Associated species include California brome (*Bromus californica*), blue wildrye and annual invasives such as wild oats (*Avena barbata*).

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- Valley Wild Rye Grassland. Purple needlegrass (*Nassella pulchra*) is a dominant or important species in this grassland community. Associated grass species include foothill needlegrass (*Nassella lepida*), California fescue (*Festuca californica*), California melic (*Melica californica*), and blue wildrye (*Elymus glaucus*). Associated wildflower species include coast iris (*Iris longipetala*), soap plant (*Chlorogalum pomeridianum*) and a rare perennial sunflower species, Diablo helianthella (*Helianthella castanea*).
 - Coastal Terrace Prairie. Coastal prairies dominated by Pacific reedgrass (*Calamagrostis nutkaensis*), California oatgrass (*Danthonia californica*), or tufted hairgrass (*Deschampsia caespitosa*) are a limited but integral component of the plan area.
5. Salt marsh: Salt marsh vegetation is found along the tideland margin of San Francisco Bay and in Brisbane Lagoon.

Key Services

1. Education services: Brisbane School District (public education from kindergarten through eighth grade), Jefferson Union High School District (public education from 9th through 12th grade).
2. Emergency services: North County Fire Authority, Brisbane Police Department, and San Mateo County Department of Emergency Management.
3. Energy delivery and communication services: Peninsula Clean Energy, PG&E, radio, television, cellular and landline phone, and internet.
4. Government administration and community services.
5. Public transit access: SamTrans, Caltrain, Commute.org shuttles, and Peninsula Corridor Joint Powers Authority.
6. Solid waste removal: South San Francisco Scavenger Company, Recology.
7. Water and wastewater: City of Brisbane Public Works Department (wastewater services), City of Brisbane Water District and Guadalupe Valley Municipal Improvement District (water services). The City of Brisbane operates two separate water districts providing water to residents and businesses. The Brisbane Water District serves Central Brisbane, Sierra Point and the Baylands. The Guadalupe Valley Municipal Improvement District serves Crocker Park and the Northeast Ridge residential development. The water districts are interconnected and are operated together to maximize circulation and flow within the system. The City's only source of potable water is the San Francisco Public Utilities Commission. The city also operates wastewater and stormwater collection in both Brisbane and Guadalupe Valley Municipal Improvement District.

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