CITY OF ENCINITAS
CLIMATE VULNERABILITY ASSESSMENT & ADAPTATION FRAMEWORK

November 17, 2022

Updates made include information up to January 26, 2023

ORGANIZATION

This document includes the following chapters:

Chapter 1- Introduction

This chapter describes climate adaptation planning and the applicable State requirements as they relate to this Vulnerability Assessment and Adaptation Framework.

Chapter 2 – Community Profile

This chapter provides a description of the City's general environment and demographics. Special emphasis is made to reveal disadvantaged communities and vulnerable populations.

Chapter 3 – Vulnerability Assessment

This chapter includes forecasts of each of the five climate-related hazards. It also maps where those hazards are most likely to affect Encinitas and which areas are most vulnerable to these changes.

This chapter evaluates the City's current capacity to address the five climate-related hazards. This includes an assessment of the City's current policies and programs and how they address the ability to respond to hazard events.

Chapter 4 – Adaptation Framework: Recommendations to Improve Resilience

This chapter includes potential actions and policy recommendations to increase the City's ability to adapt to hazards and meet the needs of its vulnerable communities.

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CHAPTER 1. INTRODUCTION

According to the State of California's Legislative Analyst's Office:

> *"Addressing the widespread impacts of climate change represents a significant challenge for the state. A changing climate presents California with five key climate hazards: (1) higher temperatures and extreme heat events, (2) more severe wildfires, (3) more frequent and intense droughts, (4) flooding due to extreme precipitation events, and (5) coastal flooding and erosion from sea-level rise. These hazards will threaten public health, safety, and well-being—including from life-threatening events, damage to public and private property and infrastructure, and impaired natural resources."*[1]

To address the potential impacts of these hazardous events on the community, the City of Encinitas is expanding upon its climate action and hazard mitigation planning efforts to focus on climate change adaptation by understanding the community's vulnerabilities to climate hazards and exploring strategies to reduce the vulnerability to projected climate change effects, increase the local capacity to adapt, and build resilience.

This vulnerability assessment and adaptation framework follow goals outlined in the City of Encinitas' Safety Element and San Diego County Multi-Jurisdictional Hazard Mitigation Plan (MJHMP) that correspond with climate adaptation planning, specifically:

Safety Element Goal 2:

"The City of Encinitas will make an effort to minimize potential hazards to public health, safety, and welfare and to prevent the loss of life and damage to health and property resulting from both natural and man-made phenomena."

Multi-Jurisdictional Hazard Mitigation Plan (Section 5: Encinitas)

"Reduce the possibility of damage and losses to existing assets, particularly people, critical facilities/infrastructure, and City-owned facilities, due to":

Goal 4. Geologic Hazards, including Earthquake, Liquefaction, and Landslides

Goal 5. Structural Fires/Wildfires

Goal 6. Flooding/Dam Failure

Goal 7. Coastal Erosion and Bluff Failure/Storm Surge/Tsunami/Sea Level Rise

Goal 8. Severe Weather, including Extreme Heat

Goal 9. Drought[2]

Encinitas Climate Action Plan

The City's existing climate change adaptation efforts are laid out in the City of Encinitas' Climate Action Plan (CAP), updated on November 18, 2020. Chapter 5, Adaptation, follows the State of California's Adaptation

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[1] State of California, Legislative Analyst's Office. 2022. Budget and Policy Post. Climate Change Impacts Across California Crosscutting Issues. April 5, 2022. https://lao.ca.gov/Publications/Report/4575. Accessed April 11, 2022.

[2] San Diego County Multi-Jurisdictional Hazard Mitigation Plan, Section Five, Encinitas. October 2017.

Planning Guide's (APG) process focused on preparing a Vulnerability Assessment, which is a method for determining the anticipated impacts of climate change on community assets and populations. The first phase evaluates a community's level of exposure to climate-related impacts and analyzes how these impacts will affect a community's population, functions, and structures. The second phase of the process used the information gathered in the Vulnerability Assessment to develop adaptation strategies and measures to help the community prepare for, respond to, and adapt to local climate change impacts. The CAP's Adaptation chapter serves as an abbreviated version of a full Vulnerability Assessment, identifies key climate-related risks faced by the City, and provides key strategies to increase the City's climate resilience and adaptive capacity. [3] Relevant strategies from the CAP are included within.

This effort aims to expand upon the City's previous work to provide more detail regarding impacted populations and facilities and lays the groundwork to form policies and programs intended for inclusion in the General Plan Safety Element.

Regulatory Drivers and Guidance for Climate Adaptation Planning

The report includes a Vulnerability Assessment and Adaptation Framework, which will be incorporated into the City's General Plan Safety Element, in compliance with SB 379, Government Code section 65302(g)(4) [4] and the Office of Planning & Research's (OPR) General Plan Guidelines.

According to SB 379, general plan safety elements must address climate change vulnerability, adaptation strategies, and emergency response strategies. SB 379 states:

> *"This bill would, upon the next revision of a local hazard mitigation plan on or after January 1, 2017, or, if the local jurisdiction has not adopted a local hazard mitigation plan, beginning on or before January 1, 2022, require the safety element to be reviewed and updated as necessary to address climate adaptation and resiliency strategies applicable to that city or county. The bill would require the update to include a set of goals, policies, and objectives based on a vulnerability assessment, identifying the risks that climate change poses to the local jurisdiction and the geographic areas at risk from climate change impacts, and specified information from federal, state, regional, and local agencies."*

As specified in Government Code section 65302(g)(4)(A), vulnerability assessments must identify the risks that climate change poses to the local jurisdiction and the geographic areas at risk from climate change impacts, utilizing federal, state, regional, and local climate vulnerability documentation such as APG 2.0 and the Cal-Adapt climate tool created by the California Energy Commission (CEC) and University of California, Berkeley Geospatial Innovation Facility. Other sources of information include data from local agencies regarding their adaptive capacity and historical data on natural events and hazards. Per Government Code section 65302(g)(4)(B), adaptation policies, goals, and objectives are to be developed based on findings from the vulnerability assessment. Additionally, Government Code section 65302(g)(4)(C) requires jurisdictions to create a set of feasible implementation measures to reduce climate change impacts on new or proposed land uses.

SB 1000, THE PLANNING FOR HEALTHY COMMUNITIES ACT

Codified in 2016, low-income residents, communities of color, tribal nations, and immigrant communities have disproportionately experienced the greatest environmental burdens and related health problems. This Vulnerability Assessment addresses environmental justice in compliance with SB 1000 as it relates to

[3] City of Encinitas Climate Action Plan. November 18, 2020.

[4] SB 379 was enacted to integrate climate change adaptation into California's general plan process.

climate adaptation. Of the six topics required by SB1000, this Vulnerability Assessment addresses air pollution exposure in vulnerable communities, as air pollution is one of the climate-related hazards.

Consistent with Government Code 65302(g)(4)(A), the following vulnerability assessment and adaptation framework also take guidance from:

CALIFORNIA'S FOURTH CLIMATE ASSESSMENT (2018)

California Natural Resources Agency (CNRA), OPR, and CEC prepared California's Fourth Climate Assessment (Climate Assessment) in 2018. The Climate Assessment was designed to present findings in the context of existing climate science, including strategies to adapt to climate impacts and key research gaps needed to spur additional progress on safeguarding California from climate change.

SAFEGUARDING CALIFORNIA PLAN (2018)

CNRA released an update to the Safeguarding California Plan in 2018, providing a roadmap for State government action to build climate resiliency. The Safeguarding California Plan presents overarching strategies and outlines ongoing actions and cost-effective and achievable next steps to make California more resilient to climate change.

OCEAN PROTECTION COUNCIL STATE SEA LEVEL RISE GUIDANCE (2018)

Between 2017 and 2018, the Ocean Protection Council (OPC) released two reports that updated their understanding of sea-level rise science and best practices for planning and addressing anticipated impacts. The reports synthesize recent evolving research on sea-level rise science and provide higher-level recommendations for planning for and addressing sea-level rise impacts, notably including a set of projections recommended for use in planning, permitting, investment, and other decisions.

CALIFORNIA COASTAL COMMISSION SEA LEVEL RISE POLICY GUIDANCE (2018)

The California Coastal Commission (CCC) adopted the Sea Level Rise Policy Guidance in 2015 and provided a science update in 2018, using information from OPC's State SLR Guidance. The document provides an overview of the best available science on sea-level rise for California and recommended methodology for addressing sea-level rise in Coastal Commission planning and regulatory actions.

CALIFORNIA ADAPTATION PLANNING GUIDE (2020)

The California Office of Emergency Services (CalOES) released the second version of the Adaptation Planning Guide in 2020 - APG 2.0 - which includes updated guidance, an increased focus on equity and outreach, and best practices. The APG is designed to help local government, regional entities, and climate organizations incorporate best practices and current science and research into their adaptation plans.

LOCAL AND REGIONAL CLIMATE PLANNING

This vulnerability assessment and adaptation framework also draws upon existing efforts in the region to address climate change. These documents include, but are not limited to:

- City of Encinitas General Plan Safety Element (Amended 1995)
- City of Encinitas Climate Action Plan (2020)
- City of Encinitas chapter of San Diego County's Multi-Jurisdictional Hazard Mitigation Plan (2017)
- California Department of Transportation (Caltrans) Climate Change Vulnerability Assessment District 11 Technical Report (2019)
- San Diego Association of Governments (SANDAG) San Diego Forward: The Regional Plan (2021)

- San Diego County Water Authority's (SDCWA) Water Shortage Contingency Plan (2020)
- San Diego Regional Climate Collaborative (SDRCC) and SANDAG Regional Adaptation Needs Assessment (2020)

Methodology and Planning Process

The APG provides a four-step process that communities can use to plan for climate change.[5] The APG is designed to be flexible and guide communities in adaptation planning.

Source: California Governor's Office of Emergency Services, 2020.

Phases of the Adaptation Planning Process

Phase 1, Explore, Define, and Initiate: This phase includes scoping the process and project, such as identifying the potential climate change effects and important physical, social, and natural assets in the community.

Phase 2, Assess Vulnerability: This phase includes analysis of exposure to, sensitivity of, and adaptive capacity to respond to climate effect to determine physical and social vulnerability.

Phase 3, Define Adaptation Framework and Strategies: This phase focuses on creating an adaptation framework and developing adaptation strategies based on the vulnerability assessment results. The adaptation strategies are the community's potential response to the vulnerability assessment.

Phase 4, Implement, Monitor, Evaluate, and Adjust: In this phase, the adaptation framework is implemented, consistently monitored and evaluated, and adjusted based on continual learning, feedback, and/or triggers.

The purpose of this report is to document Step 1 through Step 3. The vulnerability assessment and development of adaptation measures follow the approach recommended by APG 2.0.

The vulnerability assessment identifies projected climate change exposures for the City at mid- to late-century timeframes. In addition to identifying the City's exposure to the effects of climate change, the vulnerability assessment evaluates the sensitivity of key population groups and sectors to climate change and associated hazards.

[5] California Adaptation Planning Guide. June 2020.

CHAPTER 2. COMMUNITY PROFILE

Located along six miles of Pacific coastline in northern San Diego County, the City of Encinitas offers a unique blend of old-world charm, sophistication, and new-world culture. Incorporated in 1986, the City brought together the communities of New Encinitas, Old Encinitas, Cardiff-by-the-Sea, Olivenhain, and Leucadia to create a single City rich in history and steeped in tradition. With its pristine beaches and rolling hills, famous Botanic Garden, and vibrant downtown business district, the City of Encinitas attracts visitors from all over the world. [6]

According to the US Census American Community Survey (ACS), in 2020 the City of Encinitas had a population of 62,007. **Table 2-1: Demographics** displays the demographics in Encinitas and San Diego County using ACS data from 2019. The median income for Encinitas residents is 50 percent greater than that for the region. Consistent with this finding, a larger percentage of residents own their homes, and fewer live below the poverty level. The number of households with a person living with a disability is 19.1 percent for Encinitas and 21.4 percent for San Diego County.

Table 2-1: Demographics	Encinitas	San Diego
Total Population	62,007	3,323,970
Percent of residents that are children (less than 10 years)	11.0%	12.0%
Percent of households that have people 65+ years	34.1%	27.7%
Percentage of households with at least one person living with a disability	19.1%[1]	21.4%
Median age	43	36.1
Total households	23,893	1,125,277
Median household income	$120,488	$84,988
Percent of rental households	36.2%	45.6%
Percent of household income below the poverty level	7.2%	10.5%
Note: Percentage values rounded to nearest tenth decimal.		

Source: US Census Bureau, ACS 2020, ESRI 2022[1]

Compared to the region, Encinitas skews older, with 33.3 percent of the population aged 55 and older compared to 25 percent for San Diego County (See **Table 2-2: Age Distribution Comparison**). San Diego County's age distribution showed a younger population, with the largest population below 35 years of age (49.6 percent) compared to Encinitas (39.5 percent).

Table 2-2: Age Distribution	Encinitas	San Diego County
Under 5	5.6%	6.2%
5 - 14	11.7%	12.0%
15 - 24	9.5%	13.7%
25 - 34	11.5%	16.5%
35 - 44	14.0%	13.4%
45 - 54	14.4%	12.3%
55 - 64	14.7%	11.8%
Over 65	18.6%	14.1%
Note: Percentage values rounded to nearest tenth decimal.		

Source: US Census Bureau, ACS 2020, ESRI 2022[1]

[6] https://encinitasca.gov/Visitors/About-Encinitas

In California, those persons of retirement age (i.e., 65 years and older) are expected to grow more than twice as fast as the total population, and this growth will vary by region. This means that people are living longer, and the number of older persons is increasing. This trend is also evident in Encinitas, where the percentage of the population aged 65 – 74 years doubled from 2010 to 2020.

The racial and ethnic composition of a population may affect housing needs because of cultural preferences associated with different racial/ethnic groups. Cultural influences may reflect a preference for a specific type of housing. Research has shown that particular cultures (e.g., Hispanic and Asian) tend to maintain extended families within a single household.

Table 2-3: Race and Ethnicity shows that, according to the 2020 American Community Survey, the ethnic distribution of the Encinitas population was predominantly White, not Hispanic or Latino (76.4 percent), with about four percent reporting as Asian. Approximately 16 percent of the Encinitas population was of Hispanic origin. San Diego County exhibited more ethnic diversity, with 44.9 percent of the population being White, not Hispanic or Latino, 12 percent Asian, and 34 percent of Hispanic or Latino origin. The race/ethnic composition of City residents has remained stable in Encinitas compared to the 2010 Census, with the proportion of Asian residents remaining stable and the proportion of Hispanic residents increasing from 13.7 to 15.9 percent. Countywide, from 2000 to 2010, the population of Hispanic or Latino origin increased from 27 percent to 33.9 percent. [7]

Table 2-3: Race and Ethnicity	Encinitas	San Diego County
White Alone (Not Hispanic or Latino)	76.4%	44.9%
Black Alone (Not Hispanic or Latino)	0.3%	4.9%
American Indian Alone (Not Hispanic or	0.1%	0.7%
Asian Alone (Not Hispanic or Latino)	3.7%	12.0%
Pacific Islander Alone (Not Hispanic or	0.1%	0.4%
Some Other Race Alone (Not Hispanic or	0.1%	0.2%
Two or More Races (Not Hispanic or	3.4%	8.6%
Hispanic Origin (Any Race)	15.9%	33.9%
Note: Percentage values rounded to nearest tenth decimal.		

Source: US Census Bureau, ACS 2020, ESRI 2022[1]

Vulnerable Communities

Table 2-4: English Proficiency and Languages Spoken at Home Among	Number of Speakers	Percent Not Fluent in English[1]
English Only	49,181	-
Spanish	6,820	13.8%
Indo-European Languages	2,201	4.0%
Asian and Pacific Island Languages	925	14.2%
Other Languages	287	2.5%
Note: Percentage values rounded to nearest tenth decimal.		

Source: US Census Bureau, ACS 2020, ESRI 2022[1]

The City is facing challenges in meeting its housing needs. Encinitas's housing costs continue to climb, while the availability and variety of housing are lacking. According to HomeDex, a real estate data source for North San Diego County, in November 2019, the median sales price in Encinitas was 55 percent higher than

[7] City of Encinitas. 2021. Encinitas 6th Cycle Housing Element 2021-2029.

the median sales price for the North County region. At the same time, the City has a growing population, and its existing residents have changing needs.

- Baby Boomers are aging, and the City's senior citizen population (over 60 years of age) is projected to nearly double by 2035. Many seniors will seek to downsize and move into smaller homes in areas with easy access to services, transportation, and amenities.
- Millennials have been slower to buy single-family homes than earlier generations. Rising student debt, the cost of housing, and challenges in securing mortgages have contributed to this, but they often want various kinds of housing and neighborhoods than what is available today. They are looking for pedestrian and bike-friendly communities with services and amenities nearby.
- According to SANDAG's regional growth forecast, Encinitas can expect an anticipated 11 percent population growth through 2050. [8]

2.1 VULNERABLE POPULATIONS

Factors such as age, physical and/or mental condition, socioeconomic status, access to key services, and other factors affect the ability of people to prepare for and protect themselves and their property from a climate-related event. Even though hazard events may impact all parts of the City with equal severity, individuals may experience the effects differently.

Disadvantaged Communities

According to the California Office of Environmental Health Hazard Assessment (OEHHA), a community is considered disadvantaged based on its pollution burden and sensitive populations. OEHHA provides the CalEnviroScreen tool to evaluate and map disadvantaged communities. The dataset helps identify California communities that are most affected by specific sources of pollution and where people are often especially vulnerable to pollution's effects. The dataset uses environmental, health, and socioeconomic information to produce scores for every census tract in the state that is mapped using a scale based on the pollution burden of the location. The higher the percentage, the greater the burden and the higher likelihood of environmental justice concerns.

CalEnviroScreen calculates scores for two groups of indicators: Pollution Burden (e.g., PM2.5 concentrations, diesel PM emissions, adjacency to solid waste sites) and Population Characteristics (e.g., asthma emergency department visits, linguistic isolation, low-income households). **Figure 2-1: CalEnviroScreen 4.0** shows the combined Pollution Burden scores, which are made up of indicators from the Exposures and Environmental Effects components of the CalEnviroScreen model. Pollution Burden represents the potential exposures to pollutants and the adverse environmental conditions caused by pollution. Compared to all census tracts in the state, those tracts in Encinitas are all in the bottom third, meaning Encinitas's population has a lower pollution burden than other areas in the state. As a result, OEHHA does not identify any census tract in the City of Encinitas as containing disadvantaged communities.

While Encinitas may not have state-defined disadvantaged communities, the City still has populations vulnerable to climate hazard events. Each section covering a different climate hazard within the Vulnerability Assessment contains an analysis of social sensitivity using the following criteria to assess the potential impact on vulnerable populations:

- Disability status: Persons with disabilities may often have reduced mobility and experience difficulties living independently. As a result, they may have little or no ability to prepare for and

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[8] City of Encinitas. 2021. Encinitas 6th Cycle Housing Element 2021-2029.

mitigate hazard conditions without assistance from others. An estimated 19.1 percent of Encinitas households contain at least one person with a disability. [9]

- Income levels: Lower-income households are less likely to have the financial resources to implement mitigation activities on their residences. They may also struggle with having the necessary time to find and access educational resources discussing hazard mitigation strategies. Furthermore, lower-income households are less likely to be able to afford to move to areas that are safer or less at risk of being impacted by a hazard. The national poverty limit standard for the U.S. for a four-person family is an income of $26,200 or less. In Encinitas, between 2015 and 2019, an estimated 7.1 percent of households had an income that was considered below the poverty level. An estimated 2.3 percent of households received food stamps or qualified for the Supplemental Nutrition Assistance Program (SNAP). [10]
- Seniors (individuals at least 65 years of age): Seniors are more likely to have reduced mobility, physical and/or mental disabilities, and lower income levels, all of which may decrease their ability to prepare for and mitigate a hazard event. Senior Residential Facilities are mapped in **Figure 2-2: Critical Facilities and Hazardous Materials Sites**.

Homeless Population

In January 2022, the annual Point-in-Time Count found thirty-seven sheltered and seventy-six unsheltered individuals in the City of Encinitas (See **Table 2-5: Homeless County – Encinitas (2016-2022)**). The homeless are highly susceptible to impacts from direct and indirect climate effects, including extreme heat events, air pollution from wildfires, and precipitation-driven or coastal flooding.

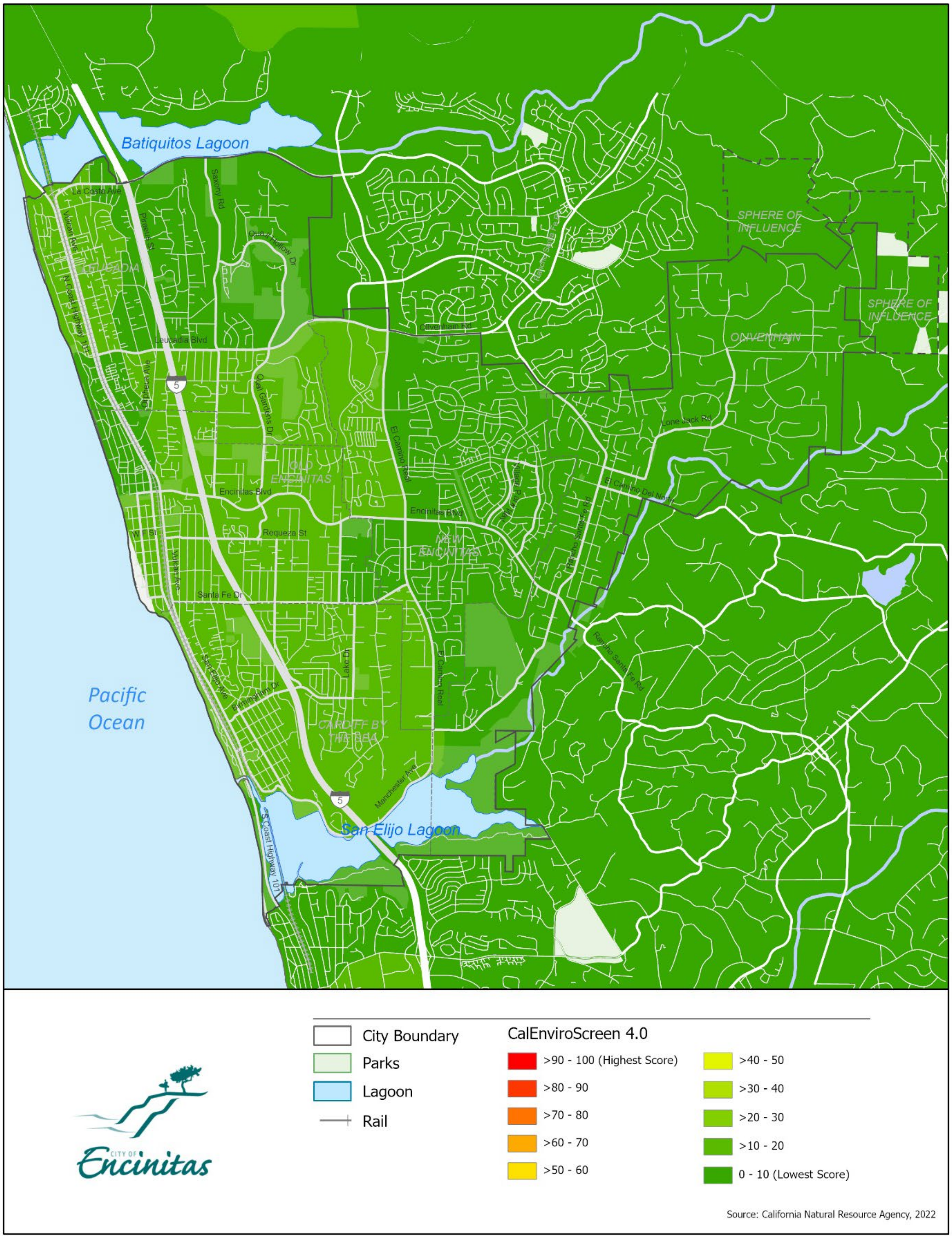
Table 2-5. Homeless Count – Encinitas (2016 – 2022)

Year	Total	Unsheltered	Sheltered
2016	93	54	39
2017	117	84	33
2018	125	86	39
2019*	120	79	41
2020*	80	47	33
2022*	113	76	37
2023*	92	73	19
Note: * Beginning in 2019, San Dieguito, Solana Beach, and Del Mar numbers were included in the Encinitas total.			

Source: San Diego Regional Task Force on Homelessness Point in Time Count

[9] US Census. American Community Survey. 2015-2019. ESRI 2022.
[10] US Census. American Community Survey. 2015-2019. ESRI 2022.

Figure 2-1: CalEnviroScreen 4.0



2.2 MAJOR COMMUNITY ELEMENTS

The City of Encinitas is bounded by the Pacific Ocean on the west. Coastal bluffs at the City's northern boundary overlook the portion of Batiquitos Lagoon that falls within Encinitas and includes lands south and southeast of the lagoon, including Indian Head Canyon, Magdalena Ecke Park, the slopes above Green Valley, and habitat north of Encinitas Boulevard between El Camino Real and Rancho Santa Fe Road. Slopes and bluffs overlook San Elijo Lagoon at the City's southern perimeter. Escondido Creek, a major east-west waterway, traverses the City's southern boundary and empties into the San Elijo Lagoon.

Portions of Encinitas are exposed to a variety of environmental hazards and resources, which may lead them to be more vulnerable to climate change. These constraints include topography, flooding, landslides and seismic hazards, and areas with natural and cultural resources. For example, areas of Olivenhain and the Sphere of Influence area beyond the City's eastern limits include slope areas greater than 25 percent and are characterized by the presence of biological habitat. Residential properties along the coast in Old Encinitas and Leucadia may be affected by the presence of coastal bluffs and erosion.

Residential Uses

With a population of approximately 63,000 residents, the City has a diverse residential base. Many existing homes are in master-planned communities that have been constructed as far back as the 1970s. New construction occurring in the City should meet the latest standards and requirements; however, neighborhoods with older homes may require retrofit improvements to reduce some of the risks to the structures.

Institutional Uses

MiraCosta College, a community college district known for its successful transfer rates, degrees, career planning, and skill-building, enrolls approximately 15,000 students each semester [11], which can increase the City's daytime population, impact roadways, and community services.

Open Space

The City of Encinitas and its residents value the importance of nature and open space. Encinitas boasts abundant opportunities to get outdoors and enjoy a hike or spend quiet time in nature. The Parks, Recreation, and Cultural Arts Department is responsible for eighty-five acres of open space and forty miles of trails. City trails provide pedestrian, bicycle and/or equestrian access to undeveloped open spaces such as Indian Head Canyon and Manchester Preserve. The Olivenhain community enjoys an extensive network of trails relative to other parts of the City. The Encinitas Ranch Specific Plan area has a large trail system as well. The San Elijo Lagoon Ecological Reserve includes approximately five miles of trails managed by the County of San Diego, which serve City residents and visitors. The City's Recreational Trails Master Plan includes plans to develop an additional forty miles of trails and pedestrian connections throughout the City. [12]

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[11] MiraCosta College Enrollment. https://www.miracosta.edu/future-students/index.html. Accessed March 31, 2022.
[12] City of Encinitas. 2022. *Trails & Open Space.* https://encinitasca.gov/Trails. Accessed April 6, 2022.

INFRASTRUCTURE ASSESSMENT

Infrastructure plays a vital role in mitigating the effects of hazard events. When infrastructure fails, it can exacerbate the extent of certain hazards or create complications for rescue workers trying to reach victims. For example, because of high winds or seismic activity, fallen utility poles can obstruct roadways and prevent emergency vehicles from reaching affected areas. The following are electrical, fossil fuel, hydrologic, and transportation networks of infrastructure in Encinitas.

Water Supply

The District's water supply portfolio includes imported water purchased from the SDCWA, local surface water from Lake Hodges, and recycled water purchased from the San Elijo Joint Powers Authority (JPA). SDCWA purchases water from the Metropolitan Water District of Southern California (MWD), sourced from both the Colorado River Aqueduct (CRA) and the State Water Project (SWP), treated water from the SDCWA (recycled water source), and local stormwater runoff from the Lake Hodges watershed east of the City. SDCWA also purchases desalinated seawater, which is treated to drinking water standards at the Claude "Bud" Lewis Carlsbad Desalination Plant (Carlsbad Desal Plant). [13]

The San Dieguito Water District (SDWD) serves the City of Encinitas by providing water to approximately 40,000 residents in the communities of Leucadia, Old Encinitas, Cardiff-by-the-Sea, and New Encinitas. The Olivenhain Municipal Water District (OMWD) provides service to the remainder of the City. The OMWD is an independent public agency addressing the water needs of up to 40 percent of Encinitas residents. OMWD primarily serves the City's eastern half, including all or a part of the communities of Olivenhain, New Encinitas, Leucadia, and Cardiff-by-the-Sea.

Stormwater Management

The Stormwater Maintenance Division in the Public Works Department is responsible for maintaining the storm drain infrastructure through comprehensive programmatic efforts. The Stormwater Management Division (Clean Water Program) in the Public Works Department is responsible for enforcing regulatory mandates related to surface water.

The Clean Water Program has two goals: to maintain water quality and protect beaches, lagoons, and creeks from illicit discharges, sewage spills, and other pollutants.

Fire and Emergency Services

The Encinitas Fire and Marine Safety Department serves residents of the coastal, rural, and agricultural communities of Encinitas, Olivenhain, Leucadia, and Cardiff-by-the-Sea. San Diego County's Service Area (CSA) 17 consists of Del Mar, Del Mar Heights, Solana Beach, Encinitas, Rancho Santa Fe, and portions of Elfin Forest. Emergency medical services are provided by the Department and San Diego Medical Services Enterprise (SDMSE) within CSA 17.

There are six strategically located fire stations in the City of Encinitas, allowing firefighters and paramedics to provide timely responses to emergencies and efficiently respond to volume demand.

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[13] San Dieguito Water District. 2020 Urban Water Management Plan, Final. June 2021. https://encinitasca.gov/Portals/0/City%20Documents/Documents/San%20Dieguito%20Water%20District/Engineering/SDWD_2020%20reduced.pdf?ver=2021-06-10-145230-143. Accessed July 12, 2022.

Police Services

The City of Encinitas contracts with the County of San Diego Sheriff's Department to provide police/ law enforcement services to the City. In addition to the City of Encinitas, the North Coastal Station, located in the City off of El Camino Real, provides a wide range of municipal law enforcement services to the cities of Del Mar, Solana Beach, and Rancho Santa Fe. Services include the following:

- Helicopters;
- A bomb/ arson squad;
- A Special Enforcement Detail team;
- Canine units;
- Modern crime lab facilities; and
- One of the nation's most modern law enforcement radio communications networks.

There are no current plans for new facilities. [14]

Wastewater Capacity

The City's Wastewater Maintenance Division in the Public Works Department is responsible for maintaining the existing sewer infrastructure within the City. The City sewer maintenance includes cleaning sewer lines, clearing blockages, repairing breaks, and responding to emergencies. Sewage is conveyed through pipes to either the Encina Wastewater Authority (EWA) in Carlsbad, north of Encinitas, or the San Elijo Water Reclamation Facility in Cardiff, south of Encinitas.

Transportation

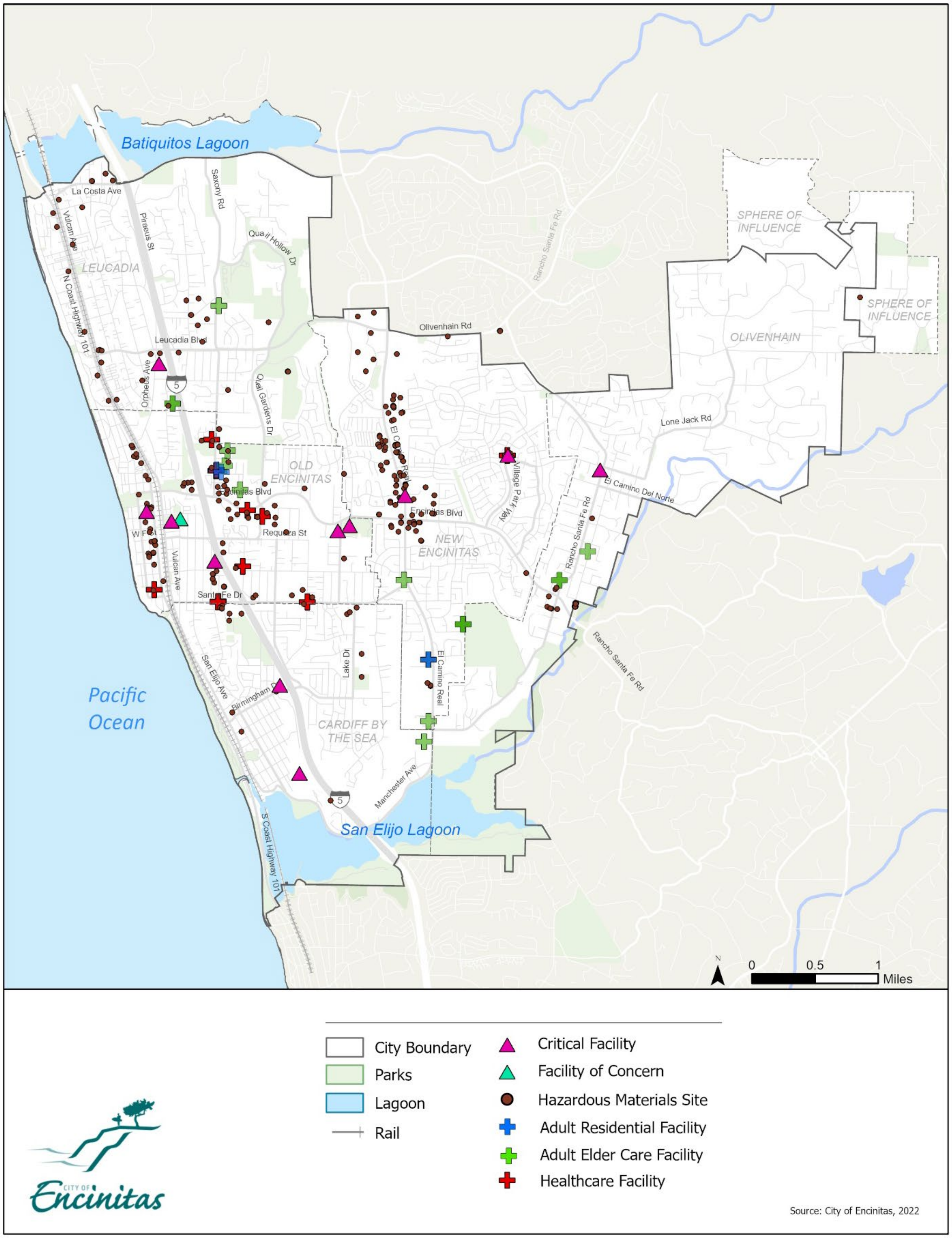
The transportation infrastructure in Encinitas consists of roadways for automobiles, bike facilities for cyclists, and sidewalks, crosswalks and trails for pedestrians. There are also other modes of travel into and out of the City, including freeways, buses/shuttles, regional bike facilities, local commuter trains, and long-distance trains.

Hazardous Waste

Hazardous materials can cause damage to physical assets in Encinitas if they are released into the environment. Corrosive hazardous materials can damage the exteriors of any buildings or structures designated as a critical facility or facility of concern by the City. Flammable hazardous materials can potentially start fires and may cause any nearby critical facilities to flashover. Sites closer to the origin for the release of the hazardous materials are more at threat than those further away**. Figure 2-2: Critical Facilities and Hazardous Materials Sites** shows Encinitas's critical facilities in relation to hazardous materials sites identified in the City.

[14] City of Encinitas. 2021. Encinitas 6th Cycle Housing Element 2021-2029: Appendix B.

Figure 2-2: Critical Facilities and Hazardous Materials Sites



CHAPTER 3. VULNERABILITY ASSESSMENT

This section provides a comprehensive assessment of the City's vulnerabilities to climate change. It identifies and describes the climate hazards and other climate effects that may affect the City in the future. The Vulnerability Assessment follows the process outlined in Phase 2 of APG 2.0 and is composed of the following three steps:

- **Exposure:** The purpose of this step is to understand Encinitas' exposure to current and projected climate hazards. Existing hazards that can be worsened by the effects of climate change are identified and described based on historical data, including the City's MJHMP. Climate data are used to develop projections for how existing hazards are expected to change by mid-and late century from future climate change.
- **Sensitivity and Potential Impacts:** This step will characterize potential future climate impacts on community populations and assets. Using historical data and research from regional and state reports on climate impacts, this step explores how sensitive vulnerable populations and assets may be affected by the projected impacts of climate change hazards.
- **Adaptive Capacity:** The City and its supporting agencies and countywide organizations have already taken steps to build resilience and protect sensitive populations and assets from hazards. Thus, the purpose of this step is to characterize Encinitas's current capability to cope with the projected impacts from climate hazards to vulnerable populations and assets. The adaptive capacity of the City to adapt to each of the identified climate impacts is determined through a review of existing plans and programs.

3.1 EXISTING HAZARDS

The City of Encinitas has historically been affected by climate or climate-induced hazards such as drought, extreme heat events, wildfires, landslides, and flooding. Examples of significant events include State-wide droughts from 2007-2011, 2012-2016, and 2021 to now. Additionally, the City was impacted by the Harmony Grove wildfire in 1996 that resulted in the loss of three homes and the evacuation and sheltering of hundreds of Encinitas residents. Bluff failures occurring from coastal erosion has resulted in loss of life and property damage. Projected changes in climatic conditions will increase the frequency, duration, and intensity of these events.

3.1.1 ECONOMIC IMPACTS OF CLIMATE CHANGE

Encinitas will be increasingly affected by climate change and has begun to prepare on multiple fronts for climate change related impacts on residents, development, infrastructure, and ecosystems. While the potential costs to Encinitas from climate change hazard impacts are not currently known, economic impact studies for San Diego County provide a glimpse of potential impacts on the City. The following are summaries of regional economic studies relevant to Encinitas:

The cost of the 2007 wildfires in San Diego was estimated at nearly $2 billion for losses in residential and commercial properties. In addition to the direct costs, many private firms and public agencies were forced to shut down during the large-scale wildfire event. A complete three-day shutdown is estimated to cost $1.5 billion. Therefore, a large-scale wildfire due to climate change can have a major impact on the economy due to productivity losses. [15]

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[15] California Climate Change Center. n.d. *Climate Change Related Impacts in the San Diego Region by 2050.*

According to the San Diego Foundation's Economic Resilience: Health and Water studies, the potential productivity and financial losses from climate change hazards include:

- Sixty-five thousand production hours lost in heat-exposed industries.
- Seventeen percent increase in commercial sector spending on electricity due to increased A/C usage.
- As much as $9.4 million in additional employee medical costs annually due to extreme heat. [16]
- Forty-six percent expected increase in San Diego County's water demand by 2035 due to increasing population, rising temperatures, less frequent rain, and increased soil and water reservoir evaporation.
- $10-18 million estimated costs to commercial, residential, and government sectors per significant flooding event. [17]

One study estimated that approximately $400 million of commercial and industrial property could be lost annually in San Diego County with 6.5 feet of sea-level rise. [18]

3.2 ANALYZING CLIMATE CHANGE

Climate change effects are categorized as direct or indirect. Direct effects are caused by the initial impacts of increased GHG emissions, while indirect effects occur because of the direct effect(s). The direct climate change effects include changes in temperature and precipitation. The indirect effects, which can occur because of isolated changes or a combination of changes in the direct effects (e.g., temperature or temperature plus precipitation), include extreme heat events, drought, wildfires, onshore flooding associated with large precipitation events, landslides, and coastal flooding and inundation resulting from sea-level rise.

To assess the potential direct and indirect effects of climate change, APG 2.0 recommends using Cal-Adapt, a global climate simulation model data. Cal-Adapt addresses uncertainty surrounding potential greenhouse gas (GHG) emissions using Representative Concentration Pathways. The RCPs in this vulnerability assessment rely upon two future emissions scenarios: RCP 4.5 and RCP 8.5. RCP 4.5 represents a medium emissions scenario of GHG emissions and assumes emissions will rise, even out near the middle of the century, and decrease to below 1990 levels by the end of the 21st century. RCP 8.5 is a high emissions scenario where GHG emissions continue to increase through the end of the 21st century. [19]

Cal-Adapt also includes ten global climate models, downscaled to local and regional resolution using the Localized Constructed Analogs statistical technique. California's Climate Action Team Research Working Group selected four of these models as priority models for research contributing to California's Fourth Climate Change Assessment. The projected future climate from these four models can be described as producing:

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[16] San Diego Foundation. n.d. *Economic Resilience: Health*. https://www.sdfoundation.org/wp-content/uploads/2016/04/economic-resilience-health.pdf. Accessed April 20, 2022.

[17] San Diego Foundation. n.d. *Economic Resilience: Water*. https://www.sdfoundation.org/wp-content/uploads/2016/04/economic-resilience-water.pdf. Accessed April 20, 2022.

[18] Kalansky, Julie, Dan Cayan, Kate Barba, Laura Walsh, Kimberly Brouwer, Dani Boudreau. (University of California, San Diego). 2018. *San Diego Summary Report*. California's Fourth Climate Change Assessment. Publication number: SUM-CCCA4-2018-009.

[19] Bedsworth et al. 2018. Statewide Summary Report. California's Fourth Climate Change Assessment. Publication number: SUMCCCA4-2018-013.

- A warm/dry simulation (HadGEM2-ES),
- A cooler/wetter simulation (CNRM-CM5),
- An average simulation (CanESM2), and
- The model simulation that is most unlike the first three for the best coverage of different possibilities (MIROC5).

3.2.1 Direct Effects of Climate Change

There are two primary direct effects of climate change: changes in temperature and changes in precipitation. These changes include increases or decreases in temperature and precipitation. They also include changes in the frequency, duration, and intensity of changes to these patterns.

Changes in Temperature

According to Cal-Adapt, Encinitas's historical (1961-1990) annual average maximum temperature was 74.3°F, and the historic annual minimum temperature was 51.7°F. As shown in **Table 3-1: Change in Annual Average Temperature**, both are projected to increase by mid-century and further increase by the end of the century. The annual average maximum temperature in the City is projected to be 77.5°F by mid-century and 78.3°F by the end of the century under the medium emissions scenario. Under the high emissions scenario, the annual average maximum temperature in the study area is projected to be 78.6 °F by mid-century and 81.6 °F by the end of the century. This equates to an increase in temperatures of 4.3 to 7.3 °F by the end of the 21st century, depending on a medium or high emissions scenario. [20]

Table 3-1: Change in Annual Average Temperature

Annual Average Temperature	Historic Annual Average Temperature (1961 – 1990)	Medium Emissions (RCP 4.5)		High Emissions (RCP 8.5)	
		Mid-Century	End-Century	Mid-Century	End-Century
Maximum	74.3	77.5	78.6	78.3	81.6
Minimum	51.7	54.8	55.8	55.9	59.1
F = degrees Fahrenheit					

California Energy Commission. 2022. CalAdapt. Local Climate Change Snapshot for Encinitas: Annual Average Maximum and Minimum Temperature. https://cal-adapt.org/tools/local-climate-change-snapshot. Accessed March 28, 2022.

Annual Average Minimum Temperature

According to Cal-Adapt, the annual average minimum temperature is expected to increase in Encinitas (**Table 3-1**), consistent with the projected trend of overall warming for the City. Under the RCP 4.5 scenario, average minimum temperatures are projected to increase by approximately 4.1°F by 2100. Under the RCP 8.5 scenario, an increase of approximately 7.4°F for average minimum temperatures by 2100 is projected. With increasing minimum temperatures, it is anticipated that the City will experience warmer conditions throughout the year; however, this does not preclude severe winter weather events from occurring.

Changes in Precipitation

Annual Average Precipitation Levels

According to Cal-Adapt, annual projected precipitation levels in the City are expected to experience modest change by the end of the century. **Table 3-2: Change in Annual Average Precipitation** identifies estimated

[20] California Energy Commission. 2022. Cal-Adapt Data Download Tool: LOCA Downscaled CMIP5 Climate Projections. https://cal-adapt.org/data/download/. Accessed March 31, 2022.

annual average precipitation levels. These projections suggest that precipitation levels will be similar to conditions currently experienced within the City during average years.

Table 3-2: Change in Annual Average Precipitation

Average Annual Precipitation	Historic Annual Average Precipitation (1961 – 1990)	Medium Emissions (RCP 4.5)		High Emissions (RCP 8.5)	
		Mid-Century	End-Century	Mid-Century	End-Century
	11.9	11.3	11.5	11.3	10.9

CalAdapt. Local Climate Change Snapshot for Encinitas: Annual Average Precipitation. https://cal-adapt.org/tools/local-climate-change-snapshot. Accessed March 28, 2022.

3.2.2 Indirect Effects of Climate Change

This analysis addresses five indirect effects of the projected changes in temperature and changes in precipitation: Extreme heat events, drought, wildfire and smoke, flooding, and liquefaction.

3.2.2.1 EXTREME HEAT EVENTS

Extreme heat events are a period when temperatures are abnormally high relative to a designated location's normal temperature range. Extreme heat events are one of the leading weather-related causes of death in the United States—from 1999 through 2009, extreme heat exposure caused more than 7,800 deaths. [21] There are generally three types of extreme heat events:

- **Extreme Heat Days:** a day during which the maximum temperature surpasses 98 percent of all historic high temperatures for the area, using the time between April and October from 1961 to 1990 as the baseline.
- **Warm Nights:** a day between April and October when the minimum temperature exceeds 98 percent of all historic minimum daytime temperatures observed between 1961 and 1990.
- **Extreme Heat Waves:** a successive series of extreme heat days and warm nights where extreme temperatures do not abate. While no universally accepted minimum length of time for a heat wave event exists, Cal-Adapt considers four successive extreme heat days and warm nights to be the minimum threshold for an extreme heat wave.

Extreme heat events will feel different from region to region since different areas have different historic high temperatures. For example, an extreme heat day on the coast will feel different from that in the High Desert. The reason for this is how humidity plays a factor in the perceived heat that people feel. Humid conditions will make a day feel hotter than non-humid conditions, even though the temperature may be the same. The difference between the perceived and actual temperatures is known as the "heat index." To illustrate the effect of the heat index, a 90-degree day with 50 percent humidity feels like 95°F, whereas a 90°F day with 90 percent humidity feels like 122°F. **Figure 3-1: National Weather Service Heat Index** shows the National Oceanic and Atmospheric Administration (NOAA) 's National Weather Service Heat Index. [22]

[21] United States Global Change Research Program, 2016: The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment. A. Crimmins, J. Balbus, J. L. Gamble, C. B. Beard, J. E. Bell, D. Dodgen, R. J. Eisen, N. Fann, M. D. Hawkins, S. C. Herring, L. Jantarasami, D. M. Mills, S. Saha, M. C. Sarofim, J. Trtanj, and L. Ziska, Eds.
[22] National Oceanic and Atmospheric Administration (NOAA)'s National Weather Service Heat Index. https://www.weather.gov/safety/heat-index. Accessed March 31, 2022.

Figure 3-1: National Weather Service Heat Index

NWS Heat Index — Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution — Extreme Caution — Danger — Extreme Danger

Source: National Oceanic and Atmospheric Administration National Weather Service Heat Index.

Historical Extreme Heat Events

Local data from within Encinitas is available using the National Weather Service Carlsbad McClellan Palomar Airport station. The data indicates that the average maximum temperature for the area from all years between 1991 and 2020 is 75.8°F, occurring in the month of August. [23] Given that the minimum threshold for an extreme heat day is 94.4°F, it is rare that the temperature exceeds this threshold in Encinitas on a regular basis. However, extreme heat events have occurred in the region, which occasionally impact the City. Significant historic extreme heat events include:

- May 2015: Strong high pressure and a strong late-season Santa Ana wind event combined to bring record temperatures exceeding 100° to the lower elevations. All-time high temperature records for the month of May were broken. [24]
- September 4-6, 2020. Forecasters issued Excessive Heat Warnings from the coast to the deserts through Labor Day. Beach temperatures were predicted to hit upwards of 95 while coastal areas could reach 105. Carlsbad McClellan Palomar Airport reached 101 degrees on September 6th. [25]
- January 15, 2021. Carlsbad McClellan Palomar Airport noted the highest maximum ever for January of 90 degrees. [26]

Unusually hot days and multi-day heat waves are a natural part of day-to-day variation in weather. As the Earth's climate warms, however, hotter-than-usual days and nights are becoming more common, and heat waves are expected to become more frequent and intense. Increases in these extreme heat events can

[23] National Weather Service. NOWData Carlsbad McClellan Palomar AP. https://www.weather.gov/wrh/climate?wfo=sgx. Accessed March 31, 2022.

[24] National Oceanic and Atmospheric Administration. May 2017. "A History of Significant Weather Events in Southern California." https://www.weather.gov/media/sgx/documents/weatherhistory.pdf

[25] North Coast Current. 2020. North coastal San Diego faces Labor Day broil as heat wave settles in. https://www.northcoastcurrent.com/encinitas/2020/09/north-coastal-san-diego-faces-labor-day-broil-as-heat-wave-settles-in/, September 4. Accessed July 14, 2022.

[26] National Weather Service. NOWData Carlsbad McClellan Palomar AP. https://www.weather.gov/wrh/climate?wfo=sgx. Accessed July 14, 2022.

lead to more heat-related illnesses and deaths, especially if people and communities do not take steps to adapt.[27]

Vulnerability to Extreme Heat Events

Exposure

The Fourth Assessment indicates that Southern California can expect longer and hotter heat wave, with continued future warming over the region.[28] The annual mean maximum temperature could increase by 7.3°F by 2100 (see **Table 3-1**).[29] As illustrated in **Table 3-3: Change in Number of Extreme Heat Days**, the annual number of extreme heat days (over 94.4°F) in Encinitas could increase up to 24 days by 2100.[30]

Table 3-3: Change in Number of Extreme Heat Days

Number of Extreme Heat Days*	Historic Annual Average Extreme Heat Days (1961 – 1990)	Medium Emissions (RCP 4.5)		High Emissions (RCP 8.5)	
		Mid-Century	End-Century	Mid-Century	End-Century
	4	9	12	12	28
*Number of days in a year when daily maximum temperature is above a threshold temperature of 94.4 °F					

Source: California Energy Commission. CalAdapt. Local Climate Change Snapshot for Encinitas: Extreme Heat Days. https://cal-adapt.org/tools/local-climate-change-snapshot. Accessed March 28, 2022.

Warm Nights

According to Cal-Adapt, a warm night event in Encinitas is a night when the evening temperature exceeds 67.3°F. **Table 3-4: Change in Number of Warm Nights** identifies the projected average number of warm nights that would occur each year under the RCP 4.5 and RCP 8.5 scenarios. By 2100, an estimated 35 to 72 warm nights (RCP 4.5 and RCP 8.5, respectively) could be experienced (compared to only four days annually based on observed historical conditions).

Table 3-4: Change in Number of Warm Nights

Number of Warm Nights*	Historic Annual Average Warm Nights (1961 – 1990)	Medium Emissions (RCP 4.5)		High Emissions (RCP 8.5)	
		Mid-Century	End-Century	Mid-Century	End-Century
	4	25	35	34	72
*Number of days in a year when daily minimum temperature is above a threshold temperature of 67.3					

Source: California Energy Commission. CalAdapt. Local Climate Change Snapshot for Encinitas: Warm Nights. https://cal-adapt.org/tools/local-climate-change-snapshot. Accessed March 28, 2022.

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[27] Sarofim, M.C., S. Saha, M.D. Hawkins, D.M. Mills, J. Hess, R. Horton, P. Kinney, J. Schwartz, and A. St. Juliana. 2016. Chapter 2: Temperature-related death and illness. In: The impacts of climate change on human health in the United States: A scientific assessment. U.S. Global Change Research Program.

[28] Southern California Association of Governments. Southern California Climate Adaptation Planning Guide. October 2020.

[29] California Energy Commission. 2022. CalAdapt. Local Climate Change Snapshot for Encinitas: Annual Average Maximum Temperature. https://cal-adapt.org/tools/local-climate-change-snapshot. Accessed March 28, 2022.

[30] California Energy Commission. 2022. CalAdapt. Local Climate Change Snapshot for Encinitas: Extreme Heat Days. https://cal-adapt.org/tools/local-climate-change-snapshot. Accessed March 28, 2022.

Sensitivity: Physical

The impacts of extreme heat events will be most severely felt in highly developed areas of Encinitas that are mostly paved and surrounded by buildings constructed of dark (heat absorbing) materials without the cooling benefits of tree shade. Urbanized areas can experience higher temperatures, greater pollution, and negative health effects, especially during summer months, than rural communities. This phenomenon is known as the Urban Heat Island Effect (UHIE). Urban heat islands are created by a combination of heat-absorptive surfaces (e.g., dark pavement and roofing), heat-generating activities (e.g., automobile engines and industrial generators), and the absence of "green spaces" (vegetative surfaces that provide evaporative cooling). During extreme heat days and heatwaves, asphalt and darker surfaces reduce nighttime cooling (as retained heat is released from these surfaces). The UHIE is known to intensify extreme heat days and heatwaves.

As illustrated in **Figure 3-2: Urban Heat Island Index**, due to coastal wind patterns, the UHIE is relatively low in Encinitas. The Urban Heat Island Index (UHII) is calculated by atmospheric modeling as a temperature differential over time between an urban census tract and nearby upwind rural reference points at a height of two meters above ground level, where people experience heat. The modeling covered 182 warm season days from 2006 and 2013, with one-hour timesteps, so the UHII is the sum of 24 * 182 = 4,368 hourly temperature differences. Since 2020, the index is also reported in degree-hours per day on a Celsius scale – a measure of heat intensity over time, calculated by dividing the UHII by 182 days. An increase of one degree over an eight-hour period would equal eight degree-hours, as would an increase of two degrees over a four-hour period. [31]

As illustrated in **Figure 3-2: Urban Heat Island Index**, the City is not severely impacted by the UHIE that may intensify extreme heat days and heatwaves. However, even without a large UHIE, the City is still projected to have extreme heat days, and many types of infrastructure are affected by extreme heat, including roads and rails. High temperatures increase the risk of pavement deterioration, depending on the paving materials and the traffic load of a given road. [32, 33] The type of pavement used is typically based on historical climate conditions; the increasing occurrence of frequent and prolonged extreme heat outside of historical norms will present challenges to the roadway system. [34] Extreme heat may also cause pavement heave and damage to transportation infrastructure and functioning. [35] Extreme heat is also problematic for rail systems, as railroad tracks exposed to high temperatures are at risk of warping or buckling. [36]

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[31] California Environmental Protection Agency. 2022. Urban Heat Island Interactive Maps. https://calepa.ca.gov/urban-heat-island-interactive-maps-2. Accessed April 12, 2022.

[32] Daniel, J.S., J.M. Jacobs, E. Douglas, R.B. Mallick, and K. Hayhoe. 2014. Impact of climate change on pavement performance: Preliminary lessons learned through the Infrastructure and Climate Network (IC Net). dot:10.1061/9780784413326.001.

[33] Rowan, E., C. Evans, M. Riley-Gilbert, R. Hyman, R. Kafalenos, B. Beucler, B. Rodehorst, A. Choate, and P. Schultz. 2013. Assessing the sensitivity of transportation assets to extreme weather events and climate change. Transportation Research Record: Journal of the Transportation Research Board 2326(1):16—23. doi:10.3141/2326-03.

[34] Holsinger, H. 2017. Preparing for change. FITWA-HRT-17-002. Public Roads 80(4). McLean, VA: Office of Research, Development, and Technology, Federal High Administration. https://highways.dot.gov/public-roads/januaryfebruary-2017/preparing-change. Accessed April 11, 2022.

[35] Guo Y, Gasparrini A, Li S, Sera F, Vicedo-Cabrera AM, de Sousa Zanotti Stagliorio Coelho M, et al. (2018) Quantifying excess deaths related to heatwaves under climate change scenarios: A multicountry time series modelling study. PLoS Med 15(7): e1002629.

[36] Magill, B. 2014. "Sun kinks" in railways join the list of climate change's toll. Scientific American, June 2. www.scientificamerican.com/article/sun-links-in-railways-Join-the-list-of-climate-change-s-toll. Accessed April 11, 2022.

As heat waves worsen, energy systems will need to adapt to help communities and businesses cope with rising temperatures. Access to air conditioning will be vital for vulnerable populations, even life-saving for the elderly, young children, and those with pre-existing health conditions. However, increased cooling needs for both air conditioning and refrigeration will place significant stress on the power system during periods of extreme heat. And if that power comes from fossil-fired power plants, there may also be an increase in soot, smog, and other forms of air pollution with the associated public health consequences. [37] Impacts on electricity resources from climate hazards can include stress and physical damage to the electricity generation, transmission, and distribution system. Transmission facilities face increasing climate change-related risks because of the increased frequency of wildfires, severe wind, and extreme heat. Extreme heat and drought can add stress to transmission systems, resulting in system failure. Electrical infrastructure may fail due to increased electrical loads and stress from longer periods of increased operation.

Sensitivity: Social

Temperature-related mortality (including from extreme heat) is projected to be among the most deadly and costly impacts of climate change in certain locations around the globe. Higher temperatures and extreme heat can lead to heatstroke and increase the risk of or exacerbate cardiovascular disease, respiratory disease, kidney failure, and preterm births. Significant differences in the projected number of heat-related deaths also exist within a particular region or City. For instance, urban areas with a large area of impervious surfaces and little shade— also known as urban heat islands—tend to be hotter than surrounding areas.

Even though extreme heat will be more frequent and severe in hotter regions of the state, one national study estimates that temperature-related mortality is projected to be higher in cooler regions because they are less prepared for the heat (for example, fewer buildings have air conditioning).

Warm night temperatures affect the ability of a community and its residents to effectively cool down from extreme heat days. If temperatures remain higher than normal during the night, the compounding impacts from high daytime temperatures can be highly detrimental to public health. Based on these projections, the City can anticipate increased demand – towards the end of the century – for cooling centers and calls for service from vulnerable populations, which are expected to be disproportionately impacted by extreme heat conditions.

Figure 3-3: Heat Health Action Index: Encinitas displays the Heat Health Action Index (HHAI) from the California Natural Resources Agency's California Heat Assessment Tool (CHAT). CHAT uses a dataset designed to investigate how the frequency of heat health events will change throughout the 21st century. The HHAI is a statistically weighted result of social (e.g., education, income, linguistic isolation), health (e.g., asthma, percent low birth weight), and environmental (e.g., pollution, tree canopy) indicators and is intended to represent overall heat vulnerability. Represented by the US Census Tract, the range is from 0 to 100, with lower scores representing less heat vulnerability. All Encinitas census tracts are projected to have low vulnerability to heat which corresponds to Cal-Adapts projections for the number of Extreme Heat Days through the end of the century (see **Table 3-3**).

[37] Abel, D.W., T. Holloway, M. Harkey, P. Meter, D. Ahl, V.S. Limaye, and J.A. Patz. 2018. Air-quality-related health impacts from climate change and from adaptation of cooling demand for buildings in the eastern United States: An interdisciplinary modeling study. PLOS Medicine 15(7):1—27.dot:10.1371/journal.pmed.1002599.

Figure 3-2: Urban Heat Island Index

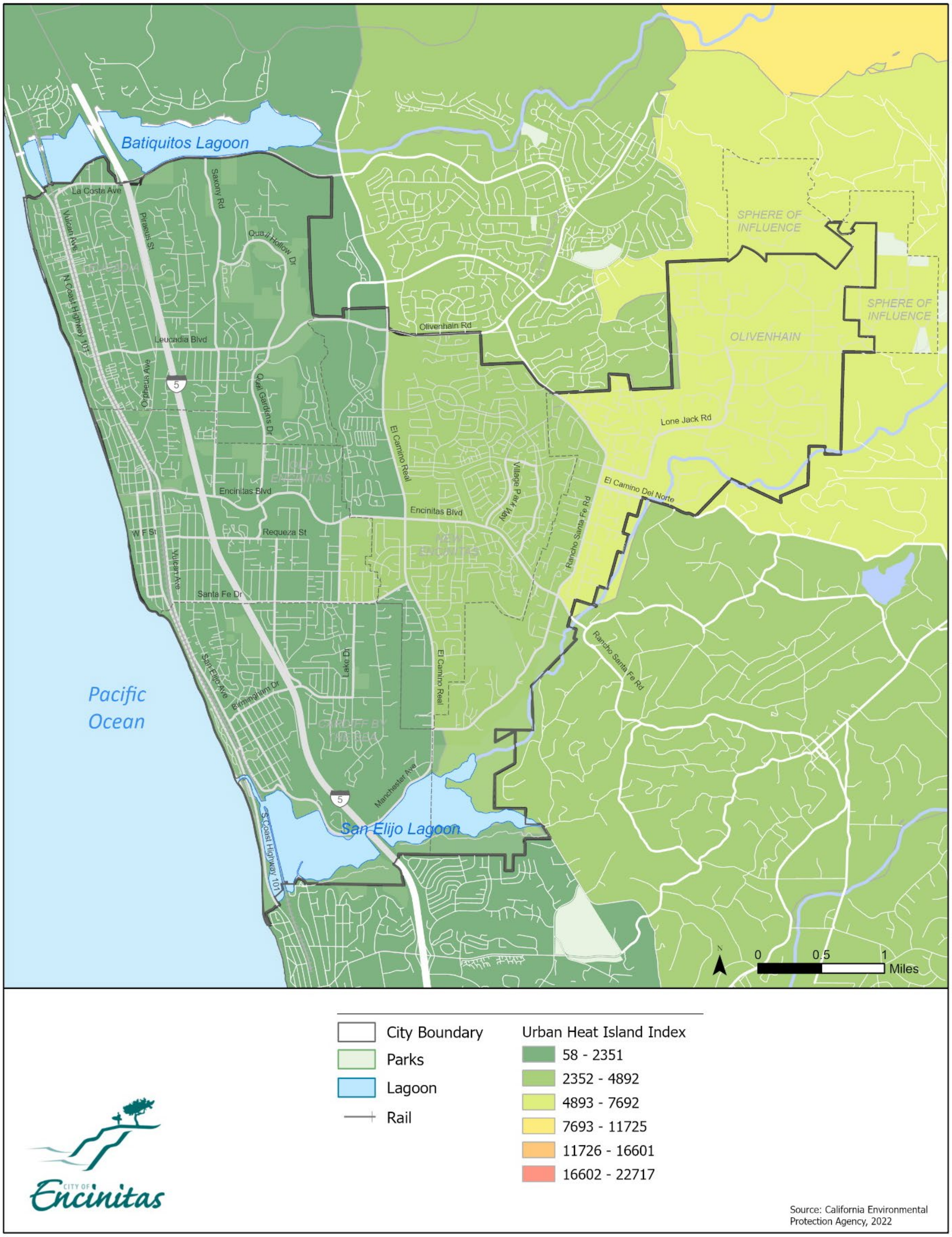
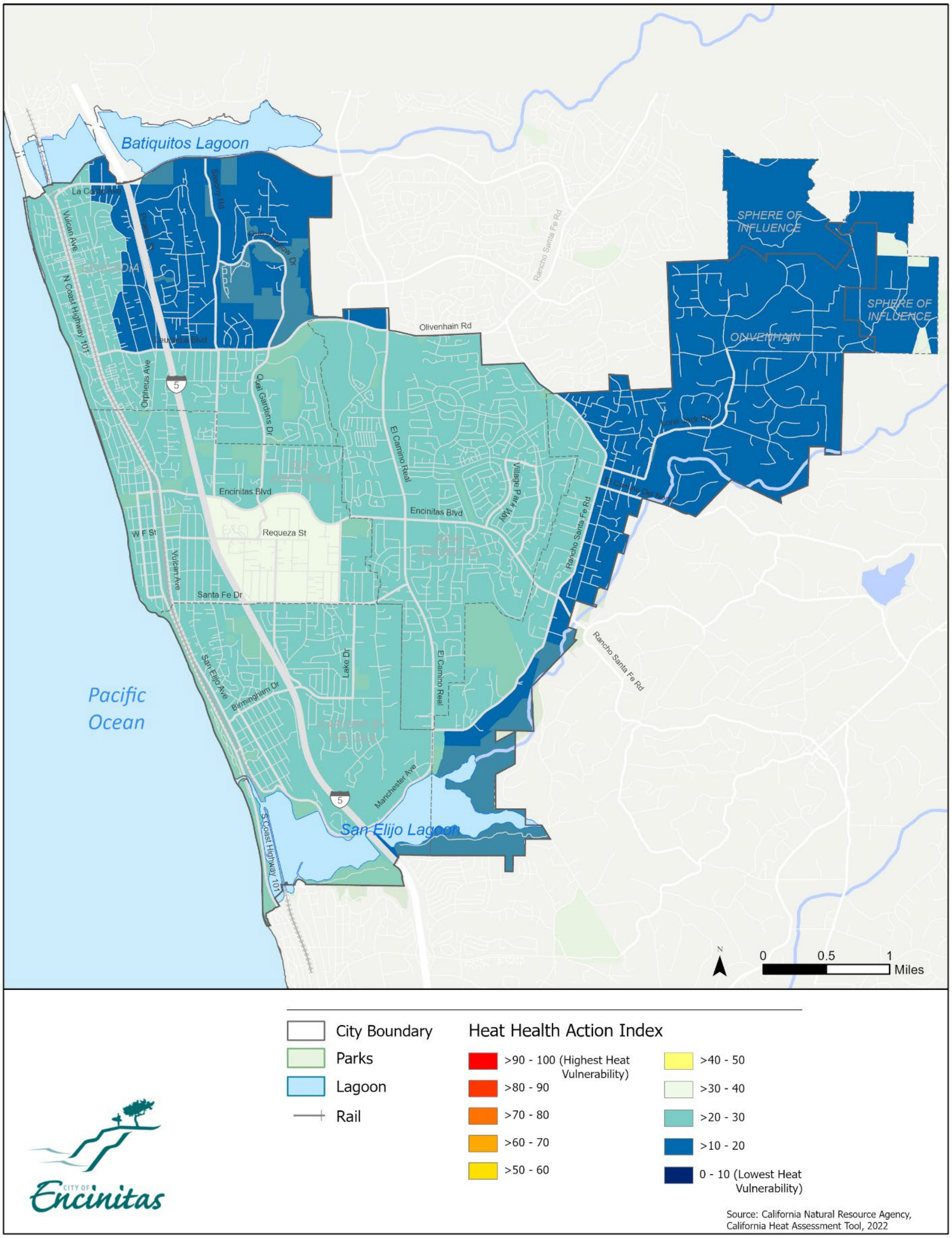


Figure 3-3: Heat Health Action Index: Encinitas



While the general population of Encinitas may be less vulnerable to extreme heat events, people have unique and individual thresholds. Extreme heat events, including heat waves, can lead to illness and death, particularly among older adults, the very young, and other vulnerable populations.

Adaptive Capacity

Current research indicates that most people can adapt biologically and physically to incremental increases in average normal temperatures. Children, pregnant women, and older adults are more susceptible to adverse effects because they are less able to regulate their body temperatures. Other at-risk groups include individuals working outdoors, outdoor athletes, the socially isolated, those with incomes below the federal poverty level, and communities of color. Continuous exposure to increased heat over time will impact how individuals are able to work and play both now and in the future. [38]

Over extended periods of time, individuals and communities can adapt to their local climates. When both warmer and colder temperatures go above or below those norms rapidly, scientific evidence shows that people become vulnerable to associated health effects related to those extremes. Studies suggest that climate change will increase the severity and frequency of extreme temperature conditions, leading to increases in temperature-related illness and death.

Beaches can help the public stay cooler during heat events, as the coastline in Encinitas is cooler than areas further inland and provides access to the ocean. The beach also provides a buffer between the ocean and the City's built infrastructure, helping to reduce erosion from waves and storm events. If beaches were to be impacted by climate hazards, they could lose the ability to provide these key amenities.

Regulation and Planning

California is dedicated to addressing the climate change impacts on transportation infrastructure, including funding and research initiatives as well as department- and agency-led projects to assess climate-related vulnerabilities and plan for more climate-resilient transportation infrastructure.

- **Chapter 5 of 2017 (SB 1, Beall)** Provided $20 Million for Climate Adaptation Planning Grants to prepare for and reduce damage from climate change impacts on transportation infrastructure.
- **Chapter 118 of 2016 (AB 2800, Quirk)** Established the Climate-Safe Infrastructure Working Group to convene a working group consisting of engineers, scientists, and architects to examine how to incorporate climate change impact data into state infrastructure planning, design, construction, operations, and maintenance.
- **Agency (CalSTA) Developed Climate Action Plan for Transportation Infrastructure.** Developed in response to Executive Order N-19-19, which called for CalSTA to leverage discretionary state transportation funds to reduce GHG emissions in the transportation sector and adapt to climate change.

Renewable energy and electricity storage technologies can add flexibility to the electricity grid. Together with microgrids, renewables can support increased grid resilience and reliability in the face of extreme

[38] National Institute of Heath, National Institute of Environmental Health Sciences. 2022. *Temperature-related Death and Illness*. https://www.niehs.nih.gov/research/programs/climatechange/health_impacts/heat/index.cfm#footnote1 Accessed April 7, 2022.

weather. Electricity storage also has the potential to replace fossil-fired "peaking" power plants, which are called upon in times of high demand for electricity, such as during extreme heat events. [39]

The City has addressed extreme heat events in planning documents such as the Climate Action Plan, Hazard Mitigation Plan, and the Urban Forest Management Plan. The City also operates programs that respond to extreme heat events for displaced residents. Finally, the City also has regulations in place that are beneficial during extreme heat events by limiting further potential public health impacts. The plans and programs for the City and supporting agencies are described below.

City of Encinitas Climate Action Plan (2020)

The City's Climate Action Plan contains actions to mitigate temperature-related effects and improve heat resiliency to protect its populations, functions, and structures in the short- and long-term. Strategies to mitigate the impacts of the UHIE, include:

- Incorporation of green infrastructure strategies by reducing the area of heat-absorbing paved surfaces and increasing landscaped area with planted vegetation, including shade trees.
- Promoting the use of solar carports on new and existing surface parking lots to mitigate heat absorption.
- Promoting the use of passive cooling design.
- Conduct outreach to educate City residents on the health risks associated with extreme heat events and strategies to prepare for these events.
- Coordinate with relevant agencies to better plan and prepare for extreme heat events and the increased demand for emergency services associated with these events.
- Work with local and regional employers to ensure worker protection measures are in place for extreme heat events.
- Work with local businesses and institutions to provide a network of "Cool Zone" areas.
- Participate in beach nourishment projects that maintain local wide sandy beaches. Encinitas beaches are considered regional "Cool Zones."

San Diego County Multi-jurisdictional Hazard Mitigation Plan (2017)

The 2017 MJHMP includes objectives and actions to decrease the risks associated with increased temperature and extreme heat events. Goal 8 of the 2017 MJHMP Chapter on Encinitas intends to "[r]educe the possibility of damage and losses to existing assets, particularly people, critical facilities/infrastructure, and City-owned facilities, due to severe weather, including extreme heat." The goal includes three corresponding objectives and seven actions to help the City prepare for the impacts of extreme heat events. Objectives and actions focus on planning, protecting vulnerable assets susceptible to extreme heat, and public education. [40]

Urban Forest Management Program

Trees are a source of shade, air conditioning, and other environmental benefits and yield both a high quality of life and economic benefits to the community, including enhanced property values. The City recognizes that its urban forest is an integral part of its infrastructure, providing significant ecological, social, and

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[39] Abel, D.W., T. Holloway, M. Harkey, P. Meter, D. Ahl, V.S. Limaye, and J.A. Patz. 2018. Air-quality-related health impacts from climate change and from adaptation of cooling demand for buildings in the eastern United States: An interdisciplinary modeling study. PLOS Medicine 15(7):1—27. dot:10.1371/journal.pmed.1002599.

[40] San Diego County Multi-Jurisdictional Hazard Mitigation Plan, Section Five, Encinitas. October 2017.

economic benefits, including improved air quality, reduced erosion and stormwater runoff, energy conservation, improved health, and enhanced livability.[41] The City's Tree Ordinance and Urban Forest Management Policy (2009) are its primary regulatory tools to provide for orderly protection of trees, promote the health, safety, welfare, and quality of life for the residents of the City, to protect property values, and to avoid significant negative impacts on adjacent properties.[42]

Leaf Blower Ordinance

Air pollution exposure is one of the primary concerns of SB1000 because of the historically larger detrimental effects on vulnerable communities. On August 21, 2019, the Encinitas City Council voted unanimously in favor of passing a progressive Leaf Blower Ordinance to help the City transition away from fossil-fuel-based off-road equipment. The benefits of prohibiting gas-powered leaf blowers include avoiding greenhouse gas emissions; decreasing noise levels; and reducing suspended dust, allergens, and other harmful particulates.[43]

Emergency Shelters

Hazardous climate events, such as extreme heat or flooding, may potentially displace Encinitas residents or the already homeless. Those displaced will require temporary shelter during hazardous conditions and severe weather events with supplies that can increase the adaptive capacity of individuals experiencing homelessness.

In February 2019, the City of Encinitas adopted Ordinance 2019- 01, which permitted emergency shelters within the Light Industrial (LI) and Business Park (BP) zones as required by California Government Code Section 65583(a)(4) (A- D). In selecting an appropriate location for emergency shelters, access to public transit was an important consideration, as individuals and households experiencing homelessness do not have reliable means of transportation. The LI and BP zones are well served by public transportation and regional connections providing access to jobs and services.

Cool Zones

The Cool Zone program is an established network of free, air-conditioned settings (such as libraries or community centers) across San Diego County that allow respite for older adults, persons with disabilities, or anyone looking to escape the extreme heat during the summer. Cool Zones are a way for residents to lower individual utility usage and help conserve energy for the whole community. In partnership with San Diego Gas & Electric (SDG&E), the Cool Zone program is managed by Aging & Independence Services (AIS), a division of the County of San Diego Health and Human Services Agency.

The Community Resource Center (CRC) is an important local partner to the City in providing housing navigation and supportive services for those experiencing homelessness and other at-risk populations. The facility is a County designated "Cool Zone" making it a local respite from hot weather.[44] The Encinitas Public

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[41] City of Encinitas. 2009. Urban Forest Management Program Council Policy C027.
[42] City of Encinitas. 2022. Urban Forest Management Program. https://encinitasca.gov/Government/Departments/Public-Works/Urban-Forest-Management-Program. Accessed April 11, 2022.
[43] City of Encinitas. 2019. *Leaf Blower Ordinance. https://encinitasca.gov/leaf-blower-ordinance.* Accessed April 11, 2022.
[44] City of Encinitas. 2022. Community & Senior Center. https://encinitasca.gov/Residents/Senior-Citizens/Community-Senior-Center. Accessed July 14, 2022.

Library, Cardiff-by-the-Sea Library, and the Community Senior Center are also San Diego County designated Cool Zone facilities. [45]

The City of Encinitas has partnerships with regional service providers. The City provides Community Development Block Grant program funds to homeless service providers for homeless prevention and regional shelter efforts. Other North County facilities and services for those experiencing homelessness include (with distance from Encinitas in parenthesis):

- Mental Health Systems (Oceanside— 12.2 miles)
- Interfaith Community Services (Vista — 16.4 miles)
- La Posada Shelter (Carlsbad — 7.8 miles)
- Women's Resource Center (Oceanside — 12.2 miles)
- Operation Hope (Vista — 15.6 miles)
- Haven House (Escondido— 16.4 miles)
- Interfaith Community Services (16.4 miles)
- North County Lifeline (Oceanside 13.1)
- Oceanside Transit Center (Oceanside — 13.1 miles) [46]

3.2.2.2 DROUGHT + WATER SUPPLY

Warmer temperatures also contribute to more frequent and intense droughts by leading to a decline in and faster melting of winter snowpack, greater rates of evaporation, and drier soils. These conditions decrease the amount of spring and early summer snowmelt runoff upon which the state historically has depended for its annual water supply, while they increase the demand for irrigation water in both agricultural and urban settings. The period of 2012 through 2015 represents the state's four driest consecutive years on record in terms of statewide precipitation, and 2021 is the third driest single year. Moreover, 2022 already experienced the driest consecutive January and February in the Sierra Nevada, based on records dating back over one hundred years.

Drought may lead to water-related problems. When rainfall is less than normal for weeks, months, or years, the flow of streams and rivers declines, water levels in lakes and reservoirs fall, and the depth to water in wells increases. If dry weather persists and water-supply problems develop, the dry period can become a drought. [47]

As a result, droughts have widespread impacts across the state, including mandatory water use restrictions, reductions in agricultural crop production, over-pumping of groundwater—which damages infrastructure from land sinking and dries up domestic wells in communities—and degraded habitats for fish and wildlife. [48]

Historical Drought Events

The 2007–2011 California drought marked the beginning of increased restrictions on State Water Project (SWP) pumping from the Bay-Delta due to environmental considerations. In April 2007, Metropolitan Water

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[45] San Diego County Health and Human Services Agency. 2022. Cool Zones. https://www.sandiegocounty.gov/hhsa/programs/ais/cool_zones/. Accessed July 14, 2022.
[46] City of Encinitas. 2021. Encinitas 6th Cycle Housing Element 2021-2029.
[47] United States Geological Survey. 2022. California Water Sciences Center. California Drought. https://ca.water.usgs.gov/california-drought/what-is-drought.html. Accessed April 12, 2022.
[48] State of California, Legislative Analyst's Office. 2022. Budget and Policy Post. Climate Change Impacts Across California Crosscutting Issues. April 5, 2022. https://lao.ca.gov/Publications/Report/4575. Accessed April 11, 2022.

District of Southern California (MWD) notified its member agencies that it expected challenges in meeting demands due to insufficient imported water supplies from the SWP and the Colorado River. To meet demands, MWD announced that it would implement shortage-related actions consistent with its Water Surplus and Drought Management Plan (WSDMP).

In January 2014, Governor Brown proclaimed a state of emergency throughout California, calling for increased conservation across the state. In response to the governor's drought declaration and call for conservation, the Water Authority activated its WSDRP for the second time since its adoption in 2006, declaring in February 2014 a regional drought response Stage I, Voluntary Supply Management. On April 2, 2017, Governor Brown lifted the drought emergency. This five-year drought (2012 – 2016), which is the most recent, has well-documented agricultural (e.g., extremely agricultural surface water allocations), physical (e.g., groundwater depletion-related subsidence) and environmental impacts (e.g., fish mortality). Surface and groundwater withdrawals were used to mitigate water supply impacts. Water transfers were a primary tool to move water to areas of need, such as permanent crops. [49]

On April 21, May 10, and July 8, 2021, Governor Newsom issued proclamations that a state of emergency exists in a total of 50 counties due to severe drought conditions and directed state agencies to take immediate action to preserve critical water supplies and mitigate the effects of drought and ensure the protection of health, safety, and the environment. On October 19, 2021, Governor Newsom signed a proclamation extending the drought emergency statewide and further urging Californians to reduce their water use.

On January 4, 2022, the State Water Resources Board passed Resolution No. 2022-0002 adopting an emergency regulation to supplement voluntary water conservation. [50]

As of May 24, 2022, new statewide regulations prohibit watering decorative grass in common areas of subdivisions and homeowners associations, as well as on commercial, industrial, and institutional properties. [51]

Vulnerability to Drought

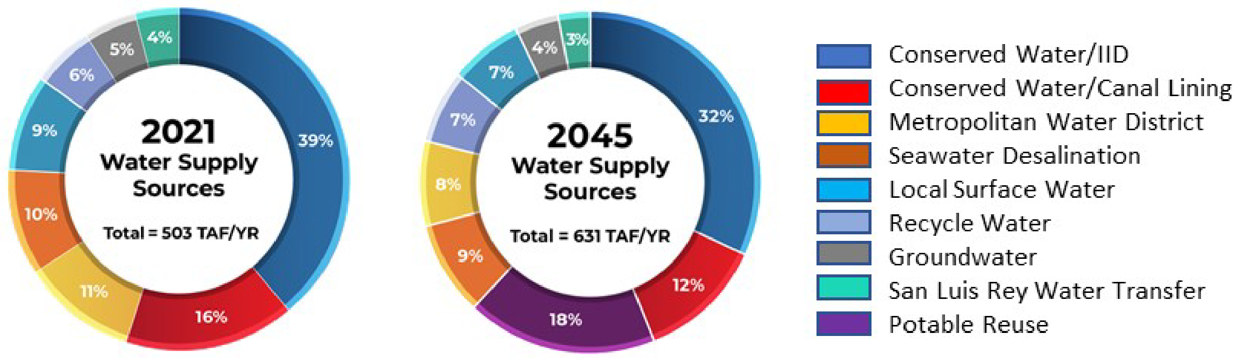
Exposure

Drought conditions in Encinitas are contingent upon precipitation and snowpack conditions in other parts of the state and region in which Encinitas' potable water is sourced – the Sierra Nevada and Colorado River Basin. The western United States, including California, and by default Encinitas, has been experiencing prolonged periods of drought. Recent research suggests that extended drought occurrence (a "mega-drought") could become more pervasive in future decades. An extended drought scenario is predicted for all of California from 2025 to 2075 under the HadGEM2-ES simulation and high emissions scenario. The extended drought scenario is based on the average annual precipitation between 1961 and 1990 of 10.9 inches. However, as shown in **Figure 3-4: Water Resource Portfolio for San Diego County**, the San Diego

[49] United States Geological Survey. 2022. California Water Sciences Center. California Drought. Comparisons. 2012-2016 California Drought: Historical Perspectives. https://ca.water.usgs.gov/california-drought/california-drought-comparisons.html. Accessed July 13, 2022.
[50] California Department of Water Resources. 2022. Resolution no. 2022-0002 to adopt an emergency regulation to supplement voluntary water conservation. January 4.
[51] San Diego County Water Authority. 2022. Summer of Water Savings, State Mandates. June 21, 2022.

County Water Authority has diversified water sources that are projected to supply water to the region for years to come.[52]

Figure 3-4: Water Resource Portfolio for San Diego County



Source: San Diego County Water Authority. 2022. Water Resource Portfolio. https://www.sdcwa.org/your-water/. Accessed July 15, 2022.

Sensitivity: Physical and Social

Encinitas' drought vulnerability is tied to the vulnerability of imported water purchased from the SDCWA, local surface water from Lake Hodges, and recycled water purchased from the San Elijo Joint Powers Authority.[53]

Changes in rainfall and snowmelt timing in water supply source areas can affect SDCWA's ability to provide adequate and safe drinking water on a reliable basis. As temperatures in Encinitas and the surrounding areas increase, there will also be a higher demand for potable water. While SDCWA may be able to rely on groundwater to provide additional supply, drawing from these sources can substantially lower water tables, resulting in land subsidence. Furthermore, drought conditions can increase the concentration of industrial chemicals, heavy metals, and agricultural runoff contaminants in groundwater.[54] Precipitation variability will also affect the local surface and groundwater supply causing the region to rely on other sources such as desalination and potable reuse. It is estimated that by 2040, countywide water demand will increase by 30 percent from 2015 levels due to population and economic growth, further straining the need for a sustainable water supply.[55] Increased episodes of drought and increased water demand could result in water shortages for the region, endangering ecological systems (e.g., flood control or sensitive habitat, recreational areas).

As vegetation changes because of drought conditions, the animal species that depend on certain plant communities for food supply and habitat may be affected. The projected increase in the duration of

[52] California Energy Commission. Cal-Adapt. 2022. Extended Drought Scenarios. https://cal-adapt.org/tools/extended-drought/#lat=33.0450&lng=-117.2539&boundary=place&climvar=Wildfire. Accessed April 12, 2022.
[53] San Dieguito Water District. 2020 Urban Water Management Plan, Final. June 2021. https://encinitasca.gov/Portals/0/City%20Documents/Documents/San%20Dieguito%20Water%20District/Engineering/SDWD_2020%20reduced.pdf?ver=2021-06-10-145230-143. Accessed July 12, 2022.
[54] Rudolph, L., Harrison, C., Buckley, L. & North, S. 2018. Climate Change, Health, and Equity: A Guide for Local Health Departments. Oakland, CA and Washington D.C., Public Health Institute and American Public Health Association.
[55] San Diego County Water Authority. 2016. *Urban Water Management Plan*.

droughts through the end of the century may threaten ecosystems as species become weak due to limited access to water and become susceptible to disease, pests, and decay. [56]

Adaptive Capacity

The City's reliance on various regional water resources, including the San Diego Water Authority, will remain a critical issue for the City's resilience to drought periods. The City will consider how future supply and demand for water resources in the region may change because of climate change. Considering conservation programs, maintenance of current adjudicated surface water rights, recycled water supply, and additional imported water from SDCWA, the City anticipates having sufficient water supply to meet current and future customers' needs through at least 2035. Therefore, water supply does not place a constraint on near-term development. The Olivenhain Municipal Water District, a member of the SDCWA, has stated their commitment to protecting its water sources, and continually looks for ways to increase its local supply. Programs include groundwater basin studies, recycled water, watershed outreach and education, and joint projects such as the Olivenhain Water Storage Project and the North San Diego County Regional Recycled Water Project. [57]

The City has addressed drought in planning documents such as the Climate Action Plan and Hazard Mitigation Plan. Finally, the City and the water districts that supply water to the Encinitas have regulations, plans, and programs in place that are beneficial during periods of drought by limiting water use. The plans and programs for the City and supporting agencies are described below.

City of Encinitas Climate Action Plan (2020)

Considering the potential decrease in regional water resources available to the City due to decreases in annual precipitation, the City will implement the following strategies to increase the community's resilience with regard to water supplies:

- Coordinate with local and regional partners (SDWD, OMWD, SDCWA) to support and improve water conservation efforts and programs for City residents.
- Expand and/or improve the recycled water efforts currently in place at the San Elijo Water Reclamation Facility.
- Work with relevant water agencies, including SDCWA, OMWD, and SDWD, to evaluate current and future water supply systems and vulnerabilities.
- Continue marketing and outreach programs to promote participation in existing water conservation rebate and incentive programs in the region. [58]

San Diego County Multi-jurisdictional Hazard Mitigation Plan (2017)

The 2017 MJHMP includes objectives and actions to decrease the risks associated with increased temperature and extreme heat events. Goal 9 of the 2017 MJHMP Chapter on Encinitas intends to "[r]educe the possibility of damage and losses to existing assets, particularly people, critical facilities/infrastructure, and City-owned facilities, due to drought". The goal includes four corresponding

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[56] California Natural Resources agency, Governor's Office of Planning and Research, and California Energy Commission. 2019. California's Fourth Climate Change Assessment; San Diego Region Report. Available: https://www.energy.ca.gov/sites/default/files/2019-11/Reg_Report-SUM-CCCA4-2018-009_SanDiego_ADA.pdf. Accessed April 12, 2022.

[57] Olivenhain Municipal Water District. 2022. https://www.olivenhain.com/your-water-supplies/overview/. Accessed July 15, 2022.

[58] City of Encinitas, Climate Action Plan. November 2020.

objectives and fifteen actions to help the City prepare for the impacts of drought. Objectives and actions focus on planning, protecting vulnerable assets susceptible to wildfire/structural fires, agency coordination, and public education, as follows:

Objective 9.A.1: Develop a comprehensive approach to reducing the possibility of damage and losses due to drought.

Action 9.A.1: Continue to promote water conservation as a means to mitigate future drought conditions (Municipal Code 23.26), including criteria for drought related actions and updating of SDWD Drought Response Plan.

Objective 9.B: Protect existing assets with the highest relative vulnerability to the effects of drought.

Action 9.B.1: Continue the use of reclaimed water for landscaping at city parks and facilities, where available.

Action 9.B.2: Implement water efficiency upgrades at municipal buildings, parks and publicly owned facilities.

Action 9.B.3: Explore options of public outreach, including providing residents with resources for water efficient plumbing and landscaping.

Objective 9.C: Coordinate with and support existing efforts by federal, state, local governments, utility providers and other organizations to mitigate the effects of drought.

Action 9.C.1: Support groundwater recycling efforts by San Elijo JPA.

Action 9.C.2: Support regional efforts to diversify and improve water supply and delivery systems, including the construction of the Carlsbad desalination plant.

Action 9.C.3: Support OMWD water conservation initiatives, including the use of mandatory water restrictions as part of its drought response plan, when necessary.

Action 9.C.4: Continue to coordinate with other agencies to improve water reuse as part of the North County Water Reuse Coalition.

Action 9.C.5: Continue to work with State Water Resources Control Board, San Diego County Water Authority, Office of Emergency Services, SFID and OMWD to assess vulnerability to drought risk and monitor drought conditions.

Action 9.C.6: Support OMWDs efforts to extend recycled water to Village Park (through the conversion of Wiegand Tank) and possible conversion of Wankett Tank to recycled water tank as a regional project.

Action 9.C.7: Provide support for the implementation of ongoing Lake Hodges Water Quality Improvement Projects (Prop 84), which are important for improving the ability to transport local supplies in regional system.

Action 9.C.8: Remain informed of state legislation regarding drought and water conservation.

Objective 9.D: Educate citizens about drought, its potential impacts and opportunities for mitigation actions.

Action 9.D.1: Continue to provide outreach materials to residences within the city for water conservation, in coordination with SFID and OMWD.

Action 9.D.2: Encourage residents to adopt drought tolerant landscaping or xeriscape practices to reduce dependence on irrigation. [59]

City of Encinitas Water Efficient Landscape Regulation

The State Legislature determined in the Water Conservation in Landscaping Act (the "Act"), Government Code Section 65591 et seq., that the state's water resources are in limited supply. The Legislature also recognized that while landscaping is essential to the quality of life in California, landscape design, installation, maintenance, and management must be water efficient. The City implements this regulation via Chapter 23.26 Water Efficient Landscape Regulations. [60]

San Dieguito Water District (2022) Water Master Plan

The Water Master Plan for the San Dieguito Water District provides an assessment of the existing water system conditions and demands. The plans concluded that the overall system is adequately sized to accommodate future 2030 growth demands. In the San Dieguito Water District, the current average daily demand for the district is 6.63 million gallons per day. The Master Plan identifies areas for improvement that were then included in the future planning horizon CIP. These CIP upgrades include pipeline system upgrades, valve replacement, meter replacement, and treatment plant upgrades. [61]

Olivenhain Municipal Water District Urban Water Management Plan (2020)

Olivenhain Municipal Water District (OMWD) has prepared this 2020 Urban Water Management Plan (UWMP) to guide its conservation and water resource management programs and to comply with state law. The Urban Water Management Planning Act [California Water Code (CWC) §§ 10610 – 10656] (Act) requires urban water suppliers to report, describe, and evaluate various aspects of their water resources and plans for providing water service, such as:

- Water deliveries and uses
- Water supply sources
- Efficient water uses
- Demand Management Measures (DMMs); and
- Water shortage contingency planning

OMWD is a California public water system providing potable water, wastewater services, recycled water, hydroelectricity, and park services and is headquartered in Encinitas, San Diego County, California. In 2020, OMWD served 22,592 accounts and delivered 17,100 acre-feet (AF) of potable water. Under the Act, as amended, OMWD is required to submit an UWMP every five years and this report is the fiscal year (FY) 2020 plan. [62]

OMWD Drought Response

The State Water Resources Control Board officially prohibited certain wasteful water practices by introducing the conservation emergency regulation (State Water Resources Control Board Resolution No.

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[59] San Diego County Multi-Jurisdictional Hazard Mitigation Plan, Section Five, Encinitas. October 2017.
[60] City of Encinitas Water Efficient Landscape Regulation. Chapter 23.26. https://library.qcode.us/lib/encinitas_ca/pub/municipal_code/item/title_23-chapter_23_26-23_26_090. Access April 13, 2022.
[61] San Dieguito Water District. October 2021. 2022 Water System Master Plan.
[62] Olivenhain Municipal Water District. 2021. 2020 Urban Water Management Plan. June.

2022-0002). Under a drought-related State of Emergency, the following wasteful water practices are officially prohibited:

- Outdoor landscape irrigation resulting in visible runoff to adjacent properties
- Outdoor landscape irrigation within 48 hours of measurable rainfall
- Washing cars using a hose without a shut-off nozzle
- Using potable water to clean hardscapes except in cases where health and safety are at risk
- Using potable water in non-recirculating ornamental fountains, ponds or lakes
- Using potable water for street cleaning or construction purposes except in cases where health and safety are at risk
- Using potable water for irrigation of non-functional turf

Note: There are water use prohibitions for homeowner associations during and after a drought state of emergency.

OMWD encourages the following voluntary conservation practices:

- Restrict outdoor irrigation to no more than three days per week under the following schedule
  - Odd-numbered houses irrigating on Sunday, Tuesday, and Thursday
  - Even-numbered houses irrigating on Monday, Wednesday, and Saturday
- Restrict outdoor irrigation to no more than 10 minutes per watering station for systems not using water-efficient devices
- Irrigate residential and commercial landscape before 10 a.m. and after 6 p.m. This shall not apply to the use of a hand-held hose equipped with a shut-off nozzle to water landscaped areas.
- Use a bucket, a watering can, a hand-held hose equipped with a shut-off nozzle, or low-volume, non-spray irrigation to water landscaped areas, including trees and shrubs, located on residential and commercial properties that are not irrigated by a landscape irrigation system.
- Irrigate nursery and commercial grower's products before 10 a.m. and after 6 p.m. Watering is permitted at any time with a hand-held hose equipped with a shut-off nozzle, or when a drip/micro-irrigation system/equipment is used. Irrigation of nursery propagation beds is permitted at any time. Watering of livestock is permitted at any time.
- Serve and refill water in restaurants, bars, and other food service establishments only upon request.
- Offer guests in hotels, motels, and other commercial lodging establishments the option of not laundering towels and linens daily.
- Repair all water leaks within three (3) days of notification by Olivenhain Municipal Water District unless other arrangements are made with the General Manager.
- Use recycled or non-potable water for construction purposes when available and feasible. [63]

Carlsbad Desalination Plant

The Claude "Bud" Lewis Carlsbad Desalination Plant is the nation's largest, most technologically advanced and energy-efficient seawater desalination plant. Each day, the plant delivers nearly 50 million gallons (56,000 acre-feet per year) of fresh, desalinated water to San Diego County – enough to serve approximately 400,000 people and account for about one-third of all water generated in the County. [64]

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[63] Olivenhain Municipal Water District. 2022. Water Conservation Practices. https://www.olivenhain.com/customer-services/drought/water-use-restrictions/. Accessed July 13, 2022.
[64] https://www.carlsbaddesal.com. Accessed April 13, 2022.

San Diego County Water Authority 2020 Water Shortage Contingency Plan (2021)

In 2017, SDCWA adopted its Water Shortage Contingency Plan to effectively manage water resources when the countywide water supply is under pressure. Though SDCWA has developed a diverse water supply portfolio, supply is still threatened by climate change and drought. The plan provides background on historical drought events and provides lessons learned from those events to maintain a sustainable water supply. The plan contains a series of steps to pursue during a water shortage to minimize impacts on the region's quality of life and economy. [65] On October 28, 2021, the SDCWA Water activated the Water Shortage Contingency Plan urging regional users to increase voluntary water conservation efforts during the current drought. [66] As of May 24, 2022, new statewide regulations prohibit watering decorative grass in common areas of subdivisions and homeowners associations, as well as on commercial, industrial, and institutional properties. [67]

San Diego County Water Authority 2020 Urban Water Management Plan

Under the Urban Water Management Planning Act (Water Code Sections 10610 through 10656), SDCWA developed the 2020 Urban Water Management Plan to ensure a reliable water supply for the region. The report includes annual water supply reports, which include documentation of local and imported water supplies. The plan's overall objective was to develop a mix of drought-resilience water resources available to the region to avoid periods of water shortages. The plan also discusses the agency's role in reducing GHG emissions and climate change and its research efforts on water systems' vulnerability to climate change impacts. Under the Urban Water Management Planning Act, an urban water supplier is required to submit an updated plan every five years. [68]

Water Smart San Diego (SDCWA)

The WaterSmart Landscape Makeover Program teaches you how to create a WaterSmart landscape. The WaterSmart Contractor Incentive Program targets qualified landscape contractors and large, self-managed landscape sites. The program's goal is to improve water-use efficiency by incentivizing the upgrade of irrigation devices. [69]

3.2.2.3 WILDFIRE + SMOKE

Warmer average temperatures and drier environments create conditions that lead to extreme, high-severity wildfires. These conditions increasingly dry out vegetation and lengthen the wildfire season, which raises wildfire risks. Additionally, more frequent and intense droughts put stress on trees and make them more susceptible to pest infestations. This, in turn, can lead to more diseased, dying, and dead trees, which can exacerbate the severity of wildfires by providing more combustible fuels.

Not only do high-severity wildfires take lives and destroy homes, businesses, and community infrastructure, but they also negatively impact fish and wildlife habitats. Moreover, intense wildfires can also impair air quality throughout the state. In recent years, smoke from wildfires has grown substantially and has been a major contributor to air pollution in the western United States—making up roughly half of small particulate matter, compared to less than 20 percent a decade ago. The degree to which climate change will impact

[65] San Diego County Water Authority. 2021. 2020 Water Shortage Contingency Plan.
[66] San Diego County Water Authority. https://www.sdcwa.org/water-authority-activates-water-shortage-contingency-plan. Accessed April 13, 2022.
[67] San Diego County Water Authority. 2022. Summer of Water Savings, State Mandates. June 21, 2022.
[68] San Diego County Water Authority. 2021. 2020 Urban Water Management Plan.
[69] San Diego County Water Authority. 2022. WaterSmart. https://www.watersmartsd.org. Accessed April 13, 2022.

particulate emissions in the future is subject to uncertainty, but researchers have estimated that particulate matter in fire-prone areas could roughly double by the end of the century.

According to the state's Fourth Climate Change Assessment, by 2100, the frequency of extreme wildfires burning over 25,000 acres could increase by nearly 50 percent. As with other climate hazards, the state is already beginning to experience an increase in severe wildfires. Most of California's largest and most destructive wildfires have occurred in recent decades. This pattern has been particularly notable in the last few years, which have seen some of the worst wildfires in the state's recorded history. Five of the twenty most destructive wildfires in the state's history occurred in 2020 alone, with an additional two in 2021. [70]

The City's landscape consists of rugged coastal terrain and includes one low-lying coastal ridge. Several open space areas within the City are characterized by shrubs and native trees. During the dry months, the wildfire risk in these open, vegetated areas can increase when exacerbated by occasional Santa Ana winds and elevated temperatures. Additionally, extreme weather conditions, such as high temperature, low humidity, and/or winds of extraordinary force, may cause an ordinary, localized fire to expand into a more intense and difficult to control wildfire. Currently, many homes within Encinitas are in the urban-wildland interface (UWI) [71], which is characterized by zones of transition between wildland and developed areas and often include heavy fuel loads that increase wildfire risk (See **Table 3-8: Urban-Wildland Interface Threatened Populations**). These areas within Encinitas include neighborhoods near Saxony Canyon, South El Camino Real/Crest Drive, and Olivenhain. [72]

Historical Wildfire Events

- 1996 – Harmony Grove wildfire in Encinitas resulted in the loss of three homes and the evacuation and sheltering of hundreds of Encinitas residents.

Note: other fires like the 2007 Witch Fire have come close to the City limits but not entered the City.

VULNERABILITY TO WILDFIRE

Climate change will result in changes in precipitation patterns, increased temperature, and drought conditions. Wetter months may lead to increased vegetative growth, while following periods of drought will allow the vegetative growth to dry up, creating greater fuel for fires. Climate change will also worsen existing severe wind events, which fuel the spread and intensity of wildfires. Santa Ana wind events blow in an offshore direction in parts of Southern California. They are caused by the formation of large high-pressure systems over eastern California, Nevada, and Utah, producing strong and extremely dry winds. Santa Ana winds have caused some of the region's most damaging wildfires and account for some of the worst extreme heat events. While future wind events are predicted to decrease, the intensity of a severe wind event over a shorter amount of time is predicted to increase. [73]

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[70] State of California, Legislative Analyst's Office. 2022. Budget and Policy Post. Climate Change Impacts Across California Crosscutting Issues. April 5, 2022. https://lao.ca.gov/Publications/Report/4575. Accessed April 11, 2022.

[71] Wildland Urban Interface (WUI): The geographical intersection of two disparate systems, wildland and structures. At this interface, structures and vegetation are close enough that a wildland fire could spread to structures or fire could spread from structures to ignite vegetation. Extracted from the California Department Of Forestry And Fire Protection Fire And Resource Assessment Program, California's Forest and Rangelands: 2010 Assessment.

[72] City of Encinitas, Climate Action Plan. 2020.

[73] California Natural Resources agency, Governor's Office of Planning and Research, and California Energy Commission. 2019. California's Fourth Climate Change Assessment; San Diego Region Report. Available:

Exposure

The potential for wildland fires represents a hazard where development is adjacent to open space or within proximity to wildland fuels. Steep hillsides and varied topography within portions of the City also contribute to the risk of wildland fires. The California Department of Forestry and Fire Protection (CAL FIRE) identifies Very High Fire Hazard Severity Zones (VHFHSZ) in the City that are included in the Local Responsibility Area (LRA) (See **Figure 3-5: Fire Hazard Severity Zones**). The map identifies two key areas in the City included in the VHFHSZ. Due to the topography and vegetation of these locations, surrounding properties are at increased risk of wildfire and associated hazards. Recent wildfire events in Encinitas include the Harmony Grove Fire in 1996, which resulted in the loss of three homes and the evacuation and sheltering of hundreds of residents. [74] The area of the Harmony Grove Fire is illustrated as a part of the Historic Fire Burn Areas.

The geographic extent of this hazard includes the following areas of the City: 1) Saxony Canyon, 2) South El Camino Real/Crest Drive, and 3) Olivenhain. Properties in these and other smaller areas are susceptible to wildfire because they are situated near open spaces and canyons containing heavy fuel loads. Reoccurring periods of low precipitation have increased the risk of wildfires in the region. A greater percentage of the population is potentially exposed to wildfires, and potential losses from this hazard are comparatively larger than those associated with flooding or coastal bluff failures. Recent wildfire events in Encinitas include the Harmony Grove Fire in 1996, which resulted in the loss of three homes and the evacuation and sheltering of hundreds of residents. [75]

The California Department of Forestry and Fire Protection's (CAL FIRE) Fire and Resource Assessment Program assesses the condition of California's forests and rangelands and maps fire hazards within State Responsibility Areas based on factors such as vegetative fuels, terrain, and weather. California's seasonally dry Mediterranean Climate lends itself to wildfires, and to better prepare, CAL FIRE is required to classify the severity of fire hazards in areas of California. The maps categorize lands into moderate, high, and very high Fire Hazard Severity Zones (FHSZ). FHSZ maps consider the likelihood that an area will be burned over a 30- to 50-year period and do not consider modifications from fuel reduction efforts. [76] As shown in **Figure 3-5: Fire Hazard Severity Zones**, 6.7 square miles, or approximately 35 percent, of the City is within a very high FHSZ. Wildfires also result in secondary impacts: a major consequence of wildfires is post-fire flooding and debris flow. The risk of floods and debris flows (or mudslide) after fires increases due to vegetation loss and soil exposure. These flows are a risk to life because they can occur with little warning and exert great force on objects in their path. Health threats from debris flows include:

- Rapidly moving water and debris that can lead to trauma;
- Broken electrical, water, gas, and sewage lines that can result in injury or illness; and
- Disrupted roadways and railways that can endanger motorists and disrupt transport and access to health care. [77]
- Mud is likely contaminated with pollutants. As described in reference to the Santa Barbara County mudslide in January 2018: "That mud could contain everything from sewage, to oil and gas from ruptured lines, as well as pesticides, ash, maybe chemicals from inside houses," said Chris Bryant,

https://www.energy.ca.gov/sites/default/files/2019-11/Reg_Report-SUM-CCCA4-2018-009_SanDiego_ADA.pdf. Accessed April 12, 2022.

[74] City of Encinitas, Climate Action Plan. 2020.

[75] San Diego County Multi-Jurisdictional Hazard Mitigation Plan, Section Five, Encinitas. October 2017.

[76] California Office of the State Fire Marshall. https://osfm.fire.ca.gov/divisions/community-wildfire-preparedness-and-mitigation/wildfire-preparedness/fire-hazard-severity-zones/. Accessed March 28, 2022.

[77] Centers for Disease Control and Prevention. 2022. Landslides and Mudslides. https://www.cdc.gov/disasters/landslides.html. Accessed July 14, 2022.

a regulatory consultant with Bergeson and Campbell. A Jan. 17, 2018 advisory from the Santa Barbara County Department of Public Health said: "Unknown amounts of potentially hazardous chemicals and untreated sewage were swept into the mudslide debris that flowed through impacted areas."[78]

Table 3-5: Critical Facilities and Facilities of Concern (Fire Hazard Severity Zone)

Category	Number of Facilities	
	Critical	Concern
City Facilities (Fire, Sheriff)	0	-
Community & Senior Center	0	-
Library	-	0
Water/Sewer Facilities	1	-
Hospital	0	-
Total	0	0

Source: City of Encinitas 2022

One critical facility was identified by the City resides within the VHFHSZ: The San Elijo Wastewater Treatment Facility at 2695 Manchester Avenue. Four elder care facilities are located in the VHFHSZ:

- Belmont Village Cardiff 3535 Manchester Ave.
- Avocado Greens, 1159 Saxony Road
- Westmont of Encinitas, 3535 Manchester Ave
- Compassionate Elder Care and Encinitas Retirement Gardens II, 803 Hollyridge Drive

As the frequency, severity, and impacts of wildfire are sensitive to climate change as well as other factors, including development patterns, temperature increases, wind patterns, precipitation change, and pest infestations, it is difficult to project exactly where and how fires will burn. Instead, climate models estimate an increased risk of wildfires. The Keetch-Byram Drought Index (KBDI) represents a simplified proxy for favorability of occurrence and spread of wildfire but is not itself a predictor of fire. As shown in **Table 3-6: San Diego County KBDI > 600 (days)**, San Diego County's wildfire risk is projected to double by the end of the century compared with the historical baseline. This will lead to an increased risk for areas in Encinitas susceptible to wildfire and corresponding smoke.

Table 3-6: San Diego County KBDI > 600 (days)

KBDI > 600 (days)	Historic KBDI > 600 (days)	Medium Emissions (RCP 4.5)		High Emissions (RCP 8.5)	
		Mid-Century	End-Century	Mid-Century	End-Century
	77	126	136	133	169

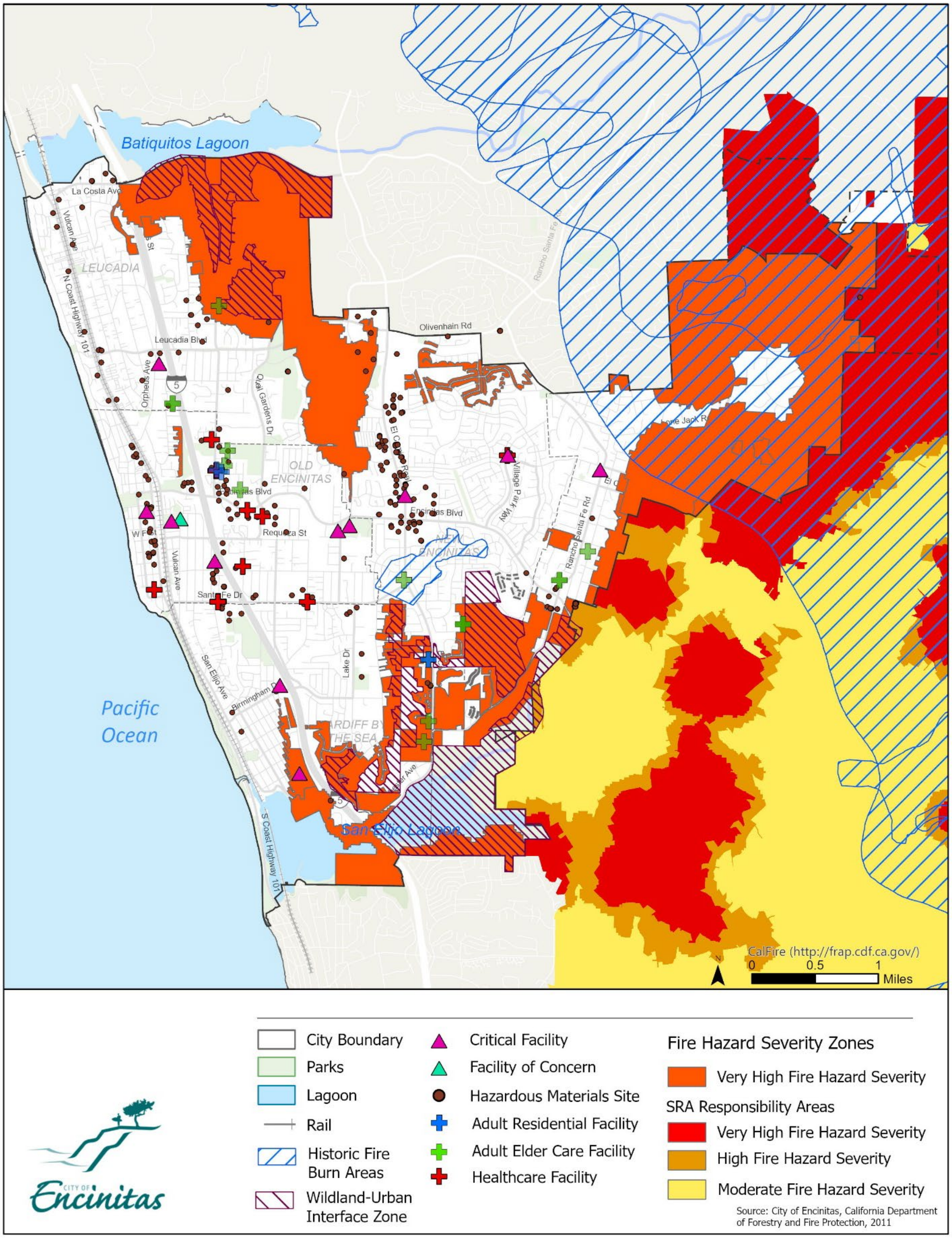
Source: California Energy Commission. CalAdapt. Local Climate Change Snapshot for Encinitas: Wildfire KBDI. https://cal-adapt.org/tools/local-climate-change-snapshot. Accessed March 28, 2022.

Sensitivity: Physical

Beyond direct damage to physical property and harmful effects on public safety, wildfires also result in secondary impacts: a major consequence of wildfires is post-fire flooding and debris flow. After fires, the

[78] Allington, Adam. 2018. Toxic Pollutants in California Mudslide Present Cleanup Challenges. Bloomberg Law. https://news.bloomberglaw.com/environment-and-energy/toxic-pollutants-in-california-mudslide-present-cleanup-challenges. January 18. Accessed July 14, 2022.

Figure 3-5: Fire Hazard Severity Zones



risk of floods and debris flows increases due to vegetation loss and soil exposure. These flows are a risk to life because they can occur with little warning and exert great force on objects in their path. Additionally, wildfire can cause direct and indirect damage to electrical infrastructure. Direct exposure to fire can sever transmission lines, and heat and smoke can affect transmission capacity. Other impacts of climate change also threaten electricity infrastructure, including wildfires that can destroy poles and towers carrying transmission lines. [79]

Furthermore, because of historical forest management trends over the past century, increased temperatures, and more frequent drought, California wildfires are characteristically hotter and more intense as compared to naturally occurring fire regimes. As such, soil structure and moisture retention are damaged, leading to increased susceptibility to erosion or landscapes. If Encinitas' coastal foothills become covered with dry, overgrown vegetation because of drought conditions, extreme heat events and high winds can increase the threat of wildfires.

Wildfire could damage roads in several ways. Unsafe conditions and damage could lead to road closures. Typical asphalt mixtures could ignite or melt/excessively soften. Debris from fires and subsequent landslides could block roads. [80, 81] Most major roads have sidewalks that create a small defensible space as well as the development of the surrounding areas.

Wildfires could alter hydrology by changing vegetation, increasing runoff, and resulting in more sediment that could block drainage and damage structures. [82] This impact would be caused by upstream factors; wildfires are unlikely to directly burn and/or damage outfalls themselves due to construction materials and placement near bodies of water.

Conservation areas and open spaces in the City of Encinitas provide crucial ecosystem services such as clean air and water and climate regulation. If conservation areas are damaged, endangered species could be at increased risk of species survival. If habitats of sensitive species are subject to frequent disturbance or destruction, resources may be needed to conserve these species. In addition, there may be more insects, pests, or invasive species in the event of damage.

Community parks are used for recreation, exercise, as gathering spaces, and sites of natural, historical, tribal cultural, and archaeological resources. Loss of or damage to community parks would interfere with their ability to serve these functions.

Sensitivity: Social

Wildfires are a major public health concern as they can cause immediate health impacts through burns, injuries, heat stress, and direct smoke inhalation. However, a wildfire can influence the health outcomes of an area larger than the burn area because the associated smoke can travel long distances and worsen the

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[79] Davis, M., and S. Clemmer. 2014. Power failure: How climate change puts our electricity at risk—and what we can do. Cambridge, MA: Union of Concerned Scientists. https://www.ucsusa.org/sites/default/files/2019-10/Power-Failure-How-Climate-Change-Puts-Our-Electricity-at-Risk-and-What-We-Can-Do.pdf. Accessed April 11, 2022.

[80] Carvel, R., & Torero, J. (2006). The Contribution of Asphalt Road Surfaces to Fire Risk in Tunnel Fires: Preliminary Findings. Proceedings of the International Conference on Risk and Fire Engineering for Tunnels, Stations, and Linked Underground Spaces (pp. 83-87). Hong Kong: Tunnel Management International.

[81] Cannon, S., & DeGraff, J. (2009). The Increasing Wildfire and Post-Fire Debris-Flow Threat in Western USA, and Implications for Consequences of Climate Change. In K. Sassa, & P. Canuti, Landslides - Disaster Risk Reduction (pp. 177-190). Verlag Berlin Heidelberg: Springer.

[82] U.S. DOT. 2018. Transportation Climate Change Sensitivity Matrix. U.S. Department of Transportation. Retrieved from https://toolkit.climate.gov/tool/transportation-climate-change-sensitivity-matrix

air quality for extended periods. Wildfires can be a significant contributor to air pollution in both urban and rural areas and have the potential to significantly impact public health through particulates and volatile organic compounds in smoke plumes. Wildfires are a major source of particulate matter, which is an air pollutant that increases one's risk for respiratory illnesses, cardiovascular disease, negative birth outcomes, and premature death.[83] Wildfire smoke contains numerous primary and secondary pollutants, including particulates, polycyclic aromatic hydrocarbons, carbon monoxide, aldehydes, organic compounds, gases, and inorganic materials with toxicological hazard potentials.[84] Wildfire smoke also increases exposure to ground-level ozone and toxic chemicals (e.g., pesticides, plastics, and paints) released from burned buildings and other human-made materials. Individuals sheltering in place are also at risk of exposure to hazardous air quality because wildfire smoke penetrates homes, particularly older homes.[85] Beyond these immediate health impacts, the stress, displacement, and loss of home and community from wildfires can cause significant mental health impacts, such as anxiety, depression, and post-traumatic stress disorder.[86]

During hazard events such as wildfires, flooding, or extreme storms, the elderly and other vulnerable populations such as persons with disabilities may require additional assistance to adequately respond. These are unique challenges for Encinitas as 37.5 percent of households in the Very HIgh Fire Hazard Severity Zone have at least one individual age 65 or older. Additionally, 18.3 percent of households have at least one person living with a disability. Challenges that these populations face include the potential inability to access emergency supplies, evacuate, or receive and understand emergency information. The effects of climate change hazards can result in infrastructure disruptions, including power outages. Such events could result in additional health hazards for the elderly or persons with disabilities who rely on power to sustain medical equipment/assistive technology use.

Table 3-7: Very High Fire Hazard Severity Zone Threatened	VHFHSZ	Encinitas
Total Population	10,245	62,007
Percent of residents that are children (less than 10 years)	9.5%	11.0%
Percent of households that have people 65+ years	36.2%	34.1%
Percentage of households with at least one person living with a disability	18.3%	19.1%[1]
Median age	43.9	43
Total households	4,055	23,893
Median household income	$151,132	$120,488
Percent of rental households	37.5%	36.2%

Source: US Census Bureau, ACS 2020, ESRI 2022[1]

A total of 1,733 Encinitas residents live within the wildland-urban interface (**Table 3-8: Wildland-Urban Interface Threatened Populations**). The geographic extent of this hazard includes the following areas of the City, for the most part: 1) Saxony Canyon, 2) South El Camino Real/Crest Drive, and 3) Olivenhain. Properties

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[83] Bell, J.E., S.C. Herring, L. Jantarasami, C. Adrianopoli, K. Benedict, K. Conlon, V. Escobar, J. Hess, J. Luvall, C.P. Garcia-Pando, D. Quattrochi, J. Runkle, and C.J. Schreck, III, 2016: Ch. 4: Impacts of Extreme Events on Human Health. The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment. U.S. Global Change Research Program, Washington, DC, 99–128.

[84] Künzli, N. et al. 2006. Health effects of the 2003 Southern California wildfires on children. Am J Respir Crit Care Med. 174:1221-8.

[85] Rudolph, L., Harrison, C., Buckley, L. & North, S. (2018). Climate Change, Health, and Equity: A Guide for Local Health Departments. Oakland, CA and Washington D.C., Public Health Institute and American Public Health Association.

[86] Hanigan, Ivan C., Colin D. Butler, Philip N. Kokic, and Michael F. Hutchinson. 2012. "Suicide and Drought in New South Wales, Australia, 1970–2007." Proceedings of the National Academy of Sciences of the United States of America 109 (35): 13950–55.

in these and other smaller areas are susceptible to wildfire because they are situated near open spaces and canyons containing heavy fuel loads. Reoccurring periods of low precipitation have increased the risk of wildfires in the region. The WUI zone in the northern portion of the City is fully within a VHFHSZ, whereas the WUI in the southern part of the City is intermixed within the VHFHZ zone.. Like the FHSZ, 24.5 percent of households have at least one person living with a disability. However, the areas are more affluent and have one-third of the number of households that have people aged 65 years or more. This should reduce the sensitivity to wildfire (and smoke) and benefit the adaptive capacity of these households. [87]

Table 3-8: Wildland-Urban	WUI[1]	Encinitas
Total Population	1,733	62,007
Percent of residents that are	10.0%	11.0%
Percent of households that have	15.9%	34.1%
Percentage of households with at	24.5%	19.1%[1]
Median age	47.6	43
Total households	640	23,893
Median household income	$153,306	$120,488
Percent of rental households	22.7%	36.2%
Percent of household income	6.2%	7.2%

Source: US Census Bureau, ACS 2020, ESRI 2022[1]

Adaptive Capacity

The City has addressed wildfire in planning documents such as the Climate Action Plan, Hazard Mitigation Plan, and the Urban Forest Management Plan. The City also operates programs that respond to wildfire events for displaced residents. Finally, the City also has regulations in place that are beneficial during wildfires by limiting further potential public health impacts. The plans and programs for the City and supporting agencies are described below.

City of Encinitas Climate Action Plan (2020)

Like many communities in the region, the City will likely experience increased wildfire risk in the future. To prepare for increased wildfire risk, the City has adopted strategies focused on key areas within the City that are most vulnerable to wildfire risk, such as residences and businesses that are in the UWI within the City. The City will implement the following strategies to address increased wildfire risk.

- Coordinate with relevant agencies, including CalOES, CAL FIRE, and the Encinitas Fire and Marine Safety Department, to map and identify current and future land uses, neighborhoods, and infrastructure that are at an elevated risk of experiencing wildfire impacts.
- Continue to update the MJHMP every five years.
- Update the Safety Element of the City's General Plan consistent with the OPR General Plan Guidelines, which requires adopted safety elements to consider climate change and climate adaptation strategies pursuant to SB 379.
- Improve coordination for emergency services related to wildfire and other related events in the City.
- Consider new development standards for City residents and businesses within the WUI.

[87] San Diego County Multi-Jurisdictional Hazard Mitigation Plan, Section Five, Encinitas. October 2017.

San Diego County Multi-jurisdictional Hazard Mitigation Plan (2017)

The 2017 MJHMP included objectives and actions to decrease the risks associated with increased temperature and extreme heat events. Goal 5 of the 2017 MJHMP Chapter on Encinitas intends to "[r]educe the possibility of damage and losses to existing assets, particularly people, critical facilities/infrastructure, and City-owned facilities, due to wildfires/structural fires." The goal includes four corresponding objectives and 26 actions to help the City prepare for the impacts of wildfires (and structural fires). Objectives and actions focus on planning, protecting vulnerable assets susceptible to wildfire/structural fires, agency coordination, and public education.[88]

City of Encinitas Municipal Code

Helping to reduce the spread of wildfire, the City specifies development setback requirements in the Zoning Ordinance (Encinitas Municipal Code Title 30).

Defensible Space (2008)

In 2008, the City of Encinitas Fire Department received a Federal Emergency Management Administration (FEMA) Fire Prevention and Safety Grant to conduct a public education program to educate Encinitas residents on defensible spaces, Firewise gardening techniques, and how best to protect homeowners from wildfires.

CALFIRE (2013)

In 2013, the City worked with CAL FIRE, to develop the City's Fire Hazard Severity Zone Map. The map identifies the VHFHSZ within the City, locating regions in the City at increased risk of wildfire risk and related hazards.

Emergency Shelters

Hazardous climate events, such as extreme heat events or flooding, may potentially displace Encinitas residents or the already homeless. Those displaced will require temporary shelter during hazardous conditions and severe weather events with supplies that can increase the adaptive capacity of individuals experiencing homelessness.

In February 2019, the City of Encinitas adopted Ordinance 2019-01, which permitted emergency shelters within the Light Industrial (LI) and Business Park (BP) zones as required by California Government Code Section 65583(a)(4) (A- D). In selecting an appropriate location for emergency shelters, access to public transit was an important consideration, as individuals and households experiencing homelessness do not have reliable means of transportation. The LI and BP zones are well served by public transportation and regional connections providing access to jobs and services.

Cool Zones

The Community Resource Center, Encinitas Public Library, Cardiff-by-the-Sea Library, and the Community Senior Center are San Diego County designated Cool Zone facilities intended to provide areas for vulnerable populations to find refuge from hot weather.[89]

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[88] San Diego County Multi-Jurisdictional Hazard Mitigation Plan, Section Five, Encinitas. October 2017.

[89] San Diego County Health and Human Services Agency. 2022. Cool Zones. https://www.sandiegocounty.gov/hhsa/programs/ais/cool_zones/. Accessed July 14, 2022.

The City of Encinitas has partnerships with other service providers. The City provides Community Development Block Grant (CDBG) program funds to homeless service providers for homeless prevention and regional shelter efforts. Other North County facilities and services for those experiencing homelessness include:

- Mental Health Systems (Oceanside— 12.2 miles)
- Interfaith Community Services (Vista — 16.4 miles)
- La Posada Shelter (Carlsbad — 7.8 miles)
- Women's Resource Center (Oceanside — 12.2 miles)
- Operation Hope (Vista — 15.6 miles)
- Haven House (Escondido— 16.4 miles)
- Interfaith Community Services (16.4 miles)
- North County Lifeline (Oceanside 13.1)
- Oceanside Transit Center (Oceanside — 13.1 miles) [90]

3.3.2.4 FLOODING

Climate models predict that California will experience less frequent but more intense storm patterns in the coming decades, including the state's precipitation more frequently falling as rain rather than snow compared to historical trends. Additionally, the state's streams and rivers will swell more in some years from earlier and faster spring snowmelt caused by higher temperatures. Scientists suggest the combination of these factors could lead to a 50 percent increase in runoff in future years, challenging the capacity of the state's existing reservoirs, canals, levees, and other flood control systems and increasing the risk of inland flooding. Floods cause significant risk to human life and damage roads, buildings, and other infrastructure. [91]

ONSHORE FLOODING

Increases in temperature and precipitation can lead to extreme precipitation events and sea-level rise, leading to flooding in Encinitas. In the context of climate change for Encinitas, this analysis categorizes flood types according to climate effect: Onshore flooding caused by precipitation-driven events and coastal flooding. The following describes the types of floods within each category.

Onshore Flooding from Precipitation-Driven Events

- **Inland flooding** occurs when moderate precipitation accumulates over several days, intense precipitation falls over a brief period, or a river overflow because of an ice or debris jam or dam or levee failure.
- A **flash flood** is caused by heavy or excessive rainfall in a brief period, generally less than six hours. Flash floods are usually characterized by raging torrents after heavy rains that rip through riverbeds, urban streets, or mountain canyons. They can occur within minutes or a few hours of excessive rainfall.

Coastal Flooding

- A **coastal flood**, or chronic inundation of land areas along the coast, is caused by higher-than-average high tide and worsened by heavy rainfall and onshore winds (i.e., wind blowing landward from the ocean).

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[90] City of Encinitas. 2021. Encinitas 6th Cycle Housing Element 2021-2029.

[91] State of California, Legislative Analyst's Office. 2022. Budget and Policy Post. Climate Change Impacts Across California Crosscutting Issues. April 5, 2022. https://lao.ca.gov/Publications/Report/4575. Accessed April 11, 2022.

- **Storm surge** is an abnormal rise in water level in coastal areas, over and above the regular astronomical tide, caused by forces generated by a severe storm's wind, waves, and low atmospheric pressure. [92]

The following analyses describe onshore flooding and coastal flooding vulnerabilities resulting from projected climate change for the City of Encinitas.

Onshore Flooding from Precipitation Events

Variability in the climate is likely to result in changes in the frequency, intensity, and duration of precipitation events causing heavy rainfall, thunderstorms, and hail. Like other California regions, the high year-to-year variability of precipitation in Encinitas is severely affected by extreme precipitation events (days having precipitation at or exceeding the 95th percentile), which accounts for 80 percent of the year-to-year variability. [93] Most of the heaviest events occur during winter. While days with measurable precipitation become less frequent in Southern California, extreme precipitation events are anticipated to intensify. It is predicted that the state will experience prolonged periods of drought followed by extreme precipitation (See Section 3.2.2.2: Drought).

For Encinitas, projections show only a slight change in average annual rainfall through the end of the century (**Table 3-2: Change in Annual Average Precipitation**). Globally, climate change is anticipated to lead to more variability in the intensity of rainfall events from year to year and longer transitions between droughts and deluges. [94, 95] Historically, Encinitas has experienced an average of three extreme precipitation events per year. Under the medium emissions scenario, the City is still expected to experience three extreme precipitation events per year through the end of the century. Under the high emissions scenario, Encinitas is expected to experience three to four extreme precipitation events per year by mid-century and four extreme precipitation events per year by the late century. [96]

The primary concern for precipitation-driven hazards is flooding. Areas of Encinitas already experiencing flooding when there are heavy rainfall events could find that flooding increases in the future. However, the forecasted changes in Maximum 1-Day Precipitation are not anticipated to be substantially different from historical records (see **Table 3-9. Change in Maximum 1-Day Precipitation**). Therefore, impacts from flooding caused by projected climate change should not be dramatically different than what the community currently experiences.

Table 3-9. Change in Maximum 1-Day Precipitation

Maximum 1-Day Precipitation (Inches)	Historic Maximum 1-Day Precipitation (1961 – 1990)	Medium Emissions (RCP 4.5)		High Emissions (RCP 8.5)	
		Mid-Century	End-Century	Mid-Century	End-Century
	1.168 inches	1.169 inches	1.189 inches	1.208 inches	1.248 inches

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[92] NOAA National Severe Storms Laboratory. *Severe Weather 101.* https://www.nssl.noaa.gov/education/svrwx101/floods/types. Accessed April 6, 2022.

[93] Jennings, M.K., D. Cayan, J. Kalansky, A.D. Pairis, D.M. Lawson, A.D. Syphard, U. Abeysekera, R.E.S. Clemesha, A. Gershunov, K. Guirguis, J.M. Randall, E.D. Stein, S. Vanderplank. (San Diego State University). 2018. San Diego County Ecosystems: Ecological Impacts of Climate Change on A Biodiversity Hotspot. California's Fourth Climate Change Assessment, California Energy Commission. Publication number: CCCA4- EXT-2018-010.

[94] Higbee, M. C. (2014). Report from San Diego County Multi-Jurisdictional Hazard Mitigation Plan Update Training Workshop #1: Climate Change and Hazards in San Diego.

[95] Swain, D. L. (2018). Increasing precipitation volatility in twenty-first-century California. Nature Climate Change.

[96] California Energy Commission. Cal-Adapt Extreme Precipitation Events Tool. Available: https://cal-adapt.org/tools/extremeprecipitation/. Accessed April 6, 2022.

Source: California Energy Commission. CalAdapt. Local Climate Change Snapshot for Encinitas: Maximum 1-Day Precipitation. https://cal-adapt.org/tools/local-climate-change-snapshot. Accessed March 28, 2022.

Historical Onshore Flooding Events

- November 17-18, 1986. Early season storm brought 1.16" to San Diego and 1.03" in Oceanside, more rain that falls in than a typical November. The storm caused numerous traffic accidents and multiple power outages. Street flooding occurred in Encinitas.
- February 18-20, 1993. Heavy rain: 2-5" in coastal areas. Urban and river flooding occurred across the region. Flooding occurred from Oceanside to Encinitas. [97]
- 1997. Heavy winter storms forced the closure of Coast Highway 101.
- March 1, 2010. Storm resulted in limited access along Coast Highway 101 due to flooding and undermining in one section that prompted emergency repairs to pump concrete slurry beneath the existing roadway and pulling existing riprap toward the road.
- 2015-2016. El Nino-related winter storms prompt temporary placement of cobble along Coast Highway 101.
- April 10, 2020. Encinitas recorded nearly 5 inches of rain in 24 hours on Friday, April 10, as a low-pressure system parked over Southern California. The five-day total was 7.39 inches in Encinitas. The city of Encinitas closed Lone Jack Road, from Crystal Ridge Road through to the east of Stratford Knoll, in Olivenhain on Friday because of heavy flooding. [98]

Exposure

Flood zones are geographic areas that the Federal Emergency Management Act (FEMA) has defined according to varying levels of flood risk. These zones are depicted on a community's Flood Insurance Rate Map (FIRM) or Flood Hazard Boundary Map. Each zone reflects the severity or type of flooding in the area. Portions of the City are located within a FEMA 100-year zone and floodways (illustrated in **Figure 3-6: Flood Hazard Zones**). These two designations coincide with the City's Floodplain Overlay Zone boundary. The low-lying areas along the floodplains of Cottonwood Creek, Encinitas Creek, Escondido Creek, and their tributaries can experience flooding during severe rain seasons. [99]

In Encinitas, the geographic extent of flooding hazard is limited to 1) Encinitas coastline, particularly "Restaurant Row" in Cardiff (south of San Elijo State Beach Campgrounds); 2) Escondido, Encinitas, and Cottonwood Creeks; and 3) low-lying areas of Leucadia and Old Encinitas. The City has experienced property-related losses resulting from localized flooding in Leucadia and coastal flooding in Cardiff, but not loss of life. Winter storms in 1997, 2005-2006, and 2010-2011 resulted in significant damages and required emergency protective measures, debris removal, and infrastructure reconstruction.

Dam Failure

Geologists estimate that a magnitude 7.5 earthquake from the Elsinore Fault 11 miles east of Lake Wohlford could result in a failure of its hydraulic fill dam. The geographic extent of this hazard is limited to the persons and properties within the inundation path surrounding Escondido Creek and San Elijo Lagoon. The dam inundation path is larger than the Escondido Creek 100-year floodway, and a greater number of persons and properties are exposed to this hazard compared to coastal bluff failures and flooding. Major arterials within the inundation path include El Camino Del Norte, Rancho Santa Fe Road, Manchester Avenue, and Coast Highway 101. The failure of Wohlford Dam (1895) and Dixon Reservoir Dam (1970) could threaten

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[97] National Weather Service. 2017. A History of Significant Weather Events in Southern California.
[98] North Coast Current. 2020. Encinitas receives nearly 5 inches of rain in 24 hours Friday. April 10.
[99] City of Encinitas. 2021. Encinitas 6th Cycle Housing Element 2021-2029: Appendix B.

City facilities and infrastructure (including the San Elijo Water Reclamation Facility, Cardiff and Olivenhain sewer pump stations, and the San Dieguito Water District 36" high-pressure supply line) and educational facilities (MiraCosta College) located in and adjacent to the inundation path. Although exposure to loss of property is significant, the potential for loss of life is limited because of the length of time before flood wave arrival (approximately 1 ½ hours), allowing for aggressive warning and evacuation measures to be initiated by the City.

The Olivenhain Dam (2003) is a concrete gravity dam located on a tributary of Escondido Creek, just west of Lake Hodges, holding 24,000 acre-feet. Stanley Mahr Reservoir (1981) is a small, earth-filled embankment dam located on a tributary of Encinitas Creek in San Marcos with a capacity of approximately 200-acre feet. A failure of Mahr Reservoir in Carlsbad would produce flooding along Encinitas Creek (which flows into Batiquitos Lagoon) in the northern portion of the City. Emergency Action Plans have been developed for these dams. The risk of failure of both dams is low due to their age and construction and existing surveillance and inspection measures. Figure 3-6: Flood Hazard Zones shows 100-year floodplains and floodways within the City. [100]

Coastal Bluff Failures

The geographic extent of the hazard is limited primarily to the Encinitas coastal sandstone bluffs. After the El Nino storms of 1982-1983, Encinitas beaches were stripped of vertical sand up to twenty feet deep, putting the coastal bluffs and homes in jeopardy of collapsing into the sea. Furthermore, the shoreline segments at Moonlight Beach and Cardiff-by-the-Sea are extremely vulnerable to coastal inundation from potential future sea-level rise. In 2000, unstable cliffs at Beacon's Beach in Encinitas caused a landslide that killed a woman sitting on the beach. The recreational bicycle path along the seaside of Highway 101 was undermined in 2010. In 2019 a failure near the Grandview Street public access killed three people.

No critical facilities or hazardous materials sites are in the 100-Year Flood Zone or associated Floodways. Public safety critical asset types have a near-negligible vulnerability to precipitation-driven flooding. Fire stations and police patrol and specialty vehicles have a low vulnerability to precipitation-driven flooding. These asset types have low exposure, meaning that none of them are located within the 100-year floodplain or floodway. None of the healthcare, elder care, or adult residential facilities are within the 100-year floodplain or floodway.

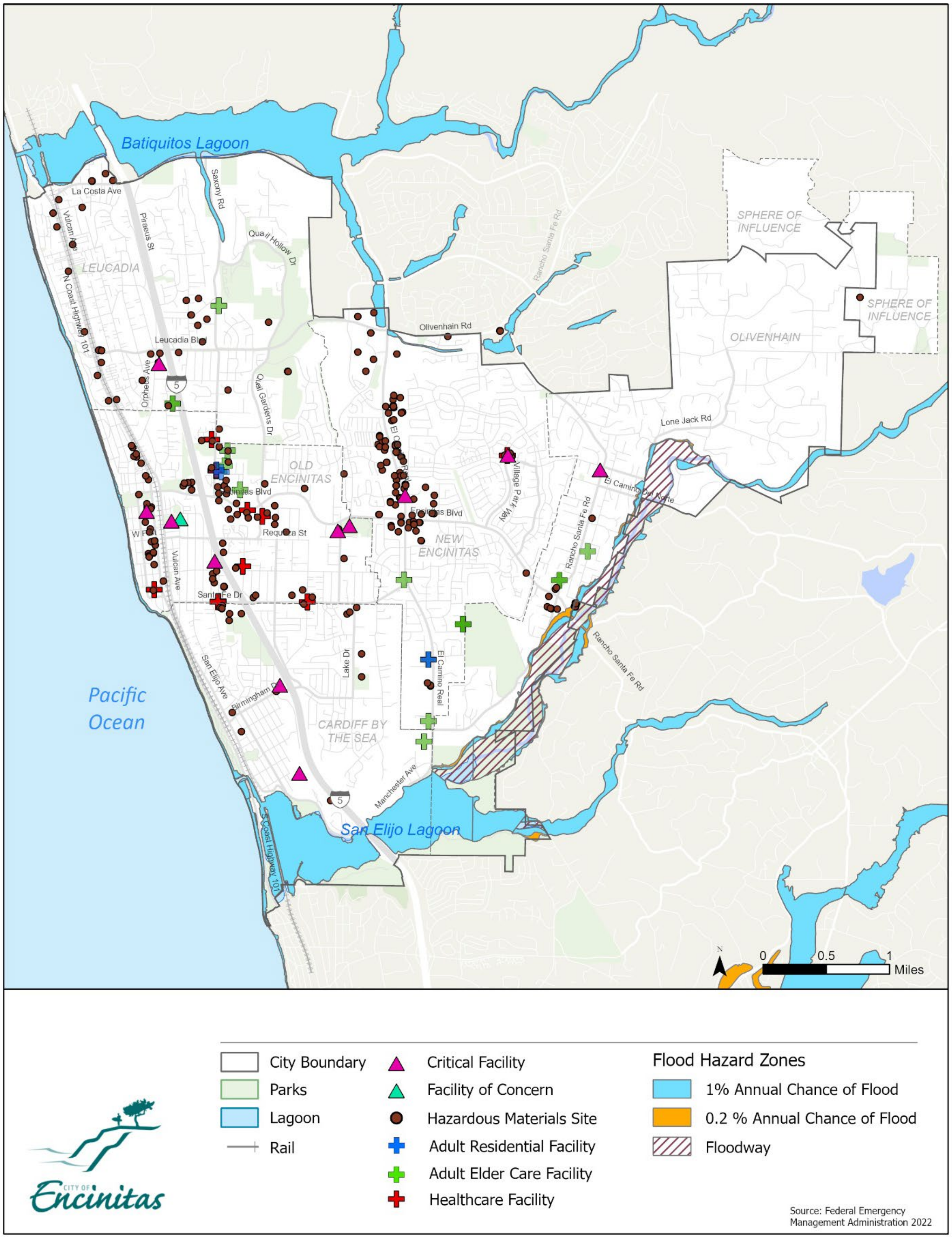
No Encinitas residents live in a FEMA flood zone. Any potential flood threat will primarily affect those residents living adjacent to a 100-year flood zone. These zones are located along drainages within the City. Flooding of this type would inundate curb cuts as well as sidewalks.

Sensitivity: Physical

Water pipes, wastewater pipes, and wastewater pump stations show low to medium vulnerability to onshore flooding and high vulnerability to coastal erosion. Flooding would not have a severe impact on underground pipes or pump stations, but erosion could compromise the functionality of the system. Higher intensity storms result in higher levels of erosion and sediment runoff into waterways, which in turn can back up/clog storm drain systems resulting in their failure. Sediment back up caused a drainage failure and subsequent flooding around Ocean Cove Dr. in 2020, so this is a recent and relevant issue.

[100] San Diego County Multi-Jurisdictional Hazard Mitigation Plan, Section Five, Encinitas. October 2017.

Figure 3-6: Flood Hazard Zones



The City has key underpasses beneath major freeways and rail lines that, if flooded, could impact circulation throughout the City. Electronic or mechanical equipment on the ground could become waterlogged and nonfunctional.

Storm events could cause erosion on trails. Periodic flooding may temporarily limit access to parks, but once floodwaters recede, the park should be usable again with limited clean-up. Leucadia Oak Parks and Encinitas Community Parks were designed to be multi-purpose as they incorporate climate adaptation features that retain upstream runoff in detention basins within the park. Under dry, non-precipitation events, these areas are recreational park features such as a volleyball court and a sports field.

Precipitation-driven flooding has the potential to impact habitats. Increased precipitation patterns could encourage the growth of invasive species. In addition, flooding in regional upland watersheds could impact water quality by bringing more nutrients and total dissolved solids into the water supply.

Sensitivity: Social

In a flood event, any people in Encinitas who walk or bike as their main form of transportation may encounter greater difficulties with their mobility if they do not have access to an alternative means of transportation. Seniors, persons with disabilities, and low-income persons are those most likely to be threatened. Flooding is the second most deadly weather-related hazard in the United States, which can be attributed mostly to drowning. Other effects can include building damage, mold, and respiratory damage. [101]

Surfing and ocean swimming are very popular activities in the City. Encinitas is an internationally known surfing hotspot and was named one of the top 20 surf towns by National Geographic in 2012. [102] Rainstorms and the subsequent runoff can introduce an influx of freshwater carrying trash, nutrient, and bacteria rich freshwater into the ocean. As stated by the San Diego County Department of Environmental Health and Quality, "Urban runoff may contain large amounts of bacteria from a variety of sources such as animal waste, soil, and decomposing vegetation. Bacteria levels can remain elevated after a rainstorm depending upon the intensity of the storm, volume of runoff and ocean conditions." Swimmers, surfers and other beach water users are typically warned to avoid going into the water at beaches and bays because recent rainfall could bring urban runoff, which can cause bacteria levels to rise significantly. [103]

Additionally, persons experiencing homelessness may be caught outside during flood conditions without any shelter. Possessions such as sleeping bags or electronic devices may be damaged or swept away by the floodwaters. Factors that make people sensitive to flooding are related to their ability to evacuate or escape the flood.

Adaptive Capacity

While there is limited physical or social vulnerability to onshore precipitation-driven flooding, the City is well prepared to adapt to future effects of climate change related to flooding. Encinitas has adopted

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[101] Hall, A., N. Berg, and K. Reich. 2018. Los Angeles Summary Report. California's Fourth Climate Change Assessment. University of California, Los Angeles. Publication number: SUM-CCCA4-2018-007.

[102] San Diego Union-Tribune. 2012. Encinitas named one of 20 best surf towns. July 26. https://www.sandiegouniontribune.com/sdut-encinitas-named-one-worlds-best-surf-towns-2012jul26-story.html. Accessed July 14, 2022.

[103] The Times of San Diego. 2022. Swimmers and Surfers Warned of High Ocean Bacteria Levels after Recent Rain. March 20. https://timesofsandiego.com/health/2022/03/20/swimmers-and-surfers-warned-of-high-ocean-bacteria-levels-after-recent-rain/. Accessed July 14, 2022.

regulations and implemented programs intended to ensure the health and safety of its residents from flooding events. These include, but are not limited to:

Floodplain Overlay Zones

Floodplain Overlay Zone regulations apply to all areas within the Special Study Overlay Zone, where site-specific analysis of the land indicates the presence of a flood channel, floodplain, or wetland. The zone also applies to all areas identified as flood channels and floodplains on maps published by the Federal Emergency Management Agency or current City and County maps designating the floodway/ floodplain areas. Any development within this zone is required to incorporate a series of improvements or modifications to ensure the ability of structures to withstand periodic flooding. The additional standards are also in place to guarantee the preservation of sensitive habitat areas.

Construction Codes

The City of Encinitas' construction codes are based upon the California Code of Regulations, Title 24, which includes the California Administrative Code, Building Code, Residential Code, Electrical Code, Mechanical Code, Plumbing Code, Energy Code, Historical Building Code, Fire Code, Existing Building Code, Green Building Standards Code, and California Referenced Standards Code. They are the minimum necessary to protect the public health, safety, and welfare of the City's residents.

COASTAL FLOODING AND INUNDATION

With six miles of coastline critical to the local economy, tourism industry, and Encinitas lifestyle, coastal hazards are a primary climate-related concern for Encinitas. Coastal hazards include coastal flooding and erosion, both of which are expected to be exacerbated by climate change. According to the closest tide gauge in La Jolla, sea levels rose 0.67 feet between 1924 and 2021. [104] The frequency of extreme coastal floods is expected to increase under all projections of sea-level rise. Rising seas boost the occurrence of severe floods (such as the 500-year flood) more than moderate floods (such as the ten-year flood) along the Pacific coast of the United States. [105] By elevating storm tide, sea-level rise makes it easier for waves to overtop natural barriers, increasing the relative frequency of flooding along the Pacific coast.

King tides in Encinitas already result in flooding along low-lying stretches of shoreline. The vulnerability considers how these conditions will change with sea-level rise in the future. The assessment evaluates tidal flooding—storm surge and sea-level rise—in terms of total water level above today's mean higher high water (MHHW) level. Using total water level recognizes the contribution of both sea-level rise and storm surge to flooding and reflects a range of scenarios.

Historical Coastal Events

- December 1-2, 1986. High tides of 7.7' at San Diego. Minor flooding (4" of seawater) along Pacific Coast Hwy.
- January 30, 1998. Very high surf, up to twenty feet, pounded the beaches of Orange and San Diego Counties. Severe beach erosion was reported, along with damage to the Ocean Beach and Seal Beach piers and thirty-two homes in San Clemente.

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[104] National Oceanic and Atmospheric Administration. (2022). Relative Sea Level Trend 9410230 La Jolla, California. NOAA Tides & Currents: https://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?id=9410170. Accessed April 6, 2022.

[105] Buchanan, M. K. (2017). *Amplification of flood frequencies with local sea level rise and emerging flood regimes*. Environmental Research Letters, 12(6), 064009.

- March 1, 2010. Storm resulted in limited access along the South Coast Highway 101, south of restaurant row (south of Chart House) in Cardiff-by-the-Sea, due to flooding and undermining along road.
- January 11, 2013. Very high "king" tides around 7.5' hit the coast. Some beach areas became inundated with seawater in Seal Beach, La Jolla Shores, and Imperial Beach. [106]
- December 23, 2015. Storm events and higher than normal tides, caused severe coastal erosion to the shoreline along Cardiff State Beach within the Encinitas City limits. Flooding occurred in both Cardiff State Beach parking lots and into the beach fronting restaurants (Pacific Coast Grill/Chart House). Public access points were closed. Severe wave action events accompanied by high tidal push, exposed portions of South Coast Highway 101.

Coastal Flooding

According to OPC's *State of California Sea-Level Rise Guidance: 2018 Update*, there is a 0.5 percent probability that Encinitas could experience between 0.9 feet of sea-level rise by 2030, 2.0 feet by 2050, and 7.1 feet by 2100 under the high emissions, RCP 8.5 scenario. [107]

These projections were used to select corresponding localized sea-level rise modeling thresholds produced by the United States Geological Service (USGS) through their Coastal Storm Modeling System version 3.0 (CoSMoS). CoSMoS produces projections of coastal flooding and inundation that could result from sea-level rise and storms while factoring in changes in beaches and the retreat of cliffs and bluffs along the California coast. [108] The sea-level rise mapping consists of a quantitative geospatial assessment of CoSMoS projected SLR and 100-year storm surge impacts on the Encinitas coastline. CoSMoS flood maps illustrate the potential extent of inundation and/or temporary coastal flooding from a 100-year storm event resulting from projected sea-level rise for specific water elevations. As the projected water level is calculated from the mean sea level, the depth of flooding on land may be less than the projected water elevation and may also vary by location based on topography.

The OPC projections were translated to the closest data available from CoSMoS. Based on this data selection process, the following sea-level rise projections were used to estimate the exposure from daily average flooding and storm surge (100-year) flooding: 0.25 meters of sea-level rise (2030 timeframe), 0.5 meters (2050 timeframe), and 2.0 meters of sea-level rise (2100 timeframe). [109]

Daily flooding was used to estimate exposure to chronic inundation and represents the extent of flooding that would occur at high tide on average each day, assuming each sea-level rise scenario (**Figure 3-7: Chronic Inundation**). Storm surge (100-year storm) flooding was used to estimate exposure to more severe but periodic flooding and represents the extent of flooding that would occur during a 100-year (one percent annual chance) storm assuming each sea-level rise scenario in **Figure 3-8: Storm Surge Flooding**). The storm surge flooding scenario is not additive to the daily flooding scenario.

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[106] National Weather Service. 2017. A History of Significant Weather Events in Southern California.
[107] Ocean Protection Council. 2018. State of California Sea-Level Rise Guidance: 2018 Update.
[108] USGS. (n.d.). Coastal Storm Modeling System (CoSMoS). https://www.usgs.gov/centers/pcmsc/science/coastal-storm-modeling-system-cosmos?qtscience_center_objects=0#qt-science_center_objects. Accessed April 6, 2022.
[109] Sea level rise (SLR) projections from the Ocean Protection Council (OPC) were provided in feet. The United States Geological Survey's CoSMoS 3.0 model used to map the extent of flooding operates using the metric system. The OPC SLR projections (with associated timeframes) were matched to the closest value in CoSMoS for use in the analyses. As a result, the scenario elevations from CoSMoS may differ from the OPC projections.

Figure 3-7: Chronic Inundation

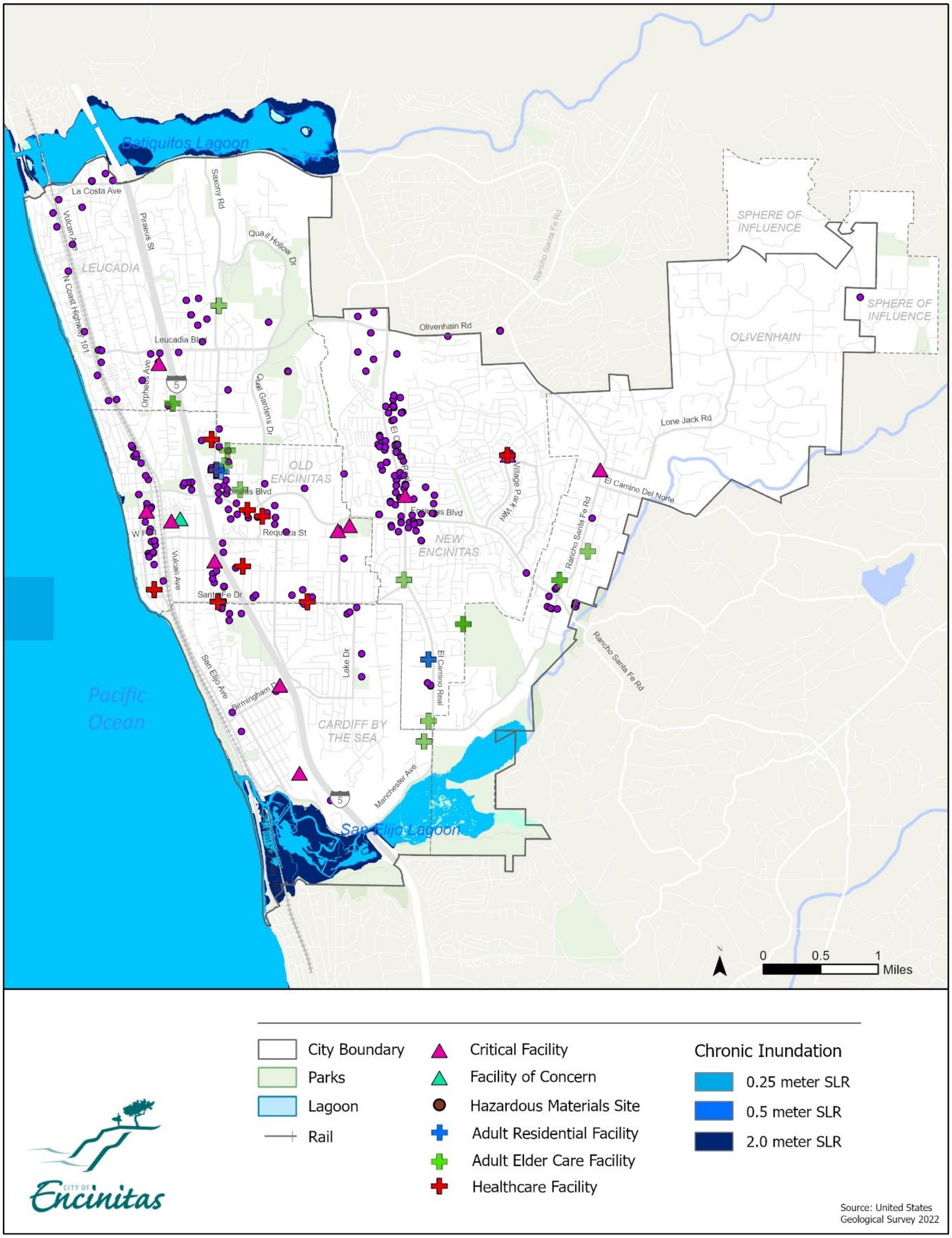
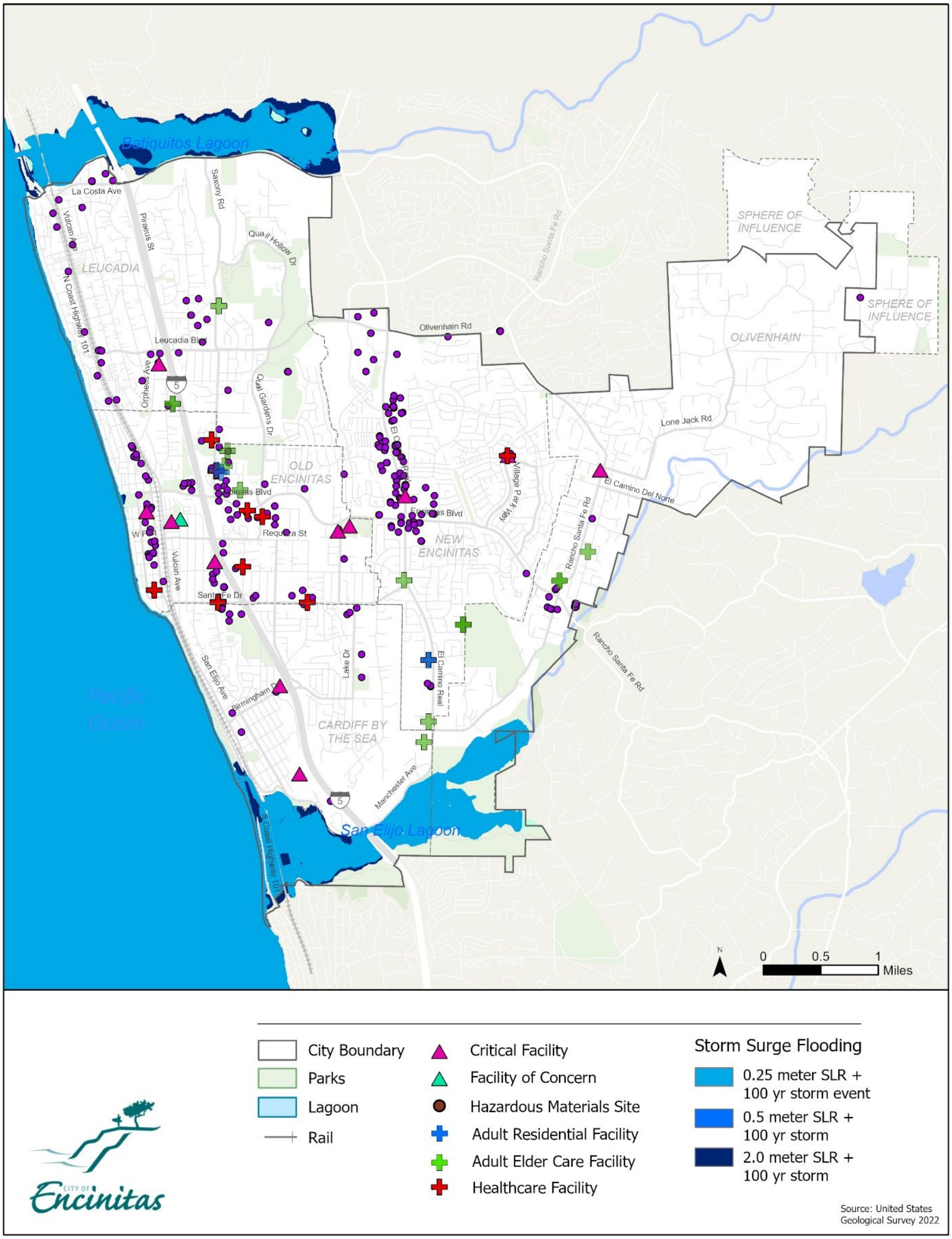


Figure 3-8: Storm Surge Flooding



Exposure

Encinitas' Climate Action Plan contains data from a 2017 assessment of potentially impacted infrastructure along the City's coastline. The 2017 sea-level rise assessment relied upon 2012 National Research Council projections for sea-level rise in the San Diego region. According to projections, sea-level is expected to rise 4-30 centimeters (2-12 inches) by 2030, 12-61 centimeters (5-24 inches) by 2050, and 42-167 centimeters (17-66 inches) by 2100, relative to the year 2000 levels. Consistent with the 2017 analysis and the 2020 CAP, this assessment utilizes a 0.5-meter increase in sea level by mid-century and a 2-meter rise in sea level by the end of the century. The City of Encinitas selected these higher-end sea-level rise scenarios consistent with a "medium-high risk-averse" approach to planning for sea-level rise resilience. [110]

Table 3-10: Encinitas Infrastructure Impacted by Sea Level Rise

Buildings Stock	Low-lying areas surrounding San Elijo Lagoon
	Erosions impacts to residential areas near Sea Cliff County Park (Swami's)
Storm Water	Stormwater systems north and west of San Elijo Lagoon and outlets on Moonlight Beach will be impacted by 2100.
	Cliff retreat has a high potential impact on the stormwater system, including inlets and outlets west of South Coast Highway 101 between San Elijo Lagoon and Sea Cliff County Park (Swami's).
Wastewater	By 2100, flooding is projected to impact Cardiff Sewer Pump Station, sewer system infrastructure surrounding San Elijo Lagoon, wastewater infrastructure at Moonlight Beach, and two lift stations in Batiquitos Lagoon.
	Higher water levels could potentially cause sewer spills into environmentally sensitive areas, such as the mouth of San Elijo Lagoon.
Drinking Water	Aboveground water distribution components, such as valves, meters, and service points north and west of San Elijo Lagoon will be exposed to impacts of flooding.
Transportation	Sections of Highway 101 near San Elijo Lagoon will experience flooding impacts by 2050 and 2100.
	Erosion is projected to impact Coast Highway 101 south of the Self-Realization Fellowship Temple and local roads along the coastal bluff, including Neptune Ave and 4th Street.
Beach and Public Access	Boneyard Beach and D Street Beach, located south of Moonlight Beach, are also projected to experience shoreline change.
	Cardiff State Beach-Seaside and Cardiff State Beach are located along the San Elijo Lagoon, which is projected to be impacted by flooding and shoreline change.

Source: City of Encinitas, ICLEI 2017

Further analysis did not identify any Critical Facilities, Facilities of Concern, or hazardous materials sites located in the chronic inundation or storm surge areas (See **Figure 3-7: Chronic Inundation and Figure 3-8: Storm Surge Flooding**). None of the healthcare, elder care, or adult residential facilities are within the chronic inundation or storm surge areas.

[110] Ocean Protection Council. 2018. State of California Sea-Level Rise Guidance: 2018 Update.

An evaluation of projected sea-level rise impacts revealed only slight differences in socio-economic impacts through the end of the century. While the effect of storm surge is larger at 2 meters, the effects of chronic inundation up to 2 meters and storm surge flooding up to 0.5 meters are the same under the three scenarios.[111] The primary reason for the similarity in impacts is 1) Encinitas properties and residents are primarily on coastal bluffs and therefore less affected by direct flooding and storm surge (and more affected by bluff erosion), and 2) the lagoons to the north and south of the City are able to accommodate much of the future flooding.

The socio-economic characteristics of the populations threatened by future sea-level rise differ from those of the general population within the City, with fewer children, fewer elderly, younger, a higher percentage of homeownership, and fewer people living below the poverty level. As a result of these characteristics, it is reasonable to assume that the population affected by future sea-level rise would not be considered vulnerable from a climate change perspective.

Table 3-11: Chronic Inundation – Threatened Populations	0.25 Meters	0.5 Meters	2 Meters	Encinitas
Total Population	448	448	472	62,829
Percent of residents that are children (less than 10 years)	6.8%	6.8%	7.0%	9.7%
Percent of households that have people 65+ years	27.1%	27.1%	27.6%	35.0%
Percentage of households with at least one person living with a disability	19.2%	19.2%	18.4%	19.1%
Median age	41.5	41.5	41.9	44.1
Total households	177	177	185	24,516
Median household income	$108,558	$108,558	$109,505	$120,888
Percent of rental households	54.2%	54.2%	52.5%	37.7%
Percent of household income below poverty level	4.5%	4.5%	4.9%	7.1%

Source: US Census Bureau, ACS 2015 – 2019, SANDAG Series 13 Regional Growth Forecast Update, ESRI 2022[1]

Table 3-12: Storm Surge Flooding Threatened Populations	0.25 Meters	0.5 Meters	2 Meters	Encinitas
Total Population	448	448	553	62,829
Percent of residents that are children (less than 10 years)	7.9%	7.9%	7.9%	9.7%
Percent of households that have people 65+ years	27.1%	27.1%	25.2%	35.0%
Percentage of households with at least one person living with a disability	19.2%	19.2%	17.3%	19.1%
Median age	41.5	41.5	43.2	44.1
Total households	177	177	326	24,516
Median household income	$108,558	$108,558	$109,666	$120,888
Percent of rental households	54.2%	54.2%	54.0%	37.7%
Percent of household income below poverty level	4.5%	4.5%	5.1%	7.1%

Source: US Census Bureau, ACS 2015 – 2019, SANDAG Series 13 Regional Growth Forecast Update, ESRI 2022[1]

Sensitivity: Physical

Critical infrastructure such as roads, rail, and the stormwater system are particularly sensitive to potential inundation. A 100-year storm event may obstruct business operations, limit public access, and/or lead to potential public safety reductions, including emergency response recovery. Transportation and stormwater

[111] Because of the presence of bluffs, the .25 meter and .5-meter scenarios for Chronic Inundation and Storm Surge impact the same group of people.

systems adjacent to flood-susceptible areas are highly vulnerable to chronic inundation and storm surge with sea-level rise.

Chronic inundation could limit access to and use of parks and fundamentally change habitat types.

Temporary coastal flooding may temporarily limit access to beaches and parks, but once floodwaters recede, the park and beach areas should be usable again. Narrowing sandy areas could limit a beach's ability to provide valuable recreational and ecological services. Current beaches may shrink as sea levels rise. Periodic flooding has the potential to limit access to beaches and wash away the sand. Once floods recede, the beach could generally resume functionality—albeit with reduced long-term functionality as sea levels rise.

If exposed to chronic inundation or storm surge-related flooding, sensitive habitats could experience damage or significant alteration. The changes to ecosystems that come with sea-level rise impacts—changes in sediment, nutrient availability, and salinity—could lead to shifts in habitat locations and may cause certain habitats to shrink or disappear. [112] If there is sufficient available space and obstacles do not exist, habitats may be able to migrate inland to reduce exposure to chronic flooding. However, not all habitat types or species would be able to keep pace with sea-level rise, given the bluff conditions in Encinitas.

Sensitivity: Social

Shoreline change from erosion and flooding can cause inconvenience; loss of amenity, and expense to repair and prevent damage. However, it usually poses no direct and immediate threat to human life. [113] Yet, when erosion threatens to damage valuable public infrastructure, or there is not enough beach width to accommodate the recreational needs of the local population and the City's many visitors, public health and safety can be compromised. [114]

Coastal access and recreational opportunities are threatened by rising seas as permanent inundation, episodic flooding, or the erosion of beaches, recreational areas, or trails occurs. In areas where beaches cannot migrate inland due to development or more resistant landforms, beaches will narrow or disappear completely. Access to, and the quality of, water-oriented activities may also be affected. For instance, increased water levels and altered sediment patterns driven by sea level rise could lead to a change in surfing conditions – a primary tourism driver in Encinitas. [115] Shoreline change that affects recreational opportunities and visitor patterns may have severe implications for businesses, households, and individuals that depend on coastal tourism for their enjoyment or economic livelihood.

BLUFF EROSION

The soft sandstone bluffs common along the Encinitas coastline are prone to erosion from waves and stormwater runoff. In addition, sea-level rise together with increased storm frequency may accelerate beach and other shoreline erosion. As the beaches narrow, sensitive sandstone bluffs are exposed to crashing waves, which carve notches into the bluffs. Bluffs affected by these notches are then prone to episodic collapse. Consequently, residential properties on the upper bluff are experiencing land loss, and

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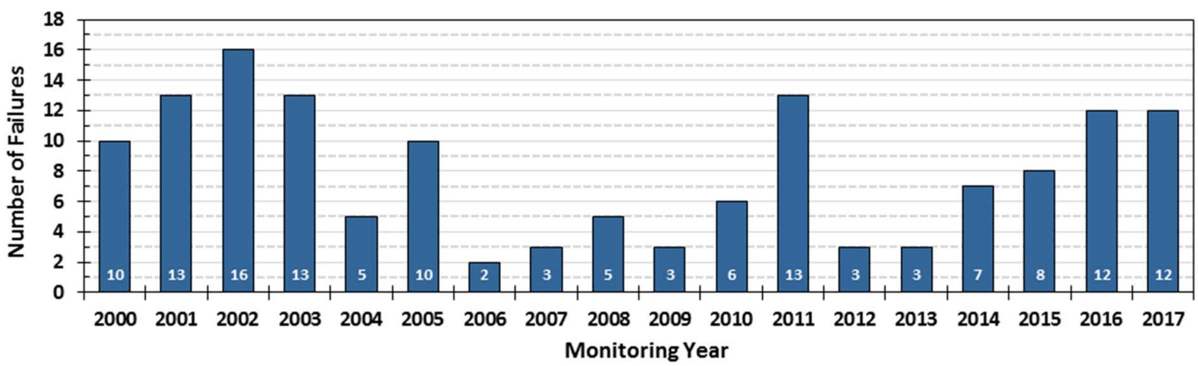
[112] ICLEI. (2017). San Diego Regional Coastal Resilience Assessment. ICLEI-Local Governments for Sustainability USA.
[113] Paterson, Shona K., Arleen O'Donnell, David K. Loomis, Ph.D. 2010. The Social and Economic Effects of Shoreline Change: North Atlantic, South Atlantic, Gulf of Mexico, and Great Lakes Regional Overview. July 30.
[114] California, State of, Department of Boating and Waterways. 2022. Shoreline Erosion Control & Public Beach Restoration. https://dbw.parks.ca.gov/?page_id=28766. Accessed July 19, 2022.
[115] California, State of, Coastal Commission. 2022. Sea Level Rise, Science & Consequences. https://www.coastal.ca.gov/climate/slr/science/. Accessed July 19, 2022.

property owners can spend significant resources to try to protect their property; otherwise, the structures will eventually be lost. In 2012, an Army Corps survey of toe notches in Encinitas showed 190 parcels had toe notches of 8-11 feet deep. The other 188 parcels had toe notches of six feet or less. [116]

In 2018, the City of Encinitas created a GIS database of bluff failure information. The database was created using the City's Bluff Explorer application and covers the period from 2000 through 2017. One hundred and forty-four coastal bluff failures were documented in the City of Encinitas during the 18-year period from 2000 through 2017. Eleven of these events were minor failures (approximately two cubic yards or less), and forty-four were major (greater than two cubic yards). The latter presents a threat to public safety and endangers both public and private property and infrastructure. The dimensions of the remaining eighty-nine bluff failures were not provided. Recorded bluff failures averaged eight events per year. [117]

Bluff Failures Documented in Encinitas, 2000-2017 [118]



Source: Coastal Frontiers Organization. 2018.

Areas where bluff failures have been most frequent include, from north to south:

- Grandview Street Public Access: This location accounts for approximately 11 percent of the total number of failures registered in Encinitas (16 events). The site was particularly active in the early 2000s, but failures have occurred at this location as recently as August 2019 when three people were killed when the oceanfront bluff collapsed. [119]
- Beacon's Beach: With 5 percent of all failures (7 events), this location was also the most active in the early 2000s. Beacon Beach: A minor bluff failure forced closures on May 2, 2022, of a parking lot above Beacon's Beach in Encinitas and a switchback trail that has provided pedestrian access to the popular seafront city park for decades. The overnight cliff collapse sent soil tumbling down toward the beach but caused no reported injuries or structural damage. [120]
- Between D Street and F Street: This site, which once again was particularly active in the early 2000s, accounted for 13 percent of all the bluff failures registered in Encinitas (19 events).

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[116] United States Army Corps of Engineers. 2012. Encinitas-Solana Beach Coastal Storm Damage Reduction Feasibility Study San Diego County, California, Appendix E: Economics. Los Angeles District.

[117] Coastal Frontiers Organization. 2018. GIS-Based Bluff Failure Database and Characterization History Cities of Encinitas and Solana Beach. Bluff Failure Characterization, 4.1. City of Encinitas. Page 8.

[118] Coastal Frontiers Organization. 2018. GIS-Based Bluff Failure Database and Characterization History Cities of Encinitas and Solana Beach.

[119] Riggins, Alex and Gary Worth. 2019. 3 People killed in Encinitas beach cliff collapse. San Diego Union-Tribune. August 3rd.

[120] Ireland, Elizabeth. 2022. Bluff Collapse in Encinitas Forces Parking, Pedestrian-Access Closures 'Until Further Notice'. Times of San Diego. May 2.

- I Street: In sharp contrast with the three previous areas, the first reported failure at this location occurred in 2006. The site is still active, with three failures occurring in 2017. A total of eight failure events have occurred in the area fronting I Street, 6 percent of the total.
- Swami's Beach: Nine bluff failures have been documented at Swami's Beach during the monitoring period (6 percent of the total). Five of these events occurred in 2016 and 2017, making Swami's Beach a particularly active site.

The 2018 Coastal Frontier's bluff failure report provided two significant conclusions regarding temporal changes and the impact of environmental variables, as follows:

Temporal Changes

The data suggest that bluff failure spatial distribution in Encinitas has changed noticeably over time. While in the early 2000s, bluff failures tended to cluster at specific locations (such as the three first sites listed above). In recent years failures have been more evenly distributed along the coastline.

Environmental Variables

When the entire study period is considered, significant correlations between the environmental variables and bluff failures were conspicuously absent:

- Wave Conditions: The years 2000 through 2005, when bluff failures were particularly frequent (67 events in six years), were characterized by unexceptional oceanographic conditions (storm days and wave energy index). The conditions were more severe from 2006 through 2013, but the number of bluff failures was significantly lower (38 events in eight years).
- Precipitation: Similarly, annual precipitation values were not significantly higher in the early 2000s when bluff failure frequency was highest than during the rest of the study period (2005 being the exception). The correlation coefficient between precipitation and bluff failure events was 0.03.
- El Niño: While a relativity high number of bluff failures occurred in 2003 and 2016 ("moderate" and "very strong" El Niño years, respectively), the number of failures recorded in 2010 ("strong" El Niño year) was modest. [121]

Figure 3-9: Bluff Retreat illustrates cliff retreat based on a USGS dataset containing projections of coastal cliff-retreat rates and positions for future sea-level rise scenarios. As the sea level rises, waves break closer to the sea cliff, more wave energy impacts the cliffs, and cliff erosion rates accelerate. The CoSMoS model also includes wave run-up, wave set-up that raises the water level during big-wave events, and tidal levels.

The various levels of exposure to beach erosion are relatively similar and are difficult to distinguish at a City-wide scale. Four maps at a more detailed extent have been created for Encinitas in **Figure 3-9 (through Figure 3-12): Bluff Retreat**s as the properties and structures appear to be similarly affected for all three SLR scenarios. In this map, "Hold the Line" assumes the current infrastructure will continue in place.

Cliff retreat data was not modeled by the USGS for the area adjacent to San Elijo State Beach parking lot (labeled 8* in Figure 3-9). This specific area is not included in the USGS CoSMoS 3.0 Cliff Retreat data set. USGS staff believe the area may not have been modeled because of a misinterpretation of the topography as dunes (versus cliffs) next to the inlet. [122]

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[121] Coastal Frontiers Organization. 2018. GIS-Based Bluff Failure Database and Characterization History Cities of Encinitas and Solana Beach.
[122] United States Geological Survey. 2022. Per email correspondence with Amy Foxgrover, September 29.

Figure 3-9: Bluff Retreat: Section 1

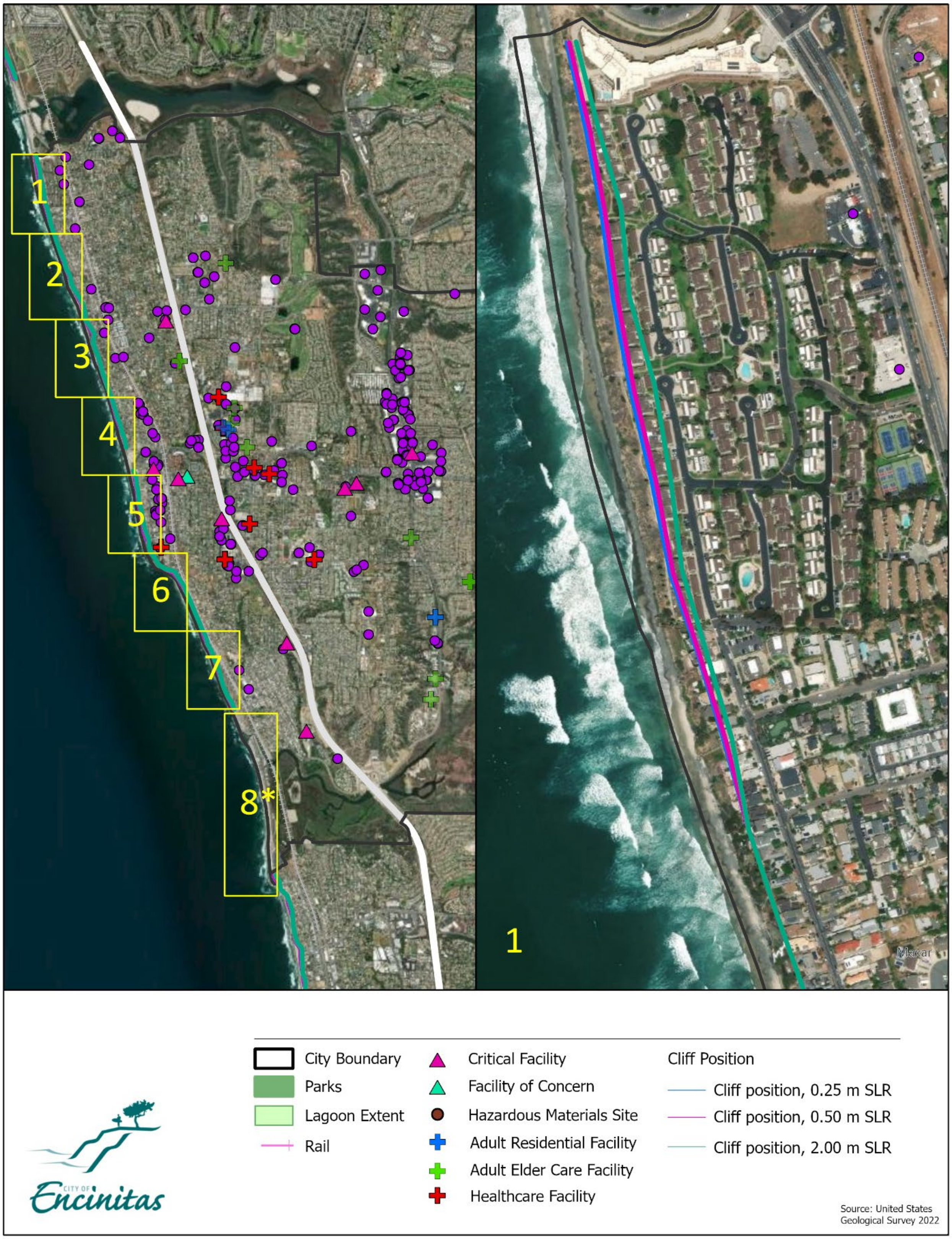

Figure 3-10: Bluff Retreat: Sections 2 and 3

Figure 3-11: Bluff Retreat: Sections 4 and 5

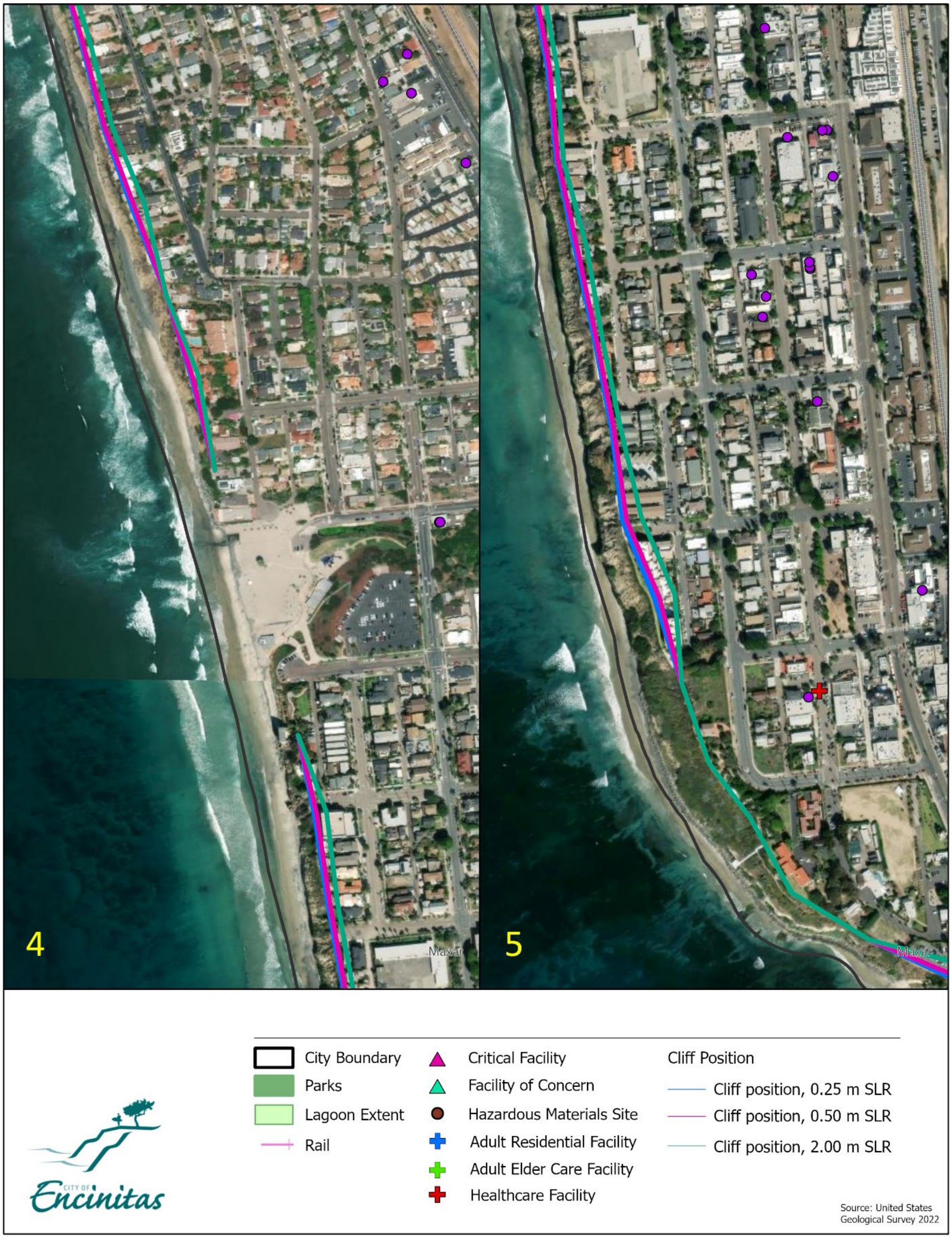

Figure 3-12: Bluff Retreat: Sections 6 and 7

Further analysis did not identify any Critical Facilities, Facilities of Concern, or hazardous materials sites located in the bluff erosion areas. None of the healthcare, elder care, or adult residential facilities are within the bluff retreat areas. The socio-economic impacts on the local community (Table 3-13) mirror those of storm surge and chronic inundation, whereby the impacted populations are not considered highly vulnerable from a climate change perspective.

Table 3-13: Bluff Retreat – Threatened Populations	0.25 – 2 Meters	Encinitas
Total Population	483	62,007
Percent of residents that are children (less than 10 years)	7.8%	11.0%
Percent of households that have people 65+ years	22.4%	34.1%
Percentage of households with at least one person living with a disability	18.0%	19.1%[1]
Median age	42.3	43
Total households	183	23,893
Median household income	$108,056	$120,488
Percent of rental households	56.7%	36.2%
Percent of household income below the poverty level	4.4%	7.2%

Source: US Census Bureau, ACS 2020, ESRI 2022[1]

Sensitivity: Physical

Bridges, major arterials, and outfalls show vulnerability to coastal erosion. Permanent impacts from erosion pose a more significant challenge for adaptation. However, there is significant redundancy in the roadway network. Rerouting traffic through a detour or temporarily limiting service on affected roads would affect fewer travelers than on state-owned routes (e.g., state highways and freeways). There is low redundancy in the bridge network. Daily flooding could require the creation of alternate routes outside of inundation zones.

It is difficult to adapt outfalls (by increasing elevation and/or adding backflow valves). There are spatial and topographical constraints to elevating outfall pipes, which add to the time and cost of required engineering. There are also the spatial constraints of other existing structures and easement widths when considering the relocation of an outfall.

Erosion could erase or significantly alter habitable land within conservation areas. The changes to ecosystems that come with sea-level rise impacts—changes in sediment, nutrient availability, and salinity—could lead to shifts in habitat locations and may cause certain habitats to shrink or disappear. Inland migration might be possible, though only likely in the lagoon adjacent areas. [123]

Economic Impacts

Among the most significant issues driving coastal management and policy in the face of sea-level rise is the need to protect private property. Sea-level rise and associated flooding will threaten nearly $100 billion worth of property along the California coast by 2100 [124], and coastal landowners and planners will inevitably act to protect their assets from these losses. Landowners overwhelmingly default to standard risk-mitigation techniques to sea-level rise induced problems – specifically, coastal armoring solutions. The results from a 2016 California State Coastal Conservancy study called into question the conventional

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[123] ICLEI. (2017). *San Diego Regional Coastal Resilience Assessment.* ICLEI-Local Governments for Sustainability USA.
[124] Heberger, M., H. Cooley, P. Herrera, P.H. Gleick, and E. Moore. 2009. The Impacts of Sea-Level Rise on the California Coast. California Climate Change Center.

wisdom that shoreline armoring is the best response to coastal erosion. In the scenarios analyzed, shoreline armoring yielded significantly lower net present values than other options. While the study notes that Monterey is not representative of all coastal areas, the result could be applicable to other urbanized stretches of the California coastline with similar levels of exposure to coastal hazards. [125]

Adaptive Capacity

The City is currently working on a series of area-specific planning efforts to increase community and local ecosystem resiliency to the impacts of sea-level rise, described as follows:

Coastal Storm Damage Reduction

Opportunities exist to reduce bluff failures and/or mitigate the danger from those failures. Encinitas employs lifeguards year-round that encourage recreating away from the base of the bluffs. As beaches are highly impacted by coastal erosion, the City can also increase the size of the beach area to provide reduced scouring and provide significant recreational benefits as well. Two engineering methods may be employed to reduce storm damage: soft-structural and hard-structural. The soft-structural method includes beach fills, sand scraping, or sand bypassing/recycling. Hard structures consist of sand retention (see below for a discussion of Beach Sand Nourishment), features that impede alongshore sand movement (e.g., groins, jetties, artificial reefs, or detached breakwaters), and storm-protective features (See Chapter 4: Climate Adaptation Framework), which directly prevent shoreline or upland erosion (e.g., coastal armoring, seawalls, or revetments). [126]

Cardiff Beach Living Shoreline Project

In collaboration with the State Coastal Conservancy and the California State Parks, the City developed the Cardiff Beach Living Shoreline. The project supports efforts for a local dune restoration project to restore heavily impacted coastal habitat and provide natural sea-level rise adaptation by protecting a vulnerable segment of Cardiff Beach. The project provided innovative approaches for climate resiliency and sea-level rise adaptation, buffering the City, specifically HWY 101, from storm surge and flooding during extreme weather events. The dune has been constructed and is currently in year 4 of a 5-year post construction monitoring period. It is currently being monitored by both consultants and academics at UCLA. The dune serves as a buffer against storm surge. In times when it has experienced significant erosion from storm surge, the dune has been replenished to as-built grade by sand from yearly maintenance dredging of the San Elijo Lagoon. As such, the dune has a reliable source of beach quality material to maintain its effectiveness. [127]

San Elijo Lagoon Restoration Project

The San Elijo Lagoon Conservancy, in coordination with the City, SANDAG, Caltrans, and supporting engineering and construction firms, completed the San Elijo Lagoon Restoration Project in 2021. The project consisted of selective dredging and filling the mudflats and salt marsh habitat within the lagoon, intended to improve tidal circulation and restore sensitive habitats currently compromised by surrounding land uses. The project provides continuity of habitats currently threatened by sea-level rise and provide increased adaptive capacity for the surrounding communities during flooding and extreme weather events.

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[125] California State Coastal Conservancy. 2016. Economic Impacts of Climate Adaptation Strategies for Southern Monterey Bay. The Nature Conservancy.
[126] United States Army Corps of Engineers. 2012. *Encinitas-Solana Beach Coastal Storm Damage Reduction Feasibility Study San Diego County, California, Appendix E: Economics.* Los Angeles District.
[127] City of Encinitas. 2022. Written comments by Liam Maxwell. June 23, 2022.

This project will add 300,000 cubic yards of material to the beach and nearshore environment, improving coastal resiliency for years. The project includes a 50-year Restoration Monitoring Plan that includes monitoring of thirteen key variables within the wetland to ensure there are no adverse impacts and the wetland ecosystem was improved. The monitoring occurs first is the wetland itself, and second is the local coastal marine environment where the project provided beach replenishment sand. [128]

Beach Sand Nourishment

U.S. Army Corps of Engineers San Diego County, CA Project (formerly known and referred to as Encinitas-Solana Beach Coastal Storm Damage Reduction Project)

The City of Encinitas and Solana Beach have partnered to bring a 50-year beach nourishment project with the support of the US Army Corps of Engineers and the State Parks and Recreation Department. This project would provide stability and resiliency to the coastline. Construction of the project is to begin in 2023. This project would increase the existing width of 7,800 feet of coastline an additional 50 feet seaward. The project will place 340,000 cubic yards of sediment on the beaches initially and renourish the beaches with 220,000 -340,000 cubic yards of sediment every 5 years thereafter for the entire 50-year lifespan of the project. It is estimated that in total this project will provide 2.32 million-3.15 million cubic yards [129] of sediment onto the beaches. [130]

Opportunistic Beach Fill Program

In 1993, SANDAG adopted a comprehensive plan for erosion mitigation known as the "Shoreline Preservation Strategy for the San Diego Region". The Strategy proposed an extensive beach building and maintenance program to provide for environmental quality, recreation, and storm protection in the coastal zone. Following a number of modest beach nourishment projects that were undertaken primarily on an opportunistic basis (i.e., when sand became available from other sources), the Regional Beach Sand Project I (RBSP I) was conceived and implemented in 2001 as a more comprehensive approach to restoring the County's sand-starved beaches. Based on the success of RBSP I, a second Regional Beach Sand Project (the RBSP II) was conducted eleven years later in 2012.

The Opportunistic Beach Fill Program identifies construction projects that export sandy beach material and then haul the material to the beach at Moonlight, Cardiff, Leucadia, or Ponto State Beach. The City collaborates with developers to conduct monitoring and permitting and share the cost for hauling the material to the beach.

2001 Regional Beach Sand Project (RBSP I)

Between April 6 and September 23, 2001, the RBSP I provided 2.1 million cy of beach-quality sand to twelve receiver beaches located between Imperial Beach and Oceanside. The material was excavated from six offshore borrow areas using a trailing suction hopper dredge and pumped onto the subaerial portion of each receiver beach (Noble, 2002). The median grain size (d50) varied considerably among the borrow areas, ranging from 0.14 mm (fine sand) to 0.62 mm (coarse sand).

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[128] The Nature Collective. 2022. San Elijo Lagoon Restoration. https://thenaturecollective.org/project/san-elijo-lagoon-restoration/ Accessed July 12, 2022.

[129] Renourishment volume ranges were determined based on low and high sea level rise scenarios. Information provided by Liam Maxwell, City of Encinitas. June 23, 2022.

[130] City of Encinitas. 2022. Written comments by Liam Maxwell. June 23, 2022.

- Beach replenishment at Batiquitos would involve the placement of dredged sediment from a point approximately 850 feet south of the Batiquitos Lagoon into the community of Leucadia and Leucadia State Beach. Batiquitos received 118,000 cubic yards along 1500 feet of beach, while Leucadia received 132,000 cubic yards along 2700 feet of beach.
- Beach replenishment from August 10th through August 16th at Moonlight Beach consisted of the placement of 105,000 cubic yards of dredged sediment along 800 feet of beach.
- Beach replenishment from August 2nd through August 10th at the Cardiff site consisted of the placement of 101,000 cubic yards of dredged sediment along 900 of Cardiff State Beach south of the San Elijo Lagoon inlet and Restaurant Row. [131]

2012 Regional Beach Sand Project (RBSP II)

The RBSP II project was smaller in scope than RBSP I, providing approximately 1.5 million cy of beach quality sand to eight receiver beaches located between Imperial Beach and Oceanside. The material was excavated from three offshore borrow areas, pumped onto the subaerial portion of each receiver beach, and shaped to the design configuration using conventional earth-moving equipment. The receiver sites were nearly identical to eight of the RBSP I sites, but four receiver beaches nourished in RBSP I were not included in the second project (Mission Beach, Torrey Pines, Del Mar, and Leucadia).

- Moonlight Beach: Sand replenishment was completed between October 20th and October 25th, 2022. Approximately 92,000 cubic yards of sand was placed on 800 feet of beach just north of the D St. access point at Moonlight Beach.
- Cardiff Beach: Sand replenishment between the Chart House restaurant and just north of South Cardiff State Beach was completed between October 25th and October 28th, 2012. Approximately 89,000 cubic yards was placed on about 1,600 feet of beach.
- Batiquitos Beach: Sand replenishment was completed between October 28th and November 4th, 2012. Approximately 106,000 cubic yards of new sand was placed on 1,400 feet of beach between the Batiquitos Lagoon mouth and the bluff-backed area of the beach. [132]

A third installment of the Opportunistic Beach Fill Program is currently planned by SANDAG.

3.3.2.5 LANDSLIDES AND LIQUEFACTION

In the context of climate change vulnerability, increased liquefaction and heightened possibility of landslide events are a concern. Both hazards have an indirect effect of increased precipitation and flooding because soils must be saturated with water for liquefaction or landslides to occur.

- Liquefaction occurs when seismic energy shakes an area with low-density, fine grain soil, like sand or silt, which is also saturated with water. When the shaking motion reaches these areas, it can cause these loosely packed soils to suddenly compact, making the waterlogged sediment behave more like a liquid than solid ground.
- Landslides occur when the earth on slopes becomes destabilized, typically after heavy rains, when the precipitation saturates the soil and makes it less stable, or when significant erosion from rainfall

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[131] SANDAG. 2000. The San Diego Regional Beach Sand Project Final Environmental Impact Report/ Review Environmental Assessment.
[132] SANDAG. 2012 Regional Beach Sand Project. https://www.sandag.org/index.asp?projectid=358&fuseaction=projects.detail. Accessed on April 6, 2022.

destabilizes the ground. Slopes that have recently burned face a greater risk from rain-induced landslides, as the fires burn the trees, brush, and other vegetation that help stabilize the earth.

Earthquakes may also be a source of liquefaction and landslides as the shaking can destabilize already loosened soils. Southern California is considered one of the most seismically active regions in the United States because the faulting is dominated by the compression regime associated with the "big bend" of the San Andreas Fault Zone.

The San Diego region is transected by several sub-parallel, pervasive fault zones and smaller faults. The City of Encinitas is in the southern part of the Peninsular Ranges geologic Province: an area exposed to risk from multiple earthquake fault zones. The San Andreas Fault, which runs from Baja, California to San Francisco, is approximately one hundred miles east of the City and poses a potential risk for the San Diego region. However, for the City, the highest risks originate from nearby zones such as the Elsinore Fault Zone, the Rose Canyon Fault Zone, and other offshore faults. Each zone has the potential to cause moderate to large earthquakes that would cause ground shaking in Encinitas. [133]

Historical Earthquake Events

- November 22, 1800 – A 6.5 magnitude occurred on the Rose Canyon fault offshore from Oceanside. It cracked adobe walls at the missions of San Diego de Alcala and San Juan Capistrano.
- May 27, 1862 – A magnitude 6.0 earthquake centered on the Rose Canyon or Coronado Band faults.
- July 13, 1986 – A magnitude 5.4 earthquake centered off the coast of Oceanside on the Coronado Bank Fault.

VULNERABILITY

Exposure

Figure 3-13: Deep-Seated Landslide Susceptibility shows the relative likelihood of deep-seated land sliding based on regional estimates of rock strength and steepness of slopes. On the most basic level, weak rocks and steep slopes are most likely to generate landslides. The map uses detailed information on the location of past landslides, the location and relative strength of rock units, and the steepness of the slope to estimate susceptibility to deep-seated land sliding. This landslide susceptibility map is intended to provide infrastructure owners, emergency planners, and the public with a general overview of where landslides are more likely to occur. [134] While no definitive scale for measuring landslides exists, landslide events are usually measured using the amount of material displaced (i.e., the cubic feet of earth that moved). In addition, to these landslide hazards, the California Geological Survey has mapped deep-seated landslide hazards, which uses a scale of landslide susceptibility based on slope steepness and the strength of the underlying rock, with zero being no susceptibility and ten being the highest susceptibility.

Only one critical facility, the wastewater treatment facility at 2695 Manchester Avenue, falls within the Deep-Seated Landslide Susceptibility area. There are 36 hazardous materials facilities that fall within the Deep-Seated Landslide Susceptibility area, comprised of medical facilities, fuel stations, and various commercial enterprises with chemicals such as diesel, nitrogen, sulfuric acid, and nitrous oxide.

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[133] City of Encinitas. 2021. Encinitas 6th Cycle Housing Element 2021-2029: Appendix B.
[134] County of San Diego, Planning and Development Services, LUEG-GIS Service and National Earthquake Hazards Reduction Program. 2017.

Figure 3-13: Deep-Seated Landslide Susceptibility

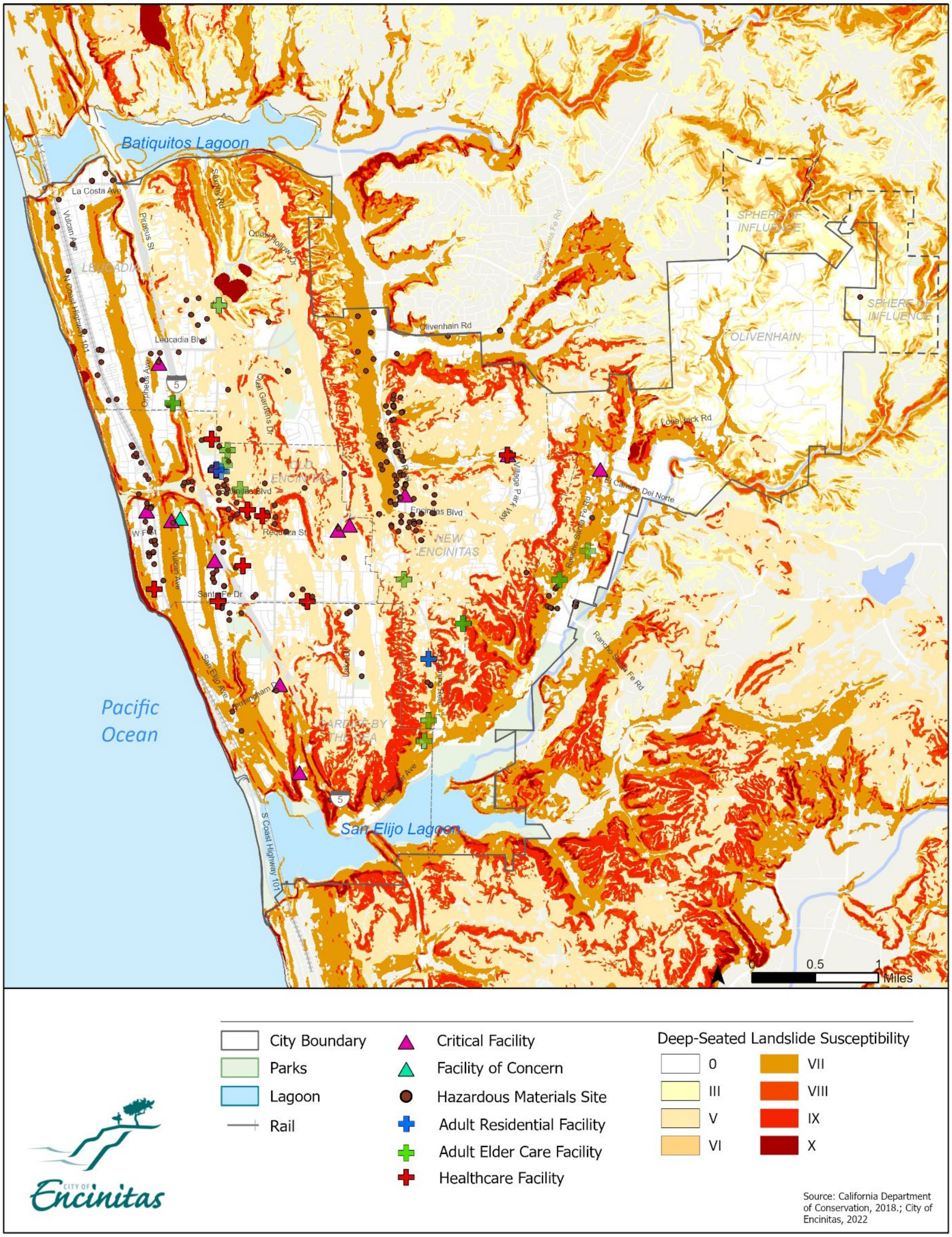


Table 3-14: Critical Facilities and Facilities of Concern (Deep-Seated Landslide Susceptibility)

Category	Number of Facilities	
	Critical	Concern
City Facilities (Fire, Sheriff)	0	-
Community & Senior Center	0	-
Library	-	0
Water/Sewer Facilities	1	-
Hospital	0	-
Total	**1**	**0**

Source: City of Encinitas 2022

Figure 3-14: Liquefaction Potential highlights areas with potential for liquefaction. In Encinitas, there may be a potential for liquefaction in areas with loose sandy soils combined with a shallow groundwater table, which typically are in alluvial river valleys/basins and floodplains. The underlying dataset combines existing liquefaction areas from local maps, National Earthquake Hazards Reduction Program, which rates soils from hard to soft and known hydric soils from the United States Department of Agriculture Soil Survey to identify the potential areas liquefaction may occur.

The liquefaction areas mirror the 100-year FEMA floodplain as illustrated in **Figure 3-6: Flood Hazard Zones**. There are no Critical Facilities, Facilities of Concern, or hazardous materials sites located in the potential liquefaction areas. None of the healthcare, elder care, or adult residential facilities are within the potential liquefaction areas.

Sensitivity: Physical

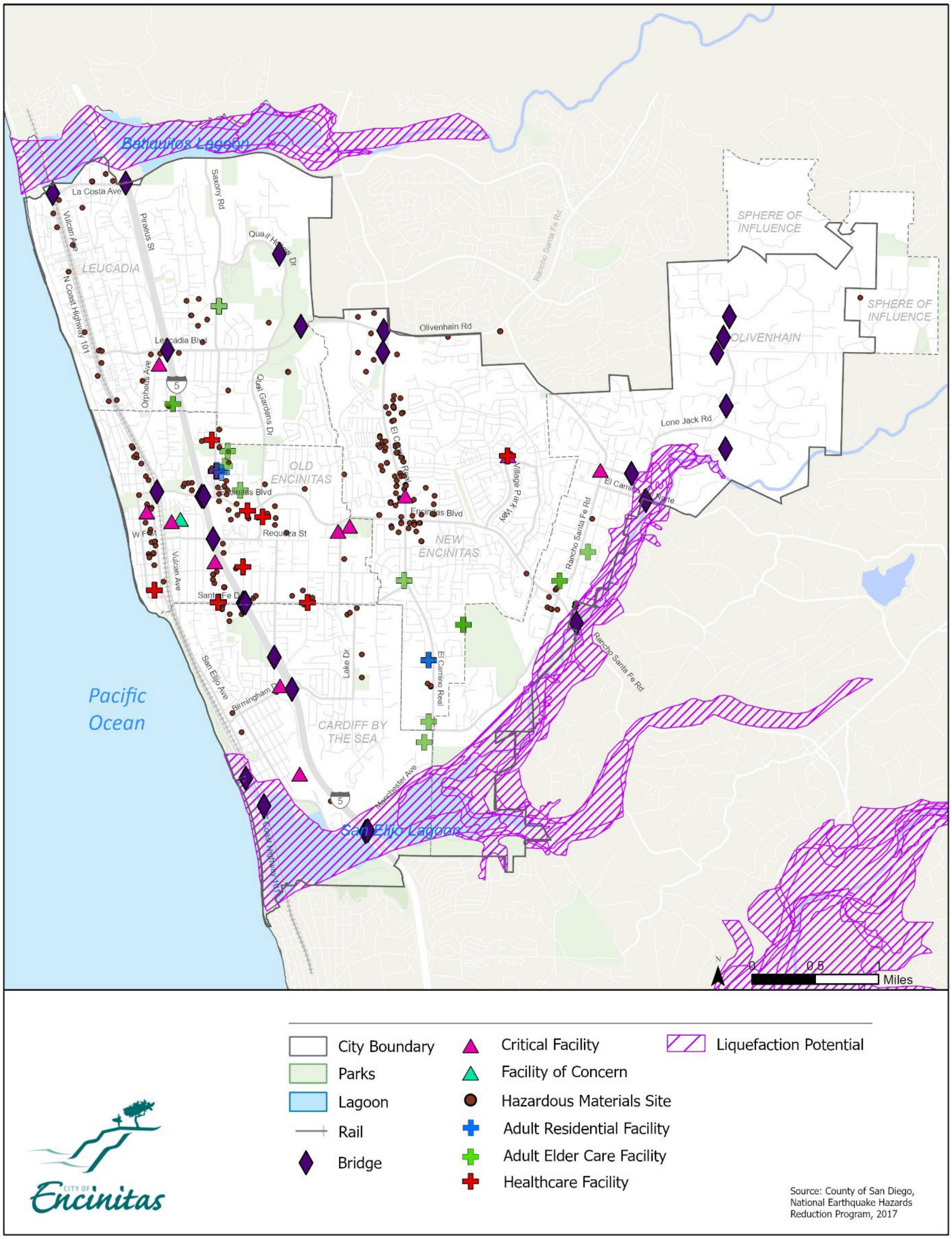
As climate change is anticipated to change the usual precipitation patterns in Southern California, including Encinitas, periods of both rain and drought are anticipated to become more intense and frequent. Therefore, depending on the circumstances, climate change could increase the future risk of liquefaction in Encinitas. Given the topography, it is anticipated that landslide risk will remain high in those areas identified in darker red in **Figure 3-13: Deep-Seated Landslide Susceptibility**. However, the City requires mitigation of these types of conditions, which reduces landslide potential in the developed areas of the City (See Adaptive Capacity: Hillside/Inland Bluff Overlay Zone regulations).

During liquefaction events, the liquified soil can lose its stability which can cause damage to buildings and infrastructure built upon it. In severe cases, buildings may completely collapse. Pipelines or other utility lines running through a liquefaction zone can be breached during an event, potentially leading to flooding or the release of hazardous materials. Considering a “major liquefied petroleum transmission line pass(es) through the community,” [135] the City should monitor the potential impacts of a seismic event on this critical infrastructure.

There are multiple bridges located in the potential liquefaction areas, including but not limited to the La Bajada, San Elijo Overcrossing, and the Railway Bridge at San Elijo. The MJHMP identifies the replacement of the Highway 101 Bridge as a Priority Action because a Seismic Vulnerability Study concluded that the bridge (constructed in 1932) is susceptible to failure/collapse during a significant seismic event or tidal influx due to strong storms. With potential changes in precipitation, bridges should be monitored periodically for seismic vulnerability.

[135] San Diego County Multi-Jurisdictional Hazard Mitigation Plan, Section Five, Encinitas. October 2017.

Figure 3-14: Liquefaction Potential



As discussed in the City of Encinitas Housing Element, major onshore and offshore fault zones present a seismic risk to the City, like most Southern California communities. In the early 1990s, the City surveyed unreinforced masonry buildings in Encinitas and identified structures vulnerable to earthquake forces. The survey provides twenty site addresses in the City that are subject to risk and their estimated occupancy information and building condition. None of the sites for lower-income households identified in the site inventory analysis are at risk due to the presence of unreinforced masonry buildings. [136]

Considering the future degradation of structures, the City will want to monitor the quality of older housing stock to ensure it is still safe in a liquefaction event. The U. S. Department of Housing and Urban Development may consider units substandard if they were built before 1940. Eight hundred sixty-two units in Encinitas were built before 1940, approximately three percent of the total housing in the City. The City has a minimal number of units in need of repair or rehabilitation, especially given the high percentage of newly constructed units. Based upon a combination of previous "windshield surveys," observations and experiences of the code enforcement and planning staff, and indicators from other surveys, the City has estimated that 50-100 units would fall into this category, although most, if not all, meet minimum housing and building code requirements.

Approximately 25 percent of the housing stock is approaching 50 years of age or older and is more likely to require major rehabilitation. Housing that is not maintained can discourage reinvestment, depress neighboring property values, and negatively impact a neighborhood's quality of life. Improving housing is an important goal of the City. The age of the City's housing stock indicates a potential need for continued code enforcement, property maintenance, and housing rehabilitation programs to stem housing deterioration. Overall, however, given residents' moderate to higher incomes, deferred maintenance is not a prevalent issue in the City. [137]

Sensitivity: Social

Approximately 15 percent of the City's households are potentially exposed to landslide hazards. The demographics of vulnerable populations mirror those of the entire City, except for the percent of households that have people aged 65 or older residing in the home is less than that of the City (approximately 643 homes). Relative to other hazards (e.g., coastal flooding), the potential losses from one large landslide or multiple landslides caused by soil saturation or an earthquake could be comparatively large in most cases.

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[136] City of Encinitas. 2021. Encinitas 6th Cycle Housing Element 2021-2029: Appendix B.
[137] City of Encinitas. 2021. Encinitas 6th Cycle Housing Element 2021-2029: Appendix B.

Table 3-15: Deep Seated Landslide – Threatened Populations

	Landslide[1]	Encinitas
Total Population	8,875	62,007
Percent of residents that are children (less than 10 years)	10.2%	11.0%
Percent of households that have people 65+ years	17.0%	34.1%
Percentage of households with at least one person living with a disability	20.3%	19.1%[1]
Median age	42.3	43
Total households	3,782	23,893
Median household income	$116,840	$120,488
Percent of rental households	38.1%	36.2%
Percent of household income below the poverty level	7.5%	7.2%

Source: US Census Bureau, ACS 2020, ESRI 2022[1]

Adaptive Capacity

The City has addressed seismic hazards in the Hazard Mitigation Plan and enforces regulations intended to protect people and assets from seismic events. The plans and programs for the City and supporting agencies are described below.

San Diego County Multi-jurisdictional Hazard Mitigation Plan (2017)

The 2017 MJHMP includes objectives and actions to decrease the risks associated with increased temperature and extreme heat events. Goal 4 of the 2017 MJHMP Chapter on Encinitas intends to "[r]educe the possibility of damage and losses to existing assets, particularly people, critical facilities/infrastructure, and City-owned facilities, due to geologic hazards, including earthquake, liquefaction, and landslides." The goal includes four corresponding objectives and twenty-three actions to help the City prepare for the impacts of wildfires (and structural fires). Objectives and actions focus on planning, protecting vulnerable assets susceptible to seismic events, agency coordination, and public education. [138]

Hillside/ Inland Bluff Overlay Zone

The Hillside/Inland Bluff Overlay Zone requires that development be restricted in those areas where slopes exceed 25% and encroachments have been minimized to the greatest extent feasible. The Hillside/ Inland Bluff Overlay Zone regulations apply to all areas within the Special Study Overlay Zone, where site-specific analysis indicates that 10 percent or more of the area of a parcel of land exceeds 25 percent slope.

[138] San Diego County Multi-Jurisdictional Hazard Mitigation Plan, Section Five, Encinitas. October 2017.

CHAPTER 4. CLIMATE ADAPTATION FRAMEWORK

This chapter provides actions to build adaptive capacity and increase resilience to climate change-related impacts in Encinitas. It is organized by climate hazard (extreme heat, drought, wildfire plus smoke, flooding, and liquefaction) consistent with the Vulnerability Assessment.

The City already has robust plans with respect to hazard mitigation and preparedness. The following recommendations are intended to augment mitigation and preparedness policies in the existing General Plan and Multi-Jurisdictional Hazard Mitigation Plan and address more fully the recovery and response components of disaster planning that are essential for achieving a more resilient community. Actions in this chapter work to address multiple hazards. For example, the measures to improve air quality correlate closely with those for extreme heat (e.g., planting trees).

As the climate will continue to evolve, it is recommended the City of Encinitas take an "Adaptive Pathways" approach to climate adaptation. Adaptive Pathways is a planning framework that considers the uncertainty of climate change and the change in risk conditions and allows for flexibility in implementation to improve effectiveness and economic efficiency. An adaptive pathways approach identifies thresholds or points in time when decisions or action pathways should be revisited, allowing for adjustments in implementation to be made based on changing conditions. It is recommended the City first identify climate change adaptation policies and programs, then construct an adaptive pathways approach appropriate to prepare and respond to individual or multiple climate hazards.

1. GENERAL CLIMATE HAZARD ADAPTATION

Interagency Coordination

1-1 Collaborate with local and regional partners to provide robust critical infrastructure and facility planning, monitoring, and maintenance to prevent and respond to damage from climate change effects, including fallen trees, flood waters, wildfires, landslides, and severe storms.

Education and Outreach

1-2 Improve flood and heat warning and information dissemination, focusing on ensuring those who lack internet access and cell phones and for whom English is a second language can receive and understand emergency warnings.

Planning and Engineering

1-3 Continue to integrate findings of climate vulnerability into all phases of emergency planning.

1-4 As necessary, identify additional community safety locations that may serve as temporary shelter or refuge during hazard events.

1-5 Develop and update protocols for routing emergency services (fire, ambulance, police) to ensure all homes and businesses can be accessed in the event of an emergency.

1-6 Consider the installation of microgrids at critical emergency response facilities such as fire stations, community centers, and designated emergency evacuation sites.

a. Address housing insecurity and reduce the exposure of persons experiencing homelessness to safety and health impacts from climate disasters.

1-7 Include provisions for special needs populations and communities with low rates of car ownership in emergency response procedures.

a. Vulnerable Population Registry. Develop a voluntary vulnerable population registry and subsequent priority list to help first responders better provide services and meet the needs of those most in need.
b. Emergency Shuttle. Explore the possibility of partnerships for providing an emergency evacuation shuttle service.
c. Know Your Neighbor Program. Coordinate a Know Your Neighbor Program where community leaders and neighbors provide resources and check in on vulnerable populations during hazard events where people shelter at home.
d. Regular Needs Assessment. Regularly meet with community leaders representing special needs populations, including seniors, to maintain continuous two-way communication. This should include surveys and other needs assessments to refine notification and response policies.

Building and Environmental Design

1-8 Use nature-based solutions to improve resilience while promoting biodiversity (e.g., green infrastructure projects such as rain gardens or bioswales, habitat corridors, and land conservation).

EXTREME HEAT EVENTS

Interagency Coordination

1-9 Coordinate with relevant agencies including, but not limited to, the San Diego County Office of Emergency Services and Encinitas Fire and Marine Safety Department to better plan and prepare for extreme heat events and the increased demand for Emergency services associated with these events. (CAP Strategy 5: Temperature and Extreme Heat)

1-10 Protect the energy grid by working with utility providers in the region to harden existing energy infrastructure systems against damage from climate change-related effects and expand redundancy in the energy network through microgrids and decentralized energy systems.

1-11 Provide working touchless water refill stations at public facilities, parks, and bus shelters.

1-12 Collaborate with regional transit providers to increase shading and heat-mitigating materials on pedestrian walkways and transit stops.

Education and Outreach

1-13 Conduct outreach to educate City residents on the health risks associated with extreme heat events and strategies to prepare for these events. Alongside general outreach, particular focus should be given to educating populations vulnerable to extreme heat, including children and the elderly. (CAP Strategy 4: Temperature and Extreme Heat)

1-14 Work with local and regional employers to ensure worker protection measures are in place for extreme heat events. Measures may include assurance of adequate water, shade, rest breaks, and training on heat risks for all employees working in the City. (CAP Strategy 6: Temperature and Extreme Heat)

1-15 Protect vulnerable populations from high temperatures:

a. Improve access to air conditioning. Improve the availability of air conditioning to those who do not currently have access.
b. Incentivize the use of air conditioning. Work with local governments and utilities to review the adequacy of programs designed to help vulnerable populations stay cool during heat waves, with attention to ways to offset the economic impacts on seniors and low-income groups.

Planning and Engineering

1-16 Expand the number of cooling centers from two (Encinitas Library and the Encinitas Community and Senior Center) to three. Determine location based on accessibility to at-risk populations.

1-17 Collaborate with local businesses and institutions to provide a "Cool Zone" area network (i.e., cooling centers) for vulnerable residents to rest in air-conditioned environments during high-temperature periods and heatwave events. (CAP Strategy 7: Temperature and Extreme Heat)

1-18 Partner with the local school districts to ensure every school has adequate air conditioning.

1-19 Expand hours of operation of cooling centers when the temperature exceeds Cal-Adapt thresholds for extreme heat days and during hazardous air days.

1-20 Supply cooling centers with refrigerators for storing medicine, backup water supplies, and social services information in multiple languages.

1-21 Collaborate with federal, state, regional, and local partners to develop a community-wide outreach program to educate vulnerable populations on how to prepare for and recover from climate change effects.

Building and Environmental Design

1-22 Incorporate green infrastructure strategies into new and existing infrastructure to mitigate the effects of the UHIE by reducing the area of heat-absorbing paved surfaces and increasing landscaped areas, including, but not limited to: (Revised CAP Strategy 1: Temperature and Extreme Heat)

a. Plant City trees. Increase City's urban tree canopy cover percentage, especially for areas with the highest UHI contribution: large parking lots, arterial roads, and dark roofs on buildings.
b. Use vegetation. For example, green walls and green roofs where trees are not possible.
c. Restore urban streams. Where possible, restore natural geomorphic and hydrologic features to failing culverted and channelized streams in urban areas.
d. Shade green open space. Use trees to provide shade at outdoor worksites and places where people recreate.
e. Ensure robust maintenance program is in place for City-maintained trees, landscaping and other vegetation.

1-23 Examine and expand the use of porous pavements in parking lots to lower nighttime surface temperatures as compared to other pavements, which also provides water quality benefits.

1-24 Promote the use of solar carports on new and existing surface parking lots to mitigate heat absorption and increase shaded areas for the City's population. Implementation priority will be given to City-owned parking lots to serve as an example. (CAP Strategy 2: Temperature and Extreme Heat)

1-25 Promote passive cooling design (e.g., appropriate building orientation, shade trees, window shading, cool roofs) and use the California Building Standards Code (CalGreen) voluntary measures for residential and non-residential buildings to improve energy efficiency. (CAP Strategy 3: Temperature and Extreme Heat)

1-26 Participate in beach nourishment projects that maintain local wide sandy beaches. Encinitas beaches are considered regional "Cool Zones." By maintaining the beach width, the City will be able to handle larger numbers of coastal visitors when needed, keeping the public a safe distance from the bluffs. (CAP Strategy 8: Coastal Erosion and Predicted Sea-Level Rise)

1-27 Promote private property tree planting by bulk purchasing trees for at-and below-cost sales to property owners for planting on private property.

2. DROUGHT + WATER SUPPLY

Interagency Coordination

2-1 Coordinate with local and regional partners (SDWD, OMWD, SDCWA) to support and improve water conservation efforts and programs for City residents. Coordinate with these agencies to provide educational outreach to residents on how best to conserve water and reduce water demand. (CAP Strategy 1: Precipitation Patterns and Water Supply)

2-2 Work with relevant water agencies, including SDCWA, OMWD, and SDWD, to evaluate current and future water supply systems and vulnerabilities and how water resources may be impacted by climate change. (CAP Strategy 3: Precipitation Patterns and Water Supply)

Planning and Engineering

2-3 Evaluate and improve the capacity of stormwater infrastructure for high-intensity rainfall events.

2-4 Invest in the use of green infrastructure (e.g. permeable pavements and landscaping) in developed areas and restrict the use of paved surfaces.

2-5 Improve sewage and solid-waste management infrastructure to reduce vulnerabilities to flooding and inundation, especially older infrastructure that is undersized or inadequate.

Education and Outreach

2-6 Expand upon existing water conservation education outreach programs for residents and businesses. Expand upon the City's existing Water Efficient Landscape Regulation to promote the use of climate-appropriate landscaping (e.g., xeriscaping) to reduce demand for potable water resources among City residents. Promote current funding available through the Save Our Water Turf Replacement Rebate Program sponsored by the CA Department of Water Resources. (CAP Strategy 5: Precipitation Patterns and Water Supply)

Water Conservation

2-7 Expand and/or improve the recycled water efforts currently in place at the San Elijo Water Reclamation Facility along with corresponding water conservation efforts to ensure that, when economically viable, all current and future City landscaping can source the majority of landscaping water needs from recycled sources. (CAP Strategy 2: Precipitation Patterns and Water Supply)

2-8 Continue marketing and outreach programs to promote participation in existing water conservation rebates and incentive programs in the region. Current programs for southern California include Water Smart San Diego (SDCWA), SoCal WaterSmart (Metropolitan Water District), and SDWD's free sprinkler nozzle program. (CAP Strategy 4: Precipitation Patterns and Water Supply)

3. WILDFIRE + SMOKE

Interagency Coordination

3-1 Coordinate with CAL FIRE, Encinitas Fire and Marine Safety Department, private landowners, and other responsible agencies to identify the best methods of fuel modification to reduce the severity of future wildfires, such as: prescribed fire, forest thinning, grazing, mechanical clearing, hand clearing, education, and defensible space. (CAP Strategy 1: Increased Wildfire Risk)

3-2 Work with relevant State agencies, including OES and CAL FIRE, to improve coordination for emergency services related to wildfire and related events in the City. Consider the development of a Community Wildfire Protection Plan to increase community resilience to wildfire events. (CAP Strategy 4: Increased Wildfire Risk)

Planning Tools

3-3 Continue to update the MJHMP every five years as required by the state to comprehensively plan for current and future wildfire risks within the City and work to implement all strategies in the City's current MJHMP. (CAP Strategy 2: Increased Wildfire Risk)

3-4 Adopt thresholds for restricting certain activities (e.g., outdoor sporting events, working outdoors) in accordance with Air Quality Index thresholds set under the California Department of Industrial Relations' Division of Occupational Health and Safety emergency regulation (July 2019) to protect workers from wildfire smoke.

Education and Outreach

3-5 Implement an alert system to warn residents of smoke hazards and inform them of actions they should take during an event (multiple languages, multiple media outlets).

3-6 Implement wildfire risk communication messaging that:

a. Occurs throughout the high wildfire risk season, so people know in advance how to use masks and air purifiers and where to get them.
b. Reaches non-English speaking individuals and those without cell phones. Educate people on the severity of smoke impacts using easy-to-understand, comparative risk language (e.g., equivalent to smoking a certain number of cigarettes a day) and publicize fresh air centers—both City-designated and informal ones like movie theatres.

3-7 Provide masks and air filters, with instructions on how to use them and information about their limitations, to the City's vulnerable populations. Develop a program for providing air filters at cost or a reduced cost.

Building and Environmental Design

3-8 Consider new development standards for City residents and businesses within the WUI, such as incorporating defensible space practices into landscape requirements for neighborhoods at increased risk of wildfire. Residential areas that should be considered for new standards include neighborhoods surrounding Lux Canyon, Saxony Canyon, the Manchester Preserve, and Escondido Creek. (CAP Strategy 5: Increased Wildfire Risk)

3-9 Support citywide tree planting efforts, as trees can settle particles in the air during wildfire-smoke episodes.

4. FLOODING – ONSHORE

Interagency Coordination

4-1 Coordinate with relevant agencies such as OES and the Encinitas Public Works Department to map and identify all critical facilities and infrastructure that may be compromised by increased flood risk. The City should plan accordingly for upgrades, relocation of facilities and infrastructure or identify beach nourishment projects to better prepare for increased risk of flooding events. (CAP Strategy 2: Increased Flood Risk)

4-2 Coordinate with relevant agencies such as FEMA, OES, and the Encinitas Fire and Marine Safety Department to better plan and prepare emergency services required for flooding events, including evacuation, flood management, and recovery services. (CAP Strategy 3: Increased Flood Risk.

Planning and Engineering

4-3 Conduct a comprehensive assessment of all stormwater and wastewater infrastructure in the City and analyze how this infrastructure may be affected or compromised by an increased risk of flooding events. (CAP Strategy 1: Increased Flood Risk)

4-4 Continue local and regional ecosystem restoration efforts to increase climate resiliency for flooding events within the City. (CAP Strategy 4: Increased Flood Risk)

4-5 Establish plans to stage equipment (e.g., portable pumps) in strategic areas before a storm event.

Education and Outreach

4-6 Launch a consumer education campaign on flood insurance and flood preparedness. (MHMP Goal 7: Objective 7E)

Building and Environmental Design

4-7 Implement requirements for managing runoff from impervious surfaces using green infrastructure. Consider design modifications for infiltration-based green infrastructure in areas with shallow groundwater.

4-8 Limit or prohibit the use of fill to elevate structures.

4-9 Implement programs to encourage flood-proofing retrofits to existing buildings and redevelopment in flood-prone areas.

4-10 Implement requirements for flood-resistant designs:

a. Design structures with flood-resistant or flood-proof building materials to enable floodable designs (those that allow for a certain level of flooding with no or negligible damage).

b. Flood-Resistant Building Materials use flood-resistant or flood-proof building materials in construction or renovation to enable floodable designs.

c. Floodable Designs – require building designs (including the use of flood-resistant building materials) that allow for a certain level of flooding with no or negligible damage.

4-11 Continue to manage and implement Urban Greening for Stormwater Management Best Management Practices ad described in the City's BMP Design Manual – Chapter 7 Engineering Design Manual. As managed by the City's Stormwater Division and implemented.[139] C

5. COASTAL FLOODING AND BLUFF EROSION

Interagency Coordination

5-1 Coordinate with regional and local transportation agencies to ensure redundancy of high-use transportation corridors to allow for continued access and movement in the event of an emergency.

5-2 Coordinate with regional and local transit providers to ensure that transit services can continue to operate during and after extreme events by coordinating with regional transit providers to identify alternative routes and stops if the primary infrastructure is damaged or closed as a result of extreme events.

[139] The City's Stormwater Division manages the program while the City's Development Services Engineering Division implements to the program.

Planning and Engineering

5-3 Support and monitor ongoing analysis of sea-level rise data relevant to the City's planning efforts. Continue to incorporate the most up-to-date information on sea-level rise into relevant planning documents, including the Safety Element of the City's General Plan. (CAP Strategy 1: Coastal Erosion and Predicted Sea-Level Rise)

5-4 Continue to implement current efforts focused on beach nourishment, coastal bluff improvements and wetland restoration, prioritizing projects that will mitigate the impacts of sea-level rise, including coastal erosion and saltwater inundation. (CAP Strategy 4: Coastal Erosion and Predicted Sea-Level Rise)

5-5 Coordinate with relevant agencies, including FEMA and OES, to prepare and plan for the impacts of coastal erosion, sea-level rise, and coastal storm surge, continuously updating and utilizing the most relevant strategies and guidance provided by relevant agencies and institutions. (CAP Strategy 5: Coastal Erosion and Predicted Sea-Level Rise)

5-6 Continue to map critical infrastructure in the City that may be impacted by sea-level rise and work with City's Public Works Department to plan accordingly. (CAP Strategy 6: Coastal Erosion and Predicted Sea-Level Rise)

5-7 Incorporate sea-level rise effects into capital improvement plans.

5-8 Update maintenance protocols to incorporate projected climate change effects and evaluate the potential for increased frequency or need to maintain transportation infrastructure.

5-9 Consider the best available and most recent scientific information with respect to the effects of long-range sea-level rise when establishing sea-level rise maps, scenarios, signals, and decision points. The City shall also support scientific studies that increase and refine the body of knowledge regarding potential sea-level rise in Encinitas and possible responses to it. As necessary, policies related to sea-level rise should be reevaluated and modified.

5-10 Safeguard groundwater supply against contamination, degradation, or loss due to flooding or sea-level rise.

5-11 Revise zoning regulations to include provisions for reasonable interim uses for properties where the highest and best use allowed by zoning is not presently attainable due to natural hazards (including sea-level rise) and other factors. Examples of reasonable interim uses include contractor's yards, modular offices and storage, and outdoor recreation.

5-12 Consider implementation of additional Overlay Zones that superimpose additional regulations on an existing zone based upon special characteristics of that zone:

a. Sea Level Rise Zone – areas that will be inundated by sea-level rise (based on agreed upon models and scenarios).
b. Protection Zone – areas with critical infrastructure and dense urban development, where the locality will permit coastal armoring; local governments could require soft-armoring techniques to be employed where feasible.
c. Accommodation Zone – areas to allow new development but may limit the intensity and density of new development, limit hard shoreline armoring, and require that structures be designed or retrofitted to be more resilient to flood impacts.
d. Retreat Zone – areas prohibiting hard armoring will limit or prohibit rebuilding of damaged structures or require the removal or relocation of structures that become inundated.
e. Preserve Zone – areas to preserve and enhance important natural resources, ecosystems, habitats, or flood buffers.

5-13 Consider implementation of additional setbacks based upon special characteristics of the area:

a. Fixed Mandatory Setbacks – require that all structures, including sea walls, be set back a specific distance from a predetermined point.
b. Erosion-Based Setbacks – determined by a projected shoreline position that assumes a specific increase in sea level and erosion rates over a specific period, such as the life of the structure.
c. Tiered Setbacks – require a lesser setback or buffer for smaller structures and a greater setback for larger structures that are more difficult to move if they become damaged and put more people at risk.
d. Buffer Zones for Vulnerable Areas – areas of land separating two distinct land uses that softens or mitigates the effects of one land use on the other.

Building and Environmental Design

5-14 Require applications for hard shoreline protection projects to demonstrate that nature-based alternatives are unavailable or will not provide the desired protection. Applicants should submit engineering reports and analyses of a range of living shoreline protection strategies explaining why a living shoreline approach is infeasible at the project location.

5-15 Encourage natural or nature-based infrastructure using natural ecological systems or processes to reduce vulnerability to climate change-related hazards while increasing the long-term adaptive capacity of coastal areas by perpetuating or restoring ecosystem services. Examples include:

a. Living Shorelines are any shoreline management system that is designed to protect or restore natural shoreline ecosystems through the use of natural elements and, if appropriate, manmade elements.
b. Wetland Restoration that allows[s] tidal wetlands to proliferate in areas that have been diked or otherwise altered from their original conditions.
c. Beach Nourishment/Replenishment to replace eroded sand or to protect against future erosion.
d. Dune Management/Restoration using engineered projects to restore eroded dune systems.
e. Sediment Management is a systems approach to deliberately manage sediments in a manner that maximizes natural and economic efficiencies to contribute to sustainable water resource projects, environments, and communities.

5-16 Maintain, repair, and raise shoreline structures.

5-17 Conduct a comprehensive assessment of shoreline structure conditions citywide to prioritize areas with deferred maintenance and other structural issues and identify ownership of each shoreline protection structure.

5-18 Establish and implement a new maintenance and repair plan for shoreline structures to reduce the amount of deferred maintenance. Focus maintenance and repair efforts on segments of the shoreline that could substantially deteriorate over time, exposing that area to overtopping and inundation if the structure fails.

5-19 Establish a strategy for addressing shoreline structures that are not owned by the City and consider adopting a policy that calls for the City to purchase the parcels when they become available.

Location-specific Sea Level Rise Adaptation Strategies

Beach Nourishment

Beach nourishment is a form of "soft" armoring that protects shorelines from erosion due to wave action and storm events by placing a replenishment of sand to increase a beach's seaward profile, length, height, and volume.

5-20 Sand supply for replenishment should be sourced by either dredging and pumping from an offshore donor site or by locating similar sediment at an upland site and transporting it to the nourishment location.

5-21 Implement a program where suitable soils excavated during private and public development projects can be used as a supply source. Said program shall also include a suitable location within the City's limits or in an area adjacent to the City, that has been deemed acceptable for purposes of storing this supply source.

5-22 Distribute the sand onto the beach or inland waterway system in a way that supports native conditions, littoral functions, recreation, and aesthetics.

Raise/Improve Seawalls

Seawalls are a form of "hard" armoring designed to reflect wave energy away from the property behind them. Seawalls are generally constructed of sheet piling (interlocking panels of metal, concrete, or other materials), driven far below grade (30 feet is typical), with a lesser portion extending above grade. Seawalls should be designed with the consideration of maintaining the existing natural coastal bluff aesthetic.

5-23 Seawalls should be used to buttress coastal bluffs with the dual purpose of protecting against wave action and supporting the bluff itself.

5-24 Design seawalls to brace near-vertical slopes and require the addition of embedded horizontal tiebacks with anchors covered with a natural bluff appearance

5-25 To slow damage from "scouring", a hard reinforcement material such as large cobble or revetment should be placed at the front of the toe to dissipate scouring energy.

Raise/Improve Revetments

Revetments are engineered slopes placed parallel to a waterline to attenuate wave energy and protect a shoreline. Large, angular rocks, concrete rubble, or gabions (large metal mesh containers filled with stone) are common revetment construction materials.

5-26 Raise or improve an existing revetment when it no longer provides sufficient protection against increasing storm surges or wave action. In these cases:

   a. Additional rock, cobble, or other materials may be added to the existing revetment to fill voids or increase its volume or length.

5-27 Revetment design must maintain a certain degree of permeability, as they are known to speed erosion by impeding the natural migration of river deposits and other upland sediment sources from reaching the open beach.

5-28 Revetments should be constructed to have a life expectancy of 30-50 years.

Groins

Groins are linear hard structures that extend perpendicular from a beach into the open ocean and form simple, physical barriers that interrupt littoral drift (naturally occurring longshore sediment movement.) Typically made of boulders, groins can also be constructed with manufactured sheet piles, concrete rubble, or large timbers.

5-29 New groin construction should look at offshore geography, tide data, and local wave energy to determine the appropriate height, width, length, and void size to achieve the desired results.

5-30 Permeability should be balanced between too little (unacceptable loss of beach on the downdrift side) and too much (not enough accretion on the updrift side to be effective.)

5-31 Consider implementing groins in conjunction with additional adaptation strategies such as beach nourishment, to mitigate beach erosion.

5-32 Place groins adjacent to estuaries, bays, and navigation channels, groins prevent sediment from accumulating in these waterways.

Raise Structures

The goal of raising a structure is to elevate the lowest living area floor to be above known flood levels, allowing its continued occupation/use, while flood waters flow unimpeded beneath or around it.

5-33 Allow the raising of existing structures as a retrofitting method for flood adaptation.

Remove Structures

Removing a structure from its location is the purposeful vacation from a hazard area and allows erosion to occur without intervention.

5-34 Structures can be removed by demolition, or by relocating them to a new site.

   b. Removal by demolition requires disposal of all debris, and disconnecting-capping gas, power, and water utilities. Earth-moving equipment is then used to backfill foundation or basement voids and re-grade the parcel.

6. LIQUEFACTION

Planning and Engineering

6-1 Design and implement Geological Hazard Abatement Districts (GHADs) to prevent, mitigate, abate, or control geologic hazards.

Building and Environmental Design

6-2 Promote retrofit efforts to reduce the impact of earthquakes and liquefaction. Explore incorporation of new requirements for new development and redevelopment permits to increase building resilience to liquefaction.

CONCLUSION

Adapting to a changing climate requires proactive planning to ensure protection of people, environmental resources and development. No single category of action(s) is considered “better”, or “best”, as different types of actions are appropriate for different locations and for different vulnerabilities and resource protection goals. Additionally, approaches can change over time depending on resources available as well as community goals and needs. In many instances, a hybrid approach to adaptation that utilizes actions across multiple categories is necessary to reduce vulnerability.

The effectiveness and ease of implementation for many actions are contingent upon decisions made around other actions. So, development and consideration of larger strategies (groups or series of actions) which can get implemented over space and time may be more effective and efficient. These larger strategies are ideally designed to be robust for the most likely future scenarios and/or can be modified or adjusted at key junctures in the future. It is essential to identify in advance how these changes would be implemented and when these changes would need to occur to help the City plan for, prioritize, and stagger investment.