CLIMATE AND HEALTH PROFILE REPORT, CONTRA COSTA COUNTY (EXAMPLE)

BACKGROUND: WHAT IS THE LINK BETWEEN CLIMATE CHANGE AND HEALTH?

What is global warming?

Modern life has been made possible by the burning of coal, natural gas, petroleum and other fossil fuels in our power plants, factories, businesses, farms, homes, and cars. Key by-products of energy production and consumption are carbon dioxide, methane, and other pollutants. These gases are called greenhouse or heat trapping gases because, as they mix in the atmosphere, they create barrier for solar radiation and heat produced by sun to escape the earth's surface. Over the last 150 years, and especially in the last few decades, measurements taken around the world show that on average the temperature of the atmosphere and oceans is gradually increasing. The average carbon dioxide concentration in the atmosphere topped 400 ppm in 2013, which far exceeds the range experienced over the last 650,000 years. [1, 2 p.435] An overwhelming consensus of scientists now warn that this warming is due to human activities and that if we do not curb our current carbon emissions, the increase in the planet's temperature will cause significant harm to natural systems and threaten our health and very existence.[2] Efforts to reduce carbon emissions, called mitigation, are imperative. Because carbon dioxide takes centuries to dissipate in the atmosphere, the increased levels already present will cause a certain amount of global warming and climate change in the immediate future that cannot be reversed. Adaptation is the term used to describe the measures we take to prepare and respond to these inevitable climate changes.

How does global warming impact climate and weather?

Changes in atmospheric and ocean temperatures affect how Earth's water behaves, and, as the atmosphere warms, it holds more water vapor. Along with temperature, the timing, amount, and the manner in which the water circulates (the hydrologic cycle) or covers the earth are part of what defines our climate and weather. Weather can be thought of the short term variability of local daily temperature, precipitation (rain, snow), wind, and events like storms (hurricanes, tornados, etc.) throughout a year. Climate can be thought of the general pattern on a larger geographic area and time scale usually in decades. California is unique in the United States and has Mediterranean type of climate with a distinct dry season (May to October) and wet season (November to April), which is modified by proximity to the coast or mountains or variable elevation.

How are future changes in climate predicted?

Scientists use historical weather data and mathematical models to describe historical trends and to predict the impacts of global warming.[3] Historical data show that on average sea levels are already rising, primarily from the expansion of water. Historical data also show that in the past century average temperatures are increasing, polar ice and glaciers are melting at increased rates, and snow pack in mountains is diminishing compared to time periods in which human-generated carbon emissions were relatively small.[2]

Climate models are a 3-D computer simulation over time of the earth's atmosphere and oceans taking into account solar radiation, surface reflection, circulating air masses and wind, heat stored in oceans, sea ice, evaporation from land surfaces and green plants, cloud cover, and other factors. A key input to climate projection models is the current and projected amount of carbon dioxide and other greenhouse gases emitted into the atmosphere.

The future amount of carbon emitted into the Earth's atmosphere has two broad drivers: 1) the dependence of economic growth on fossil fuels, and 2) the growth of the world's population. Based on the different combinations economic development strategies and population growth, scientists have constructed formal scenarios[4] of future carbon emissions during the 21st century and predicted their associated climate impacts compared to a 1990 baseline. Average global temperature is predicted to increase by 1.8°C (3.2° F) for an optimistic scenario called B2 in which world economies become much less dependent on fossil fuels and the world population levels off after 2050. In a pessimistic scenario called A2, climate models predict a 3.4° C (6.1° F) increase, based on the assumption that the world continues its path of fossil fuel intensive economic development and that the world population increases during the 21st century. On the backdrop of gradually increasing temperatures and sea levels, the climate models also predict an increase in the frequency and intensity of extreme weather events such a hurricanes, floods , and droughts. Using these global climate models as a starting point, the Scripps Institute at the University of California, San Diego has further refined climate impacts in California to 12 km grids (7 by 7 miles).[5] This allows California communities to have local data to inform their adaptation planning.

What are the general pathways that climate change impacts health?

Researchers have examined the pathways in which increased temperatures and hydrologic extremes can impact health and generally recognize three main pathways: direct exposures, indirect exposures, and socioeconomic disruption (Figure 1).

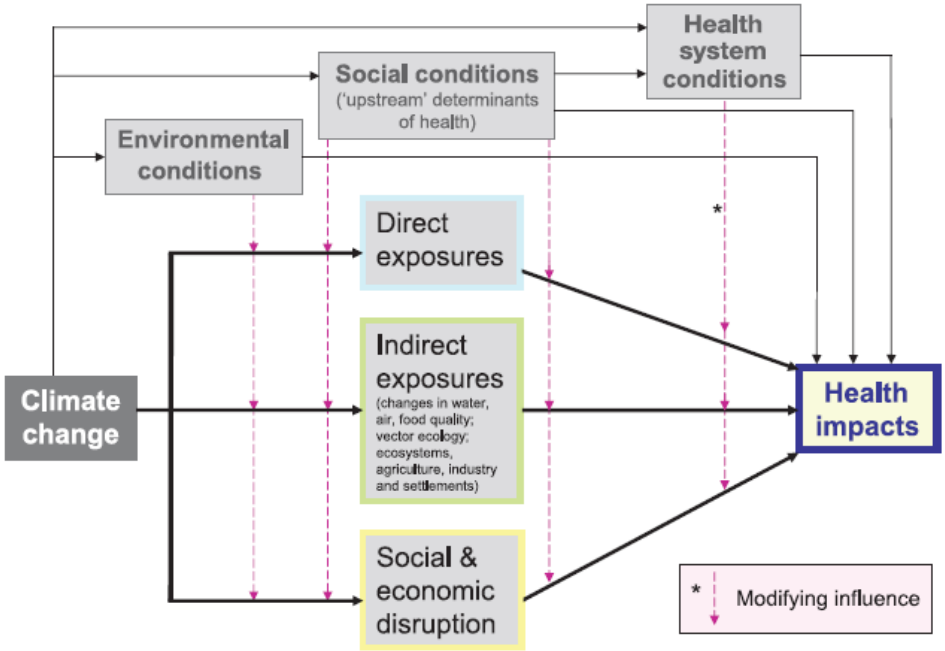

Figure 1. Climate change and general categories of health impacts

Based on the review of weather-related natural disasters and historical patterns[6, 7] and scientific judgment, public health researchers have suggested the nature and direction of health harms or benefits.[8, 9] The health risks associated with the following climatic factors in California stand out:

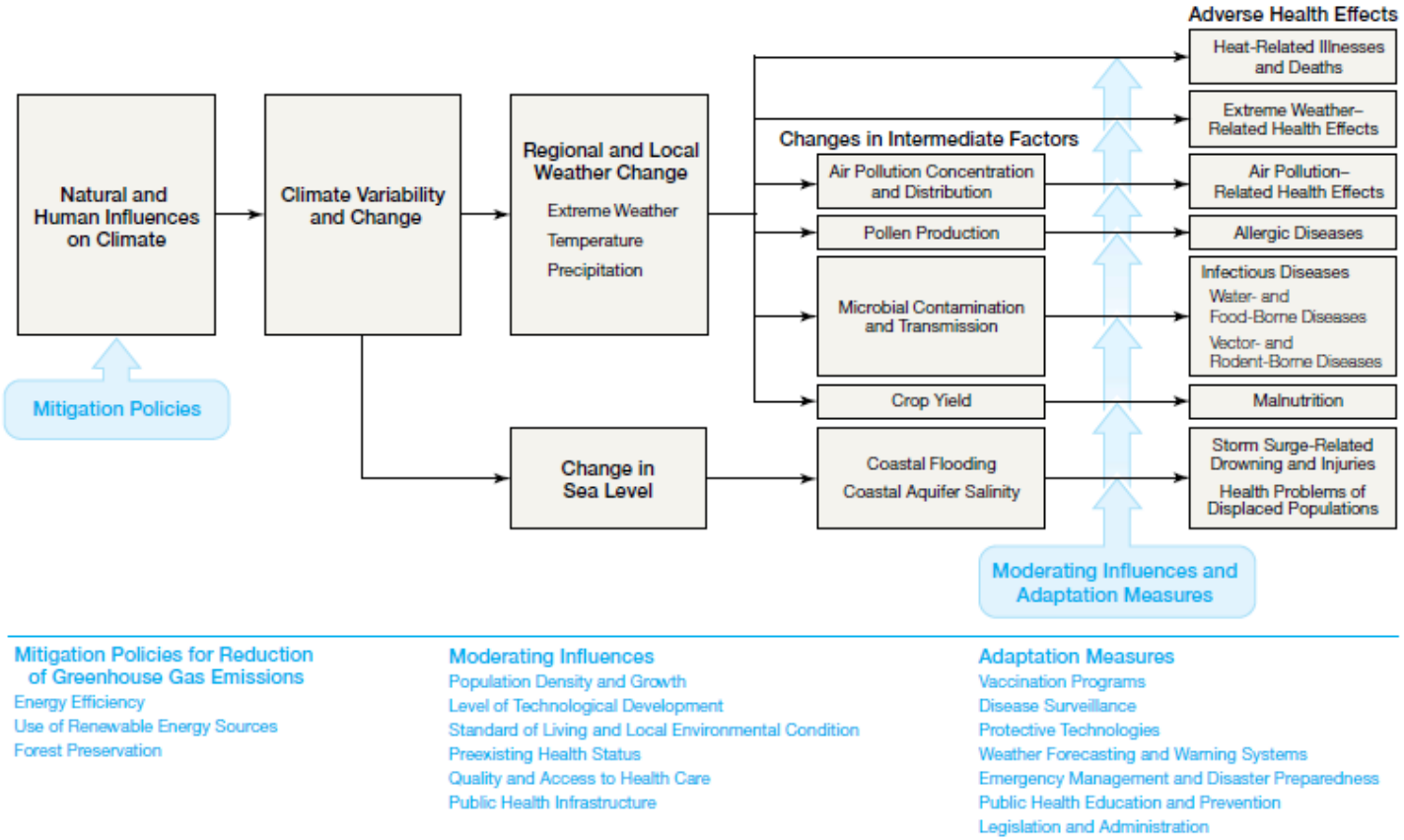

Figure 2. Direct and indirect impacts mediated through intermediate factors and moderating influences.

- Heat
- Wildfires
- Hydrologic extremes (sea level rise, storms and flooding, drought), and
- Social/economic stress or disruption

Extreme Weather-Related Injury, Mental Health and Displacement

Extreme weather events (storms, flooding) cause fatal and nonfatal injuries from drowning, being struck by objects, fire, explosions, electrocution, or exposure to toxic materials. A widespread weather-related natural disaster may destroy or ruin housing, schools and businesses and cause temporary or permanent displacement. Individuals and families experience post-traumatic stress, depression, and increased risk of suicide.[10, 11]

Direct and Indirect Health Impacts of Heat

Increased temperatures manifested as heat waves and sustained high heat days directly harm human health through heat-related illnesses (mild heat stress to fatal heat stroke) and the exacerbation of pre-existing conditions in the medically fragile, chronically ill, and vulnerable.[12, 13] Increased heat also intensifies the photochemical reactions that produce smog and ground level ozone and fine particulates (PM2.5), which contribute to and exacerbate respiratory disease in children and adults. Increased heat and carbon dioxide enhance the growth of plants that produce pollen, which are associated with allergies. Increased temperatures add to the

heat load of buildings in urban areas and exacerbate existing urban heat islands adding to the risk of high ambient temperatures.

Direct and Indirect Health Impacts of Hydrologic Extremes and Heat

Lack of moisture increases the risk of wildfires [14], already at a severe level in California due to a current multiyear year drought and decades of fuel accumulation from historical forestry and fire suppression practices. Devastating wild fires like the Rim Fire of 2013 impact watersheds and increase the risk of land-or mudslides, and sediment in run-off that reduce water quality. In addition to fire-related injuries, local and regional transport of smoke, ash, and fine particles increases respiratory and cardiovascular risks. Although the cause of the current California drought is under scientific investigation, climate scientists agree that increasing temperatures will exacerbate drought conditions. Drought decreases the availability and quality of water for humans. Drought increases the physiologic stress and decreases productivity of animals raised for food. Climatic changes alter the range, biogeography, and growth of microbes and the vectors of food, water, and vector borne illnesses. This includes the changes in aquatic environments that decrease sea food production or that favor toxins that accumulate in seafood and fresh and salt water algal blooms. Drought decreases crop yields and increases crop failures in California and elsewhere in the world. This causes both food shortages and price increases, which makes food less affordable and increases food insecurity, obesity, and malnutrition in economically constrained households. Through sea level rise, salt water may intrude into coastal aquifers thus reducing quality and quantity of water supply. Coastal erosion can contribute to the loss of recreational venues and pose a variety of hazards to infrastructure and public safety.

Socioeconomic Disruption

Widespread social and economic disruption includes damage to the infrastructure for the delivery of health services and for general economic well-being. Health care facilities, water treatment plants, and roads for emergency responders and transportation for health care personnel can be damaged in climate-related extreme weather events. Increased burden of disease and injury will test the surge capacity of health care facilities. Economic disruption can increase income loss and income insecurity, food insecurity, housing insecurity, and mental health problems, which in turn may increase substance abuse, family instability, and suicide and other health problems. Energy production and distribution are also threatened by heat and wildfires (loss of efficiency, generating capacity, and fires disrupting transmission lines). California's ports that provide the gateway to goods for California, national, and international markets are at risk from seal level rise and coastal storms.

Which population subgroups are particularly vulnerable?

All Californians are vulnerable to the health impacts of climate change. Even if one is fortunate to live, work, study, or play in a place without direct contact with wildfires, flooding, or sea level rise, no one can entirely avoid excessive heat or the indirect effects of extreme weather events. Based on medical reviews of individuals who died during heat waves and other extreme weather events, it appears that the very old and very young, individuals who have chronic medical conditions and psychiatric illness, people taking multiple medications, those without means for evacuation (no access to public transit or private cars), the medically fragile or those living in institutions or socially isolated are particularly vulnerable to the direct effects of climate

change.[12] Acclimatization to heat may help reduce risks from heat waves in the healthy general population, but may not be sufficient to protect those with underlying medical conditions.

A much larger part of the population is vulnerable to intermediate factors and social/economic disruption through preexisting physical and mental health conditions, cultural or physical isolation, occupations involving outside or high risk work, a precarious socioeconomic status, or lack of social cohesion, and collective efficacy. The latter includes lack of effective governmental action to plan and coordinate the preparation, response, and recovery to climate threats.[15] A large percentage of our underlying burden of disease and injury is accounted for by the social determinants of health.[16] Community resilience refers to actions taken by individuals, neighborhoods, organizations, and multiple sectors of government to resist and overcome obstacles, and promptly recover from climate threats. In the short run, this may include traditional elements of public health preparedness and community development. However, in the long term this may include actions that broadly promote population health and decrease the number of those with physical and mental conditions that are avoidable, unfair, and rooted in the social determinants of health.

Health inequities based on race/ethnicity, income, geography (urban/rural) are widespread today in California.[17] Even without climate change, demographic changes already underway will increase the size of vulnerable populations in California in the coming decades. The population is aging and the share of individuals aged 65 or more years will increase from 13% in 2010 to 19% in 2050.[18] In many California communities, racial and ethnic minorities constitute the majority of residents.

Table 1. What are the Climate Projections for the Bay Area at 2050 and 2099?

Climate Factor	Range of Predictions
Temperature/Heat	January: 4°F to 5°F increase in average temperatures by 2100 July: 5°F to 6°F increase in average temperatures by 2100
Precipitation	Precipitation varies widely in this region, with annual totals over 40 inches in northern Sonoma County to roughly 15 inches in the eastern portions of Solano and Contra Costa counties. A moderate decline in annual rainfall, 1 to 3 inches by 2050 and 4 to 5 inches by 2090 is projected throughout the region.
Sea Level Rise	By 2100, sea levels may rise up to 55 inches, posing considerable threats to coastal areas and particularly to low-lying areas adjacent to San Francisco Bay. The number of acres vulnerable to flooding is expected to increase 20 to 30 percent in most parts of the Bay Area, with some areas projected for increases over 40 percent. Coastal areas are estimated to experience an increase of approximately 15 percent in the acreage vulnerable to flooding.
Heat Wave	Along the coast, particularly to the south, heat wave is defined as five days over 72°F to 77°F; in other areas the threshold is in the mid- to upper 90s. Over most of the region a limited increase in the number of heat waves is expected by 2050 with only the eastern areas expecting more than one or two more per year. By 2100, between six and 10 more heat waves can be expected per year.
Wildfire Risk	There is little change in projected fire risk in this region, save for the slight increases expected in western Marin County.

What is the current health status, health inequities, and population vulnerabilities in Contra Costa County?

Contra Costa County has an overall mortality rate similar to the State average. However, within the county, there are health disparities:

- African Americans experience nearly twice the rate of mortality and asthma than whites;
- Residents living below the federal poverty line are twice as likely to have been ever-diagnosed with asthma compared to those at the highest income levels.
- More than 282,000 residents in a population of 1.2 million report a chronic condition such as active asthma, diabetes, high blood pressure, congestive heart failure, or psychological distress.
- In an average year, approximately 675 residents are treated in emergency rooms for heat-related illnesses.

While all residents are vulnerable to the effects of climate change, some have heightened vulnerability due to socioeconomic status; pre-existing physical and mental health conditions; physical, cultural, or linguistic isolation; live in neighborhoods communities that lack social cohesion or institutional responsiveness, or occupation. For example, 10 percent of residents report living with a disability. A large percentage of the population is economically challenged (living in poverty, housing cost-burdened, food insecure). A smaller percentage (1-14%) of the population experiences physical, social, or linguistic isolation (elderly living alone, living in rural areas, linguistically isolated, institutionally confined or dependent). Approximately one third of households are estimated to lack air conditioning, a strategy to counter adverse effects of heat. For potential mobility options in emergencies, roughly one third do not live close to frequent public transit. Approximately, 6000 current residents live in an area that would be inundated by the combined effects of a 100 year flood and a 55” rise in sea level in a bad case carbon emissions scenario. Nearly 36,000 residents currently live in high severity wildfire zones, and over the past decade there have been 6 wildfires greater than 300 acres that consumed a total of 2,384 acres. Climate models project a 60-80% increase in the annual acreage burned for the higher (A2) GHG emissions scenario. The number and proportion of elderly (like California as a whole) aged 65 years and older will be increasing over the next decades due to aging of the population and projected population growth. Even without climate change, the number of deaths will increase if the baseline rate is not reduced. Based on worst case projections of excessive temperature and heat waves, the added burden could be 7 times the current number of annual deaths of approximately 25.

What are some of the public health strategies and action steps for adapting to climate change?

The California Department of Public Health has elaborated 9 strategies for adapting to climate change (Table 2). These include community education and engagement, public health workforce development, identification of co-benefits, bolstering existing functions of public health preparedness and surveillance, multi-sectorial partnership building, and research. Figure 2 offers a framework for identifying opportunities along a continuum of upstream and downstream causes and consequences of climate change and health inequities.

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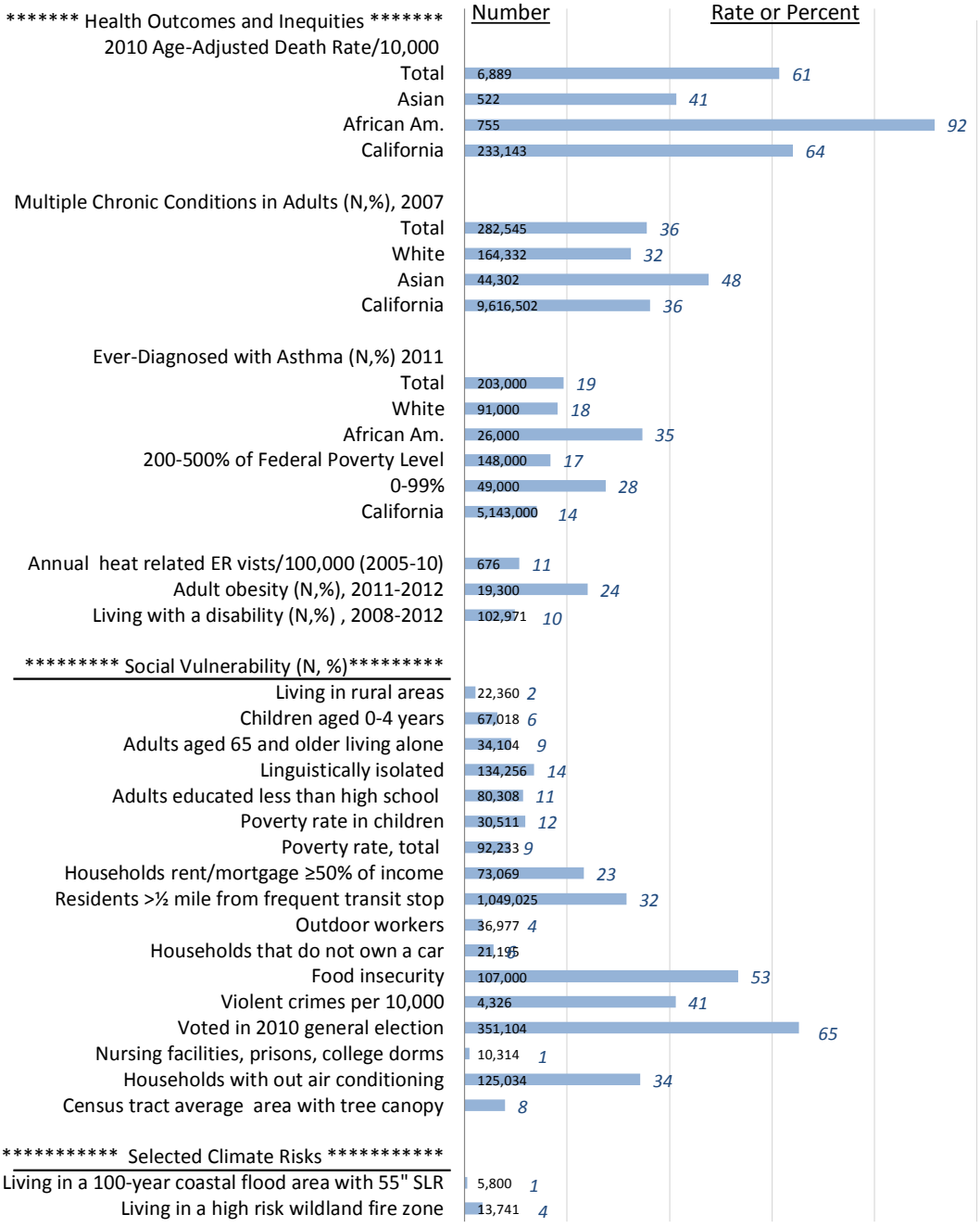
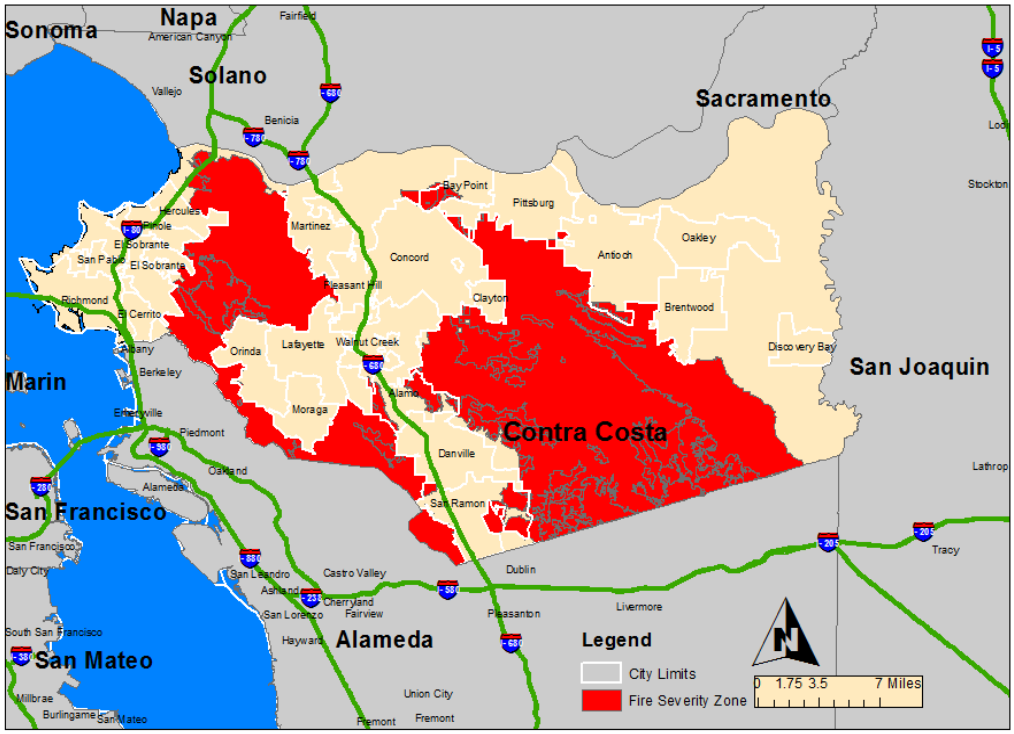
Profile of Health Outcomes and Inequities, Social Vulnerabilities and Climate Risks, Contra Costa County

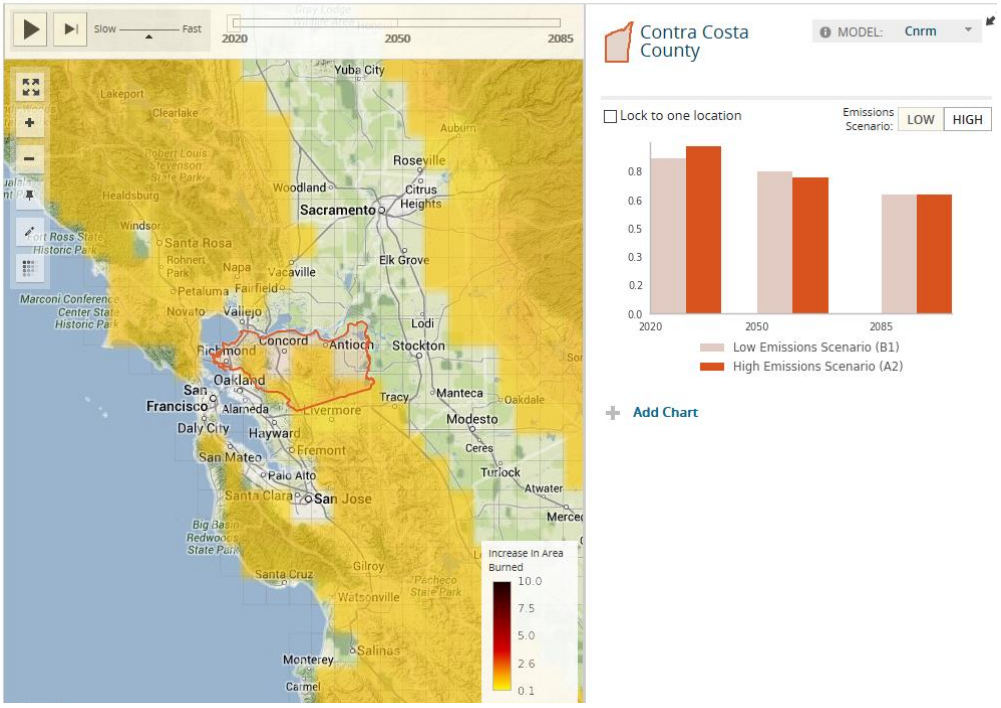


Fire Severity Zones and 100 Year Floods, Contra Costa County

Fire Hazard Severity Zone, Contra Costa County

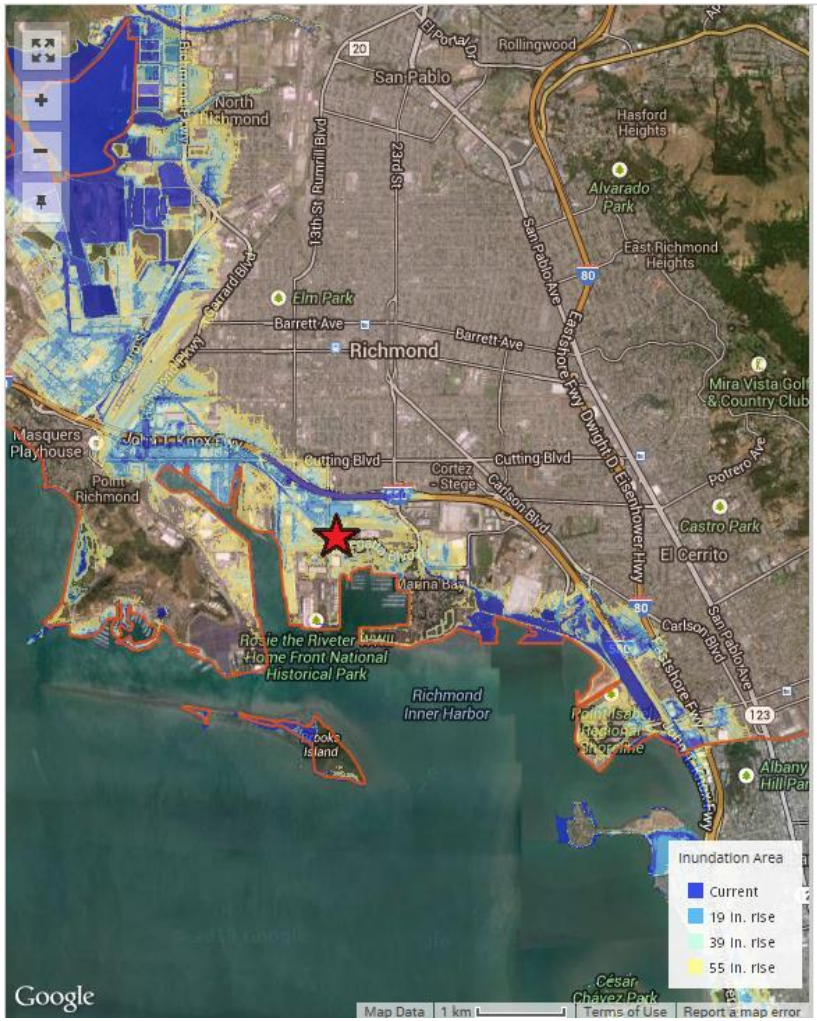


WILDFIRE: FIRE RISK MAP



Sea Level Rise + 100 Year Flood, San Francisco Bay Area Near CDPH's Richmond Laboratory Campus

SEA LEVEL RISE: THREATENED AREAS MAP



Contra Costa County

Metric

	Estimated Acreage in 2000	Estimated Acreage in 2100	Percent Change
Bay Area:	15,846.1	19,285.1	+18%
Coast:	5,819.9	6,802.2	+14%

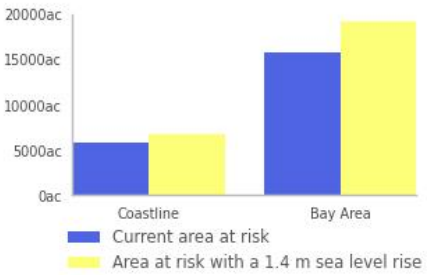


Table 2. What are some of the public health strategies and action steps for adapting to climate change?

Strategy	Action Steps	
	Near-term	Long-term
1. Promote community resilience to climate change to reduce vulnerability	• Promote healthy built environments • Identify and reduce health vulnerabilities • Improve food security and quality	• Promote food sustainability • Reduce heat islands • Support social and community engagement • Promote increased access to health care
2. Educate, empower and engage California residents, organizations and businesses to reduce vulnerability through mitigation and adaptation	• Educational outreach campaign tying into existing efforts • Specific outreach to vulnerable populations	• Proactive social marketing campaign
3. Identify and promote mitigation and adaptation strategies with public health co-benefits	• Identify and prioritize strategies with co-benefits	
4. Establish, improve and maintain mechanisms for robust rapid surveillance of environmental conditions, climate-related Illness, vulnerabilities, protective factors and adaptive capacities	• Monitor outcomes (state and local levels) • Develop existing environmental contaminant biomonitoring • Maintain and upgrade water accessibility information • Improve heat warning systems	• Convert to electronic surveillance systems to improve disease reporting, management and surveillance
5. Improve public health preparedness and emergency response	• CDPH and local health departments should refine existing preparedness plans and conduct exercises	
6. Work in multi-sectoral partnerships (local, regional, state, and federal)	• Expand training and education to build collaborative capacity	
7. Conduct applied research to enable enhanced promotion and protection of human health	• Vulnerability assessments • Research collaboration • Assess local impacts on health	
8. Implement policy changes at local, regional and national levels	• policy collaboration with stakeholders • occupational safety standards	• Model policies & training • Public engagement
9. Identify, develop, and maintain adequate funding for implementation of public health adaptation strategy	• identify and develop funding mechanisms	• develop funding mechanisms/AB32 for education, research

Source: California Department of Natural Resources (http://resources.ca.gov/climate_adaptation/docs/Statewide_Adaptation_Strategy.pdf)

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