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## CLIMATE CHANGE VULNERABILITY, RESILIENCY, AND ADAPTATION



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## Introduction

The State has identified the changing climate as an issue that will have a wide variety of impacts on human health and safety, the economy, water supply, ecosystems, habitats, and the provision of basic services. Since 2006, the State has completed a series of studies documenting existing and potential climate change impacts in the county - including in the unincorporated county - and around the state. These potential impacts and the County's current and potential future efforts and strategies to increase adaptation and resilience are discussed in this chapter.

The State has adopted a climate adaptation strategy and adaptation guide. In addition to providing guidance, the State requires local governments to identify potential local impacts from a changing climate and incorporate climate adaptation and resiliency strategies into key planning documents such as general plans.

This adaptation planning process includes a total of nine steps as outlined in Figure 4.1. These steps can be grouped into three phases: assessment of vulnerability, development of adaptation strategies, and implementation.

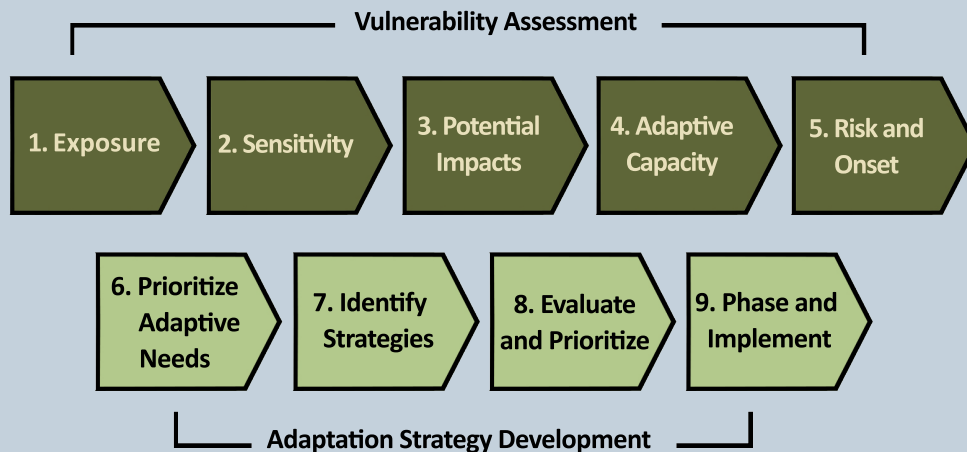


Figure 4.1 The Nine Steps in the Adaptation Planning Process

- **Phase One – Vulnerability Assessment:** The California Energy Commission (CEC) tool, Cal-Adapt, was used to conduct the Vulnerability Assessment of potential future local and regional impacts from a changing climate on the unincorporated county. This assessment identified a range of direct potential impacts such as increasing temperatures, annual precipitation changes, and sea-level rise, and indirect impacts such as increased risk of wildfires that could have negative effects on the health, economy, and

environment in the unincorporated county. The detailed findings from this Vulnerability Assessment can be found in Appendix D.

- **Phase Two – Adaptation Strategy Development:** During this phase, climate adaptation strategies and measures are identified and prioritized to protect county populations and County assets that may be vulnerable to climate change. These strategies and measures are intended to increase the capacity to prepare for, respond to, and adapt to a changing



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climate. Many adaptation strategies interface with multiple resources areas and should be aligned with other county planning efforts to be effective.

- **Phase Three – Implementation:** This is the point in the process where the implementation roadmap is created. This will include certain on-going initiatives, such as updating the county's portion of the the Multi-Jurisdictional Hazard Mitigation Plan (MHMP),

Local Coastal Program, and the Safety Element of the General Plan as required by Senate Bill 379. Many of the Climate Action Plan **greenhouse** gas (GHG) reduction strategies and measures themselves will have important adaptation and resilience co-benefits. This chapter includes a more comprehensive list of potential implementation actions that the County will consider to increase climate adaptation and resiliency.

## Summary of Climate Change Effects and Vulnerability Assessment

This section summarizes the results of the Vulnerability Assessment, which includes identification of local exposure to a changing climate and related effects, an assessment of potential areas of sensitivities, and consideration of how likely and quickly impacts will occur. The complete Vulnerability Assessment, which follows the first five steps of the Adaptive Planning Guide's adaptation planning development, can be found in Appendix D. More specific details on the historical timeframes referenced in the following sections can be found in Appendix D.

Where possible, effects of a changing climate in the county are characterized for two periods of time: mid-century (around 2050) and the end of the century (around 2100). Historical data are used to identify the degree of change for these two future periods in time.

### Effects of a Changing Climate

The first step in assessing vulnerability is to identify how the county is exposed to effects from a changing climate now and into the future. To begin assessing potential impacts over time, the county used Cal-Adapt, a climate

change scenario planning tool developed by CEC and the University of California, Berkeley, Geospatial Innovation Facility. Cal-Adapt downscales global climate simulation model data to local and regional resolution under both high and low global GHG emissions scenarios. Results from both emissions scenarios are considered in this summary and distinguished, where possible.

The direct, or primary, changes analyzed for the county include average temperature, annual precipitation, and sea-level rise. Secondary impacts, which can occur because of individual changes or a combination of these changes, are also assessed and include extreme heat and its frequency, wildfire risk, and changes in precipitation and hydrology (California Natural Resources Agency [CNRA] 2012:16-17).

### Increased Temperatures

As described in this paragraph, annual temperatures are projected to climb steadily. The county's historical average annual maximum temperature, based on data from 1950 to 2005, is 74.9 degrees Fahrenheit (°F). Under the Low-Emissions Scenario (where emissions will peak at around 2040 and then decline), annual average maximum temperature is projected to increase to 79.8



°F by 2099, an increase of 4.9 °F (CEC 2017a). The annual average maximum temperature under the High-Emissions Scenario (where emissions continue to rise strongly through 2050 and plateau around 2100), is projected to increase 9.9 °F to 84.8 °F by the end of the century (2099) (CEC 2017b).

The county's historical average annual minimum temperature, based on historical data from 1950 to 2005, is 47.8 °F. Under the Low-Emissions Scenario, annual minimum temperature is projected to increase to 53.3 °F by 2099, an increase of approximately 5.5 °F (CEC 2017c). The annual average minimum temperature under the High-Emissions Scenario is projected to increase to 57.7 °F by 2099, an increase of approximately 9.9 °F (CEC 2017d).

These increasing temperatures can exacerbate air quality issues such as increasing levels of ozone and particulate matter in certain areas leading to public health issues, including increased rates of cardiovascular and respiratory diseases, cancer, allergies, and cataracts (CNRA 2012: 31).

## Increased Frequency of Extreme Heat Events and Heat Waves

Cal-Adapt defines the "extreme heat" day threshold for the county as 96.3 °F or higher. Historically, when averaged over the land area of the unincorporated county, the county has experienced an average of 4.2 extreme heat days a year. The number of extreme heat days is projected to increase substantially by 2099. Under the Low-Emissions Scenario, the county is projected to experience an average of 33 extreme heat days between 2090 to 2099, an increase of about 29 days (CEC 2017e). Under the High-Emissions Scenario, the county is projected to experience an average of 67 extreme heat days between 2090 to 2099, an increase of about 63 days (CEC 2017f)

Heat waves, which can be defined as five or more consecutive extreme heat days, have been historically

infrequent in the county, with no more than two heat waves occurring in a year. However, a significant rise in the frequency in heat waves is projected under both emissions scenarios. Under the Low-Emissions Scenario, projections show an increase of heat wave events with around three per year at the middle of the century and up to seven per year in 2090 (CEC 2017g). The High-Emissions Scenario also shows an increase in annual heat wave events, with up to five heat wave events occurring annually by mid-century and as high as 16 heat wave events occurring annually by the end of the century (CEC 2017h). Along with an increased frequency of heat events, heat waves are also projected to occur both earlier and later in the season, which historically started in late May/early June and ended in mid-September.

Heat waves have been historically infrequent in the county; however, a significant rise in the frequency in heat waves is projected to occur due to the changing climate (CNRA 2012:5).

## Changes to Precipitation Patterns

The region's water supply is partially drawn from the State Water Project, which depends on spring and early-summer snowmelt in the Sierra Nevada. While projections generally show little change in total annual precipitation in California, even modest changes could have a significant effect on California's ecosystems that are conditioned to historical precipitation levels. Intense rainstorms following drought conditions can cause severe runoff situations. In 2016, a number of intense rainstorms caused serious runoff, which impacted many park facilities and trails and caused severe erosion and sink holes. Further, traditional agricultural irrigation practices may become obsolete and wasteful as precipitation events become less reliable combined with increased demand associated



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with population growth. Changes in weather patterns resulting from increases in global average temperatures could also result in a decreased volume of precipitation falling as snow in California and an overall reduction in snowpack in the Sierra Nevada. Based upon historical data and modeling, the California Department of Water Resources (DWR) projects that the Sierra snowpack will decrease by 25% to 40% from its historic average by 2050 and 48% to 65% by 2100 (DWR 2008:4, 2013:3-64).

Reduced precipitation could lead to higher risks of drought, while increased precipitation may cause flooding and soil erosion (CNRA 2014:25).

The county is not located in an area where snow typically accumulates; however, major water districts and utilities in the county receive and depend on a notable amount of water from the State Water Project (i.e., 20%), which depends on spring and early-summer snowmelt in the Sierra Nevada for water supply. Additionally, 64% of water supply comes from imports from the Colorado River, 70% of which heads in the high elevations of the Rocky Mountains (San Diego County Water Authority [SDCWA] 2016, Christensen et al. 2004).

The Carlsbad Desalination Plant, which became operational in December 2015, provides a local drought-proof source of potable water. The facility can provide up to 50 million gallons per day of water, representing up to 10% of the region's drinking water (Poseidon Water 2017). The county overlays 37 discrete groundwater basins, which supply about six percent of the county's water supply. The State has designated four of these basins as medium-priority and subject to the Sustainable Groundwater Management Act (SGMA) (i.e., Borrego Valley, San Diego River Valley, San Luis Rey Valley, and San Pasqual Valley).

Cal-Adapt's annual averages tool depicts an annual average precipitation in the county from 1950 to 2005 of 14.6 inches. Under the Low-Emissions Scenario, annual precipitation in the county is projected to be 15.6 inches per year by the end of the century (2099), a rise of one inch (CEC 2017i). Under the High-Emissions Scenario, annual precipitation is projected to be 19.3 inches by the end of the century (2099), a rise of 4.7 inches (CEC 2017j).

## Increased Wildfire Risk

The county's topography consists of a semi-arid coastal plain and rolling highlands which, when fueled by shrub overgrowth, occasional Santa Ana winds and high temperatures, creates an ever-present threat of wildland fire. Extreme weather conditions such as high temperature, low humidity, and/or winds of extraordinary force may cause an ordinary fire to expand into a less controllable, more intense fire.

According to the MHMP prepared by the Governor's Office of Emergency Services (OES), the county (including the incorporated cities) have a history of wildfires, with more than 1,000,000 acres of the region's 2,897,000 acres burned since 1950 (OES 2015:4-43).

Increased temperatures and changes in precipitation patterns associated are expected to increase the risk of wildfire in the county. Cal-Adapt's wildfire tool estimated an average of 21,042 acres burned each year from 1950 through 2005 due to wildfire in the county. Under the Low-Emissions Scenario, the tool projects an annual

In 2010, 91% of unincorporated county residents, lived in Very High, High, and Moderate Fire Hazard Severity Zones compared to the statewide average of seven percent.



average of 17,971 acres of burned land by 2050 and 24,546 acres by 2099. Under the High-Emissions Scenario, an annual average of 20,972 acres are expected to burn in 2050 increasing to 29,499 acres by 2099 (CEC 2017).

## Increased Likelihood of Flooding

A changing climate is likely to lead to changes in the frequency, intensity, and duration of extreme events, such as sustained periods of heavy precipitation and increased rainfall intensity during precipitation events. These projected changes can lead to increased flood magnitude and frequency (Intergovernmental Panel on Climate Change 2014:14).

Average annual precipitation in the region ranges from 10 inches on the coast to approximately 45 inches on the highest point of the Peninsular Mountain Range that transects the county, and three inches in the desert east of the mountains.

In 2015, about 17,000 people and 7,000 residential and commercial buildings in the unincorporated county were located within the 100-year floodplain (OES 2015:4-81).

Several factors determine the severity of floods, including rainfall intensity and duration. Flash floods occur when a large amount of rain falls over a short period of time. The National Weather Service's definition of a flash flood is a flood occurring in a watershed where the time of travel of the peak of flow from one end of the watershed to the other is less than six hours.

## Sea-Level Rise

According to the 2015 MHMP for the region, sea levels measured in La Jolla show a six-inch rise over the last century (OES 2015). The average global sea level rose approximately 7 inches during the last century. If sea-level changes along the California coast continue to reflect global trends, sea level along the state's coastline in 2050 could be 10-18 inches (0.25-0.45 meters [m]) higher than in 2000, and 31-55 inches higher (0.78-1.4 m) than 2000 levels by the end of this century (CEC 2012:9).

Only 1.64 square miles (1,050 acres) of unincorporated areas exists within the coastal zone, none of which contains coastline. As such, sea-level rise impacts to the unincorporated county would be substantially less as compared to the region (County 2017).

## Current Actions

The County has already begun to address many of the challenges associated with a changing climate through existing local policies, plans, programs, resources, and institutions. On a planning level, the county addresses current and future impacts related to existing natural hazards, as evidenced by the update to the MHMP in 2015, which identified current hazard risks and mitigation strategies for flooding, sea-level rise, extreme heat, drought, earthquakes, and fires.

Furthermore, the General Plan includes policies aimed at reducing local contributions to GHG emissions and encourages sustainable land development, mobility, water use, waste management, and energy use; best management practices; and ecological stewardship (County 2011). It also covers vulnerable populations, including policies aimed at achieving more equitable



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outcomes for low-income populations in the county, as well as its aging population that requires better access to public services and housing.

In addition to planning efforts, the County has embarked on a number of climate adaptation-related efforts, which are summarized in the following sections.

The County adopted a landscaping ordinance to conserve water use for landscaping through efficient design and technology, while respecting the economic, environmental, aesthetic, and lifestyle choices of individuals and property owners (County Code Title 8, Division 6, Chapter 7 Section 86.701 et seq.).

## Efforts Related to Increased Temperature and Extreme Heat Frequency

The County does not currently have long-term mitigation plans or adaptation strategies in place for extreme heat, due to historically moderate temperatures. However, the County does have a Comprehensive Excessive Heat Response Plan for emergent heat waves. Additionally, the County's Public Health Services Department is currently engaged in evaluating the county's vulnerability to temperature-related health risks and plans to pursue additional adaptation planning to prepare the county for high heat associated with a changing climate. The MHMP recognizes extreme heat as a hazard for the county and Cool Zones are available during periods of extreme heat.

## Efforts Related to Changes in Precipitation Patterns and Water Supply

The County and local agencies have several water conservation programs, including rebates for appliances and water saving devices, guidance on deployment of greywater systems, recycled water programs, and

landscaping and watershed ordinances. However, the county is still currently vulnerable to water supply issues due to drought, increased temperatures, and other factors. The primary local purveyor of water, SDCWA, has developed a Water Shortage and Drought Response Plan that outlines a series of potential actions to respond to a shortage of imported water supplies due to drought conditions. With the construction of the planned local water supply projects, as specified by the SDCWA's Urban Water Management Plan and once the Metropolitan Water District's Integrated Water Resources Plan is fully implemented, no water shortages are anticipated within the SDCWA's service area through 2030 (SDCWA 2012). The Integrated Water Resources Plan is a blueprint for long-term water supply reliability in Southern California. In addition, the region can rely on local drought-proof sources of water such as the Carlsbad Desalination Plant for a portion of the demand. However, impacts from a changing climate are expected to occur on a longer timescale as previously described. Therefore, continued long-term responses from local agencies will be necessary to adapt to changing water supplies. The State has identified four groundwater basins as medium-priority and as subject to the SGMA. Notably, groundwater sources represent approximately eight percent of the county's water supply (see Appendix A), but groundwater is the only source of water for some residents in the eastern portion of the county.

## Efforts Related to the Increased Risk of Wildfire

The San Diego region is at high risk for wildfires. Programs and policies in place show a current capacity to address this risk. Increased temperatures and potential prolonged periods of drought will create a more wildfire-prone landscape. The county will need to continue to adapt to this projected increase.



## Efforts Related to The Increased Likelihood of Flooding

Levees and structures have been built to protect the county from a 100-year flood event and the Flooding Management Plan addresses structural weaknesses in flood infrastructure. Also, the 2014 San Diego County Emergency Operations Plan, combined with the completed evacuation plans in the county, provides important details regarding flood protection and evacuation. However, evacuation plans have not been completed for all unincorporated communities within the county. The systems in place will need to be updated to account for potentially more intense storms.

## Efforts Related to Sea-Level Rise

Less than one percent of the region's population (7,498 residents) live in areas at risk of inundation from a 55-inch rise in sea level by 2100 (California Building Resilience against Climate Effects [CalBRACE] 2016). Even fewer residents in the unincorporated county live within the coastal zone. As a result, the county is not considered high risk for sea-level rise related impacts; however, many residents of the unincorporated county commute to jobs in incorporated cities which are affected by sea level rise. Inundation of roads and electrical and natural gas infrastructure could affect the day-to-day functions of unincorporated county residents. More data and studies will need to be conducted as environmental conditions change in the coming years.



*Increased temperatures and potential prolonged periods of drought create a more wildfire-prone landscape.*



Resiliency and Adaptation Strategies

This section outlines strategies for the County to consider in the next update of the MHMP and the Safety Element of the General Plan to further its climate adaptation efforts. These strategies can build upon current efforts to be more sustainable, adaptive, and forward-thinking. The General Plan contains several policies to reduce local contributions to GHG emissions and encourage sustainable land development, mobility, water use, waste management, and energy use; best management practices; and ecological stewardship (County 2011). The strategies within this section represent potential opportunities to prepare for the future effects of a changing climate.

Other County plans, programs, efforts, and policies can support this vision and contribute to addressing risks and vulnerabilities.

Adaptation strategies are classified into five categories to address identified vulnerabilities: temperature, wildfire, precipitation, flooding, and sea-level rise. Each category considers programs and policies the County may implement to remain responsive to the challenges created by changing weather patterns. Strategies also have the potential to provide other important benefits to the community, or co-benefits. These benefits are identified within each strategy, where applicable.

Strategies that can be considered by the County are categorized as follows:

- Prepare for Increases in Temperatures and Extreme Heat
- Prepare for Changes in Precipitation Patterns and Water Supply
- Prepare for Increased Wildfire Risk
- Prepare for Increased Flood Risk
- Prepare for Sea-Level Rise

Co-Benefits:

- Lowered Energy Demand
- Lowered Energy Bills
- Lowered Building and Operating Costs
- Reduced Fossil Fuel Reliance
- Improved Air Quality
- Improved Quality of Life



## Prepare for Increases in Temperatures and Extreme Heat

Temperature-related impacts due to changing weather patterns are likely to affect the unincorporated areas in several ways. Increased average temperatures, along with more frequent extreme heat events, are likely to increase already high temperatures, in what are known in developed areas as urban heat islands. Built-up areas tend to have a prominence of asphalt and less vegetation which create, intensify, and retain heat, a phenomenon known as the Urban Heat Island Effect (UHIE). Other human activities that contribute to the UHIE include combustion-engine vehicles and air conditioning. To help curb the UHIE in developed areas, the County can incorporate “green” and “cool” infrastructure into new and existing development.

Examples of green infrastructure include trees and climate-appropriate landscaping for increased shade and reduced pavement, complete streets (through reflective pavement, landscaping, and green infrastructure), rain gardens, and rooftop gardens. The County can also incorporate cool pavement and cool roofs (with high reflectivity) in new and existing development while also including more shade trees in parking lots. Additionally, implementation of electric vehicle charging infrastructure (e.g., on carports) and improved transit would serve to reduce the UHIE as well.

The county’s agricultural industry will also be affected by extreme heat. Shorter, warmer winters, including warm nighttime temperatures may reduce or eliminate the required number of “chill hours” that specialty and other crops need to bud. Measures to improve the adaptive capacity of the county while maintaining a thriving agricultural industry will involve transitioning to the production of crops more appropriate for a warmer climate.

Understanding that health-related risks increase along with average temperatures, the County will continue to collaborate amongst various departments to ensure that the proper outreach programs and plans are in place to deal with heat-related illnesses associated with warming.

The following strategies can help the County address heat-related impacts:

- Collaborate with regional partners on temperature and extreme heat preparedness initiatives, such as:
  - Mapping of critical infrastructure vulnerable to extreme heat events;
  - Outreach programs for outdoor workers and others susceptible to extreme heat;
  - Education of disadvantaged communities on heat-related risk and methods to prevent heat-related illness;
  - Updates to the Excessive Heat Response Plan prepared by the Health and Human Services Agency;
  - Research on the effects of a warmer climate on the agricultural industry; and
  - Understanding the tolerance of current crop mixes to withstand increased temperatures.

## Prepare for Changes in Precipitation Patterns and Water Supply

The unincorporated area’s exposure to water supply constraints and the need to protect water quality may increase with a changing climate. Increased temperatures, particularly in the Sierra Nevada, which supports the State Water Project, and Rocky Mountains, which heads the Colorado River, will lead to earlier and faster snowmelt,



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which may leave the county vulnerable during dry months (July-September). Further, as temperatures rise, precipitation will fall more often at high elevations as rain rather than snow, which will reduce the Sierra Nevada and Rocky Mountain snow packs that the region needs for surface water supply. These changes are also likely to exacerbate drought in the state, which is already historically vulnerable to prolonged dry periods.

These conditions, if combined with a business-as-usual approach, will result in potentially severe impacts on the county's agricultural and operations sectors. Increased temperature will increase rates of evapotranspiration (i.e., transfer of water from land to atmosphere, from plants), which will increase water demand; thus, requiring improved irrigation systems and more resilient water supplies. To prepare for these conditions, the County, SDCWA, local water districts, and others will continue to evaluate the vulnerabilities of the county's water supply systems and networks through collaboration with water-related federal, State, and local agencies and organizations. These collaborative efforts will include the deployment of innovative options to improve water-use efficiency and conservation capacity to meet future water demand.

The following strategies can help the County address water supply issues:

- Collaborate with regional partners on water supply systems and conservation efforts, such as:
  - Evaluation of water supply systems and network vulnerabilities;
  - Use of on-site greywater and rainwater reuse, and recycled water systems;
  - Transfer of knowledge and technologies to assist farms with new production methods and drought-tolerant species;

- Continued efforts to reduce potable water use in outdoor landscaping;
- Expansion of existing water conservation education outreach programs for residents and businesses; and
- Collaboration with federal, State, and local agencies and organizations to identify future water supplies, explore alternative supply sources, and improve capacity.

## Prepare for Increased Wildfire Risk

The county is already at high risk of wildfire. The unincorporated areas contain high concentrations of Moderate, High, and Very High Fire Hazard Severity Zones (California Department of Forestry and Fire Protection 2007). In 2010, 91% of unincorporated county residents lived in Very High, High, and Moderate Risk wildfire areas as compared to the statewide average of seven percent (CalBRACE 2016; OES 2015:493). Increased frequency and intensity of wildfires will directly affect the safety of populations living within or near wildland areas (i.e., wildland-urban interface) prone to wildfire.

In addition to increased threats to human safety, the increased risk of catastrophic wildfire results in the release of harmful air pollutants into the atmosphere, which dissipate and can affect the respiratory health of residents across a broad geographical scope. Particulate matter (soot and smoke), carbon monoxide, nitrogen oxides, and other pollutants are emitted during the burning of vegetation, and can cause acute (short-term) and chronic (long-term) cardiovascular and respiratory illness, especially in vulnerable populations such as the elderly, children, agricultural and outdoor workers, and those suffering from preexisting cardiovascular or respiratory conditions.



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. Furthermore, due to historical forest management trends over the past century, increased temperatures, and more frequent drought, California wildfires are characteristically hotter and more intense. As such, soil structure and moisture retention are damaged leading to increased susceptibility to erosion of landscapes. These conditions may result in adverse impacts to hydropower infrastructure.

To prepare for these conditions, the County and other relevant agencies and organizations will need to adopt measures to reduce the potential for catastrophic wildfires to occur and the adverse health impacts associated with wildfire. Additionally, to preserve water quality and ecological health, the County will engage in restoration efforts in previously burned and future burn areas.

The following strategies can help the County address increased wildfire risks:

- Collaborate with regional partners on wildfire prevention and preparedness, such as:
  - Mapping to identify locations that are newly at risk, or at higher risk for fire hazards;
  - Mapping of critical infrastructure in previously burned areas and in locations vulnerable to wildfires, and upgrades to infrastructure where applicable;
  - Strategy coordination with federal, State, and local agencies to establish ecological recovery programs;
  - Coordination and improvement of emergency preparedness systems; and
  - Expansion of existing underground utilities program.

## Prepare for Increased Flooding Risk

Unincorporated areas of the county are vulnerable to flash flooding. In 2015, about 17,000 people and 7,000 residential and commercial buildings were in the 100-year floodplain and approximately 20,000 people and 8,500 residential and commercial buildings were located in the 500-year floodplain in the unincorporated areas (OES 2015:4-81). Further, infrastructure (e.g., roadways, power lines) can be damaged during flood events, which will disrupt communications, energy transmission, public services, and transportation systems.

Floodwater can interact with sources of pollution and distribute hazardous pollutants locally and regionally. The resultant water contamination may result in human health impacts, as well as degradation of ecosystems. Further, catastrophic flooding can erode topsoil, destroy crops, and impair ecosystem health.

The County could use several measures to restore the natural environment to combat flooding. Identifying streamside areas that could be restored will not only buffer buildings, roads, and crops from floods, but will also improve natural landscapes and air quality.

The following strategies can help the County prepare for increased flooding risks:

- Collaborate with regional partners on flooding preparedness initiatives, such as:
  - Evaluation of and improvements to stormwater infrastructure for high-intensity rainfall events;
  - Improvements to sewage and solid-waste management infrastructure;
  - Use of pervious pavements and landscaping in developed areas;
  - Mapping of critical facilities and infrastructure



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locations vulnerable to flooding and upgrade and/or relocation of infrastructure where applicable;

- Replanting of bare or disturbed areas;
- Implementation of the MHMP to address climate change-related flooding impacts; and
- Improve flood warning and information dissemination.



*Unincorporated areas of the county are vulnerable to flash flooding.*

## Prepare for Sea-Level Rise

Less than one percent of the region's population (7,498 residents) live in areas at risk of inundation from a 55-inch rise in sea level by 2100 (CalBRACE 2016). This rise in sea level may put these residents at risk of physical injury and property loss. Moreover, sea level fluctuates to higher-than-average levels due to high astronomical tides, wind, waves, and storm surges. Presently, the San Diego coast experiences one hour of high sea levels per year on average; however, by 2030, high sea levels are expected to occur 12 hours per year on average and 62 hours per year by 2050 (OES 2015). Notably, only 1.64 square miles (1,050 acres) of unincorporated land exists within the coastal zone, none of which contains coastline. As such, sea-level rise impacts to the unincorporated areas will be substantially less as compared to the region as a whole (County 2017), though impact to the livelihood and day-to-day activities of unincorporated county residents will likely be affected through the inundation of infrastructure in incorporated cities.

The following strategies can help the County address risks related to sea-level rise:

- Collaborate with regional partners on sea-level rise preparedness initiatives, such as:
  - Mapping to identify areas affected by sea-level rise;
  - Support and monitor ongoing analysis of sea-level rise data; and
  - Updates to the County's MHMP to incorporate sea-level rise.