

California Legislature
Senate Committee on
Environmental Quality

CONSULTANTS
RACHEL MACHI WAGONER
REBECCA NEWHOUSE
JOANNE ROY
COMMITTEE ASSISTANT
SUE FISCHBACH

BOB WIECKOWSKI
CHAIR



INFORMATIONAL HEARING OF THE
SENATE ENVIRONMENTAL QUALITY COMMITTEE
BOB WIECKOWSKI, CHAIR

Friday, May 29, 2015
10:00 a.m.
OAKLAND CITY HALL
CITY COUNCIL CHAMBER, 3rd FLOOR
1 FRANK H. OGAWA PLAZA
OAKLAND, CA 94612

**Bay Area Regional Adaptation Efforts to Climate Change
Impacts**

BACKGROUND INFORMATION

Climate Change Impacts and the Bay Area

The climate is warming, largely due to human activities, with serious impacts for regions throughout the state.

Worldwide, as noted in the 5th assessment report from the Intergovernmental Panel on Climate Change (IPCC), 40% increases in carbon dioxide concentrations since pre-industrial times have led to a rise of average surface temperatures of approximately 1.4°F. Current research indicates that an increase in the global average temperature of 2.0°F above present levels poses severe risks to natural systems and human health and well-being, and sea levels have already risen by nearly eight inches.

Per the U.S. Environmental Protection Agency, every 2°F increase in global average temperature is expected to result in 5-15% reductions in crop yields, 3-10% increases in rainfall during heavy precipitation events, and 200-400% increases in areas burned by wildfires in the western U.S.

In California, the frequency of extreme events, including heat waves, wildfires, floods, and droughts, are expected to increase. Higher temperatures and more frequent and severe extreme events will have a range of consequences for public health through impacts to water quality, air quality, and infectious disease spread.

Water Quality and Sea Level Rise

Sea level change has impacts on coastal planning and development, land use, and water quality. Rising sea levels can increase risks for floods, erosion of coastlines, and intrusion of saltwater into freshwater aquifers leading to reduced water usability.

As noted in the 2012 “Sea Level Rise for the Coasts of California, Oregon, and Washington” report from the National Research Council (NRC), a significant amount of development in the San Francisco Bay is at risk. This includes two international airports, two ports, stadiums, and housing developments, which have been built on fill that is only a few feet above the highest tides. Additional systems at risk include electric utilities, powerplants, storm water and wastewater treatment plants and outfalls, wetlands, fisheries, hospitals, schools, and homes.

At just 1.3 feet of sea level rise, as predicted to occur within several decades, the San Francisco International Airport will begin to flood, as shown by the blue shading in Figure 1 from the NRC report. With 3.3 feet of sea level rise, the Pacific Institute estimates the costs of replacing properties in the San Francisco Bay area that are at risk from coastal flooding at \$49 billion (at year 2000 cost).

Furthermore, 3.3 feet of rise puts 220,000 people at risk from flooding, with particularly large numbers impacted in Alameda, Marin, and Santa Clara Counties, as well as 40-45% of populations in San Mateo County.

According to the Public Policy Institute of California’s (PPIC) 2008 “Adapting California’s Water Management to Climate Change” report, sea water intrusion in the Delta could disrupt the state’s water supply for months to years (Hanak and Lund, 2008).

Across California, groundwater accounts for over 40% of drinking water. Some counties in the Bay Area are already grappling with questions about how to handle coastal properties that lose access to fresh water due to salt water intrusion with rising sea levels.

In addition to coastal areas, flooding along rivers, streams, and lakes termed “riverine flooding,” is a large concern during heavy rainfall periods in extreme weather events, which are expected to increase in both frequency and severity over the coming century. In 2006, the flood damage to the City of Napa and surrounding areas included 1,200 homes, 250 businesses, and totaled approximately \$115 million according to the California Department of Water Resources’s website.

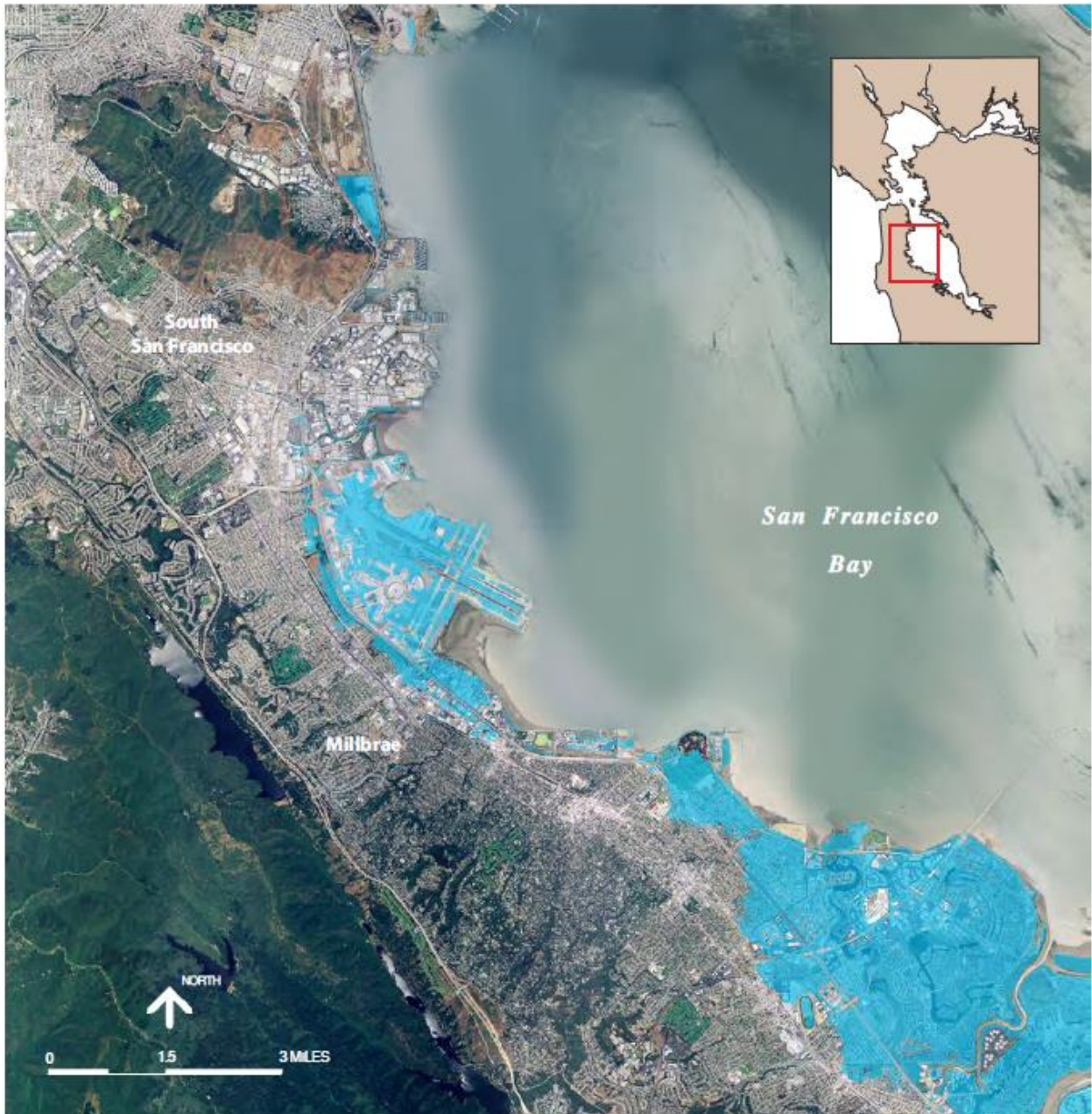


Figure 1. Expected inundation of low-lying areas, including the SF International Airport (center), in the San Francisco Bay Area with a 40 cm rise in sea level (light blue shading). SOURCE: Bay Conservation and Development Commission.

Along with sea level rise, drought is an important consideration for water quality. The nature of the current drought has likely been worsened due to the record temperatures across the state, which has additional implications on public health, job losses, and the economy, with an estimated 2.2 billion dollar price tag for California agriculture.

As river flows decline during extended drought periods, less fresh water from reservoirs is available to repel saltwater intrusion into areas of the delta where fresh water is drawn. As noted by Jon Burau at the United States Geological Survey (USGS), “Salinity is the central management challenge during a drought. People don’t realize how much water we ‘spend’ repelling salinity intrusion to maintain water deliveries.”

Though an overall reduction in rain amounts is expected with climate change, rainfall events will likely be more extreme, overwhelming sewage and water treatment facilities and resulting in further decreases in water quality. Overall, higher salinity water has reduced usability for both drinking water and agricultural purposes, and methods to obtain fresh water, such as desalination procedures, can be costly and energy-intensive, which can subsequently undermine mitigation efforts.

Air Quality and Wildfires

A number of impacts from climate change can lead to worsening air quality. Longer, hotter dry seasons lead to more ground-level pollutants like ozone and extended seasons for allergen-producing plants, which can result in increased respiratory illness and premature death. High temperatures combined with a worsening drought resulting in dry conditions lead to more wildfires. Scientific modeling has predicted 12-53% increase in large California wildfires by 2100 (Westerling and Bryant, 2006).

Wildfires can result in not only air pollution, but also concerns for water and power supply. For example, in 2013, water and power infrastructure supplying over 2.6 million Bay Area residents was threatened by the Rim Fire. During that fire, regular water testing was conducted to make sure that fallout from the fire was not jeopardizing water quality downstream.

Additionally, even in areas that are not at a high risk for wildfires, such as San Francisco, air pollution is a concern. According to the California Air Resources Board’s “Wildfire Smoke Guide,” for example, Santa Ana winds can reverse the typical onshore flow wind patterns and blow strongly towards the coast, bringing smoke from mountain fires into heavily populated areas. Smoke from wildfires can lead to minor eye and lung irritations to more serious asthma attacks, bronchitis, and premature death.

Public Health

Climate change can have a number of direct and indirect impacts on public health. For example, hot temperatures, as well as drought, facilitate the spread of diseases such as West Nile Virus (WNV) by aiding the development of mosquitoes, which spread the virus to people, birds, and other animals. Last year in California, the number of mosquitoes carrying WNV surged to unprecedented levels, and one-third of the state’s virus-positive birds were found in Santa Clara County. Earlier this month, the non-native *Aedes aegypti* mosquito was found for the first time in Alameda County and has been found in recent years in San Mateo County. This species of mosquito has the potential to transmit viruses responsible for a number of diseases, including dengue, yellow fever, and chikungunya, often biting during the day and indoors. These mosquitoes lay eggs that can stay dormant for months to years in dry environments.

In San Francisco, an eight-fold increase is expected in the number of extreme heat days (up to 90 per year) by the end of the century, leading to subsequent increases in heat-related illness and deaths, particularly for vulnerable populations, including the poor, elderly, and young children (Morello-Frosch et al., 2009). The San Francisco Climate & Health Program has highlighted a number of the primary potential health impacts in the Bay Area, as shown in Figure 2.





HAZARD	CLIMATE IMPACT	HEALTH IMPACT
Temperature 	Average yearly temperature to increase between 4.1 and 6.2 degrees Fahrenheit by 2100	<ul style="list-style-type: none"> • Heat-Related Illness <ul style="list-style-type: none"> ◦ Dehydration ◦ Heat Stroke
	Extreme Heat Days (over 85F) to increase by 15-40 by 2050, potentially 90 by 2100	<ul style="list-style-type: none"> • Heat-Related Mortality <ul style="list-style-type: none"> ◦ Heart Disease
	Increase in heat wave length and frequency.	<ul style="list-style-type: none"> • Air Quality Effects <ul style="list-style-type: none"> ◦ Respiratory Illness ◦ Asthma ◦ Allergies • Mental and Behavioral Health
Sea level Rise 	Projections indicate that in the most likely scenario, sea levels will rise between 7-15 inches by 2050 and 26-46 inches by 2100	<ul style="list-style-type: none"> • Fatal and Nonfatal Injury • Water-borne disease • Mental and Behavioral Stressors • Income Loss
Extreme Storms 	Bay Area precipitation levels are projected to fluctuate between wet and dry extremes. Currently California receives 35% - 45% of its annual precipitation from 'Pineapple Express' extreme storm events. This number could increase by up to 11% by 2100.	<ul style="list-style-type: none"> • Fatal and Nonfatal Injury • Water-borne disease • Mental and Behavioral Stressors • Strain on public health infrastructure • Income Loss
Drought 	Bay Area precipitation levels are projected to fluctuate between wet and dry extremes. In dry years where the high-pressure system off the coast does not dissipate, the frequency and severity of droughts will increase.	<ul style="list-style-type: none"> • Income Loss • Food Insecurity <ul style="list-style-type: none"> ◦ Malnutrition • Air Quality / Allergens <ul style="list-style-type: none"> ◦ Respiratory Illness ◦ Asthma ◦ Allergies • Mental and Behavioral Health

Figure 2. San Francisco and Bay Area Climate Projections and impacts over the next century. SOURCE: San Francisco Climate & Health Profile (<http://www.sfclimatehealth.org/san-francisco-climate-projections/>)

In the winter, fewer nights where the temperatures reach freezing can impact both human and plant health. For example, according to the 2014 Climate Ready Sonoma County report, vulnerabilities include proliferation of pests and pathogens due to fewer cold nights, with subsequent increases in pesticide use to combat them. Additionally, a reduction in chill hours leads to lower yields and less bloom time for flowers, fruits, and nuts. This can subsequently result in food insecurity and rising food costs with disproportionate impacts on low-income households.

Climate Change and Environmental Justice Considerations

Socially and economically disadvantaged communities will be harder hit by, and less able to adapt to, the impacts of climate change. As noted by the Pacific Institute's 2013 report on sea level rise in the Bay Area, adaptation requires tremendous investment and decisions about what to protect, which raises environmental justice concerns. They note that "what we choose to protect and how we pay for it may have a disproportionate impact on low-income neighborhoods and communities of color." Lack of access to a vehicle to evacuate during emergencies, inability of renters to invest in major reinforcements for their homes, and lack of access to emergency communications for non-English speakers are some of the many important considerations in equitably preparing for climate change impacts.

Additionally, minorities and low-income people are more likely to live close to facilities such as powerplants and refineries (Boyce and Pastor, 2013) and hazardous materials sites. Not only are these residents regularly exposed to worsened air quality from high local emissions, such as particulate matter and nitrogen oxide, they are at risk of exposure to toxic chemicals during inundation from extreme events and flooding. The Pacific Institute found that, with a one meter sea level rise, 208 hazardous waste facilities along the San Francisco Bay are at risk from a 100-year flood event. As an example, one month after Hurricane Katrina, sediment samples in New Orleans had levels of arsenic, lead, and the gasoline constituent benzene in excess of drinking water standards (Adams et al. 2007).

Adapting and Building Resiliency to the Impacts

California has been a leader in pursuing policies and strategies to reduce greenhouse gases (GHGs). These reductions are an important part of the global effort to reduce the most severe impacts of climate change. However, even if all GHG emissions ceased today, many impacts of climate change would still be unavoidable because the climate system changes slowly. As we are already seeing the effects of climate change with many more impacts to come, developing comprehensive adaptation strategies to address them are of great importance.

State Efforts in Climate Adaptation

A number of state laws, regulations, and executive orders (EOs) have focused on GHG emission reduction efforts, while a subset address adaptation and resiliency. Governor Brown's recent EO, B-30-15, focused on state efforts to address climate adaptation by directing the Natural Resources Agency to coordinate regular updates to California's Climate Adaptation Strategy and all state agencies to consider climate change and adaptation in their planning and investment decisions. Last year, AB 2516 (Gordon), Chapter 522, Statutes of 2014, created a Planning for Sea Level Rise Database to inventory sea level rise planning in the state biannually.

State Resources & Planning Documents

State agencies have worked together, and through coordinating bodies such as the Climate Action Team and the Strategic Growth Council, to produce multiple climate change assessments

and guidance documents, as well as provide funding for affordable housing and sustainable communities. Key recent and upcoming documents include:

- The 2012 Adaptation Planning Guide (APG), which provides guidance and support for local governments and regional collaboratives in addressing the impacts of climate change;
- The 2014 Safeguarding California Report, an update to the 2009 California Climate Adaptation Strategy, which summarizes impacts from climate change across sectors and provides policy guidance for state decision makers and recommendations for adaptation strategies;
- The upcoming Fourth Climate Change Assessment, which will provide scientific information to support adaptation decisions, implement much of the state’s Climate Change Research Plan to coordinate state research on climate change, and identify additional climate change research projects; and
- Cal-Adapt, which is a web-based climate adaptation planning tool intended to benefit local planning efforts by downscaling climate change scenarios and research for regions within California.

State Strategies and Recommendations

The Safeguarding California report listed key cross-sector strategies for adaptation, which included integrating climate change into government activities; considering vulnerable populations, significant and sustainable funding sources, and research data and tools; prioritizing projects with multiple benefits; and prioritizing communication, education, outreach, and collaborative, iterative processes. The guiding principles of this Climate Adaptation Strategy update included involving all relevant stakeholders and establishing partnerships across levels of government and between public and private sectors. This emphasis on collaboration from state agencies is further highlighted in the Adaptation Planning Guide, which states, “Climate adaptation requires a sustained iterative process meaning both local and regional staff and community members should be engaged throughout the process.”

Regional Efforts in Climate Adaptation

The Bay Area has been very engaged in climate adaptation. Local leaders in this area have described both the laudable number and quality of adaptation partnerships and projects, as well as the ongoing need for improvements in regional structure and communications across stakeholder groups.

Regionally, there have been a number of initiatives focused on climate change in a variety of sectors. One of the regional coordinating bodies has been the Bay Area Joint Policy Committee (JPC), which coordinated the planning efforts of the Association of Bay Area Governments (ABAG), the Bay Area Air Quality Management District (BAAQMD), the Bay Conservation and Development Commission (BCDC), and the Metropolitan Transportation Commission

(MTC). The Bay Area Climate & Energy Resilience Project (BACERP) collaborative, a project of the Bay Area Joint Policy Committee (JPC), brought together over 300 public, private, and nonprofit stakeholders in the Bay Area. BACERP was also part of the larger Alliance of Regional Collaboratives for Climate Adaptation (ARCCA) network, which includes four additional collaboratives in the San Diego, Los Angeles, Capital, and Sierra Nevada regions.

In November 2014, many of the key projects and programs on climate adaptation in the region were summarized in BACERP's Bay Area Climate Asset Map, and included efforts focused on flooding, water, energy, natural systems, health, and multi-impact initiatives at the local, government, regional agency, non-profit, and private sector levels. Regional agency initiatives include ABAG's Regional Disaster Resilience Initiative, the Bay Area Regional Hazard Mitigation Plan, the BAAQMD Regional Climate Protection Strategy, and Plan Bay Area, which is an integrated transportation, housing, and land use strategy through 2040. Additionally, a number of local health departments have been working with the California Department of Public Health's (CDPH) "CalBRACE: California Building Resilience against Climate Effects" project to plan for and reduce health risks from climate change.

In addition to agency collaboration, regional coordination is occurring through broad partnerships in both the public and private sectors and across levels of government. From the many dynamic regional and subregional efforts in the Bay Area, some highlights include:

- **Climate Readiness Institute (CRI):** CRI is a partnership with universities, the regional collaborative, and leaders from the local government and non-profits developing climate science, adaptation strategies, and mitigation tools.
- **Adaptation to Rising Tides (ART):** Led by the BCDC and the National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center, ART is a collaborative planning effort for adapting to sea level rise and storm flooding while protecting ecosystem and community services; ART engages stakeholders across levels of government, nonprofits, and private organizations.
- **State Route 37 Stewardship Study:** Through a partnership of Bay Area transportation, environmental groups, and resource protection agencies, this project works to determine planning solutions for both people using the highway and the natural environment regarding dangers from sea level rise.

Local Efforts on Climate Adaptation

County-Level

The nine counties of the Bay Area have been engaged in both climate mitigation and adaptation to varying extents. Planning and coordination efforts in climate adaptation were summarized recently in the 2014 "Bay Area Climate Adaptation & Resilience Nine County-Level Snapshots: Projects, Plans, Structures & Needs" report from BACERP. As noted in the report, throughout the process of creating it, the major points to come out of the discussions with stakeholders included moving from individual to more coordinated projects, identifying and developing

sustainable funding, building support and engagement with the public, and providing centralized information and assistance. A subset of the many county-level and sub-regional efforts covered in the report is highlighted below.

1) Alameda County

- a. *Hayward Area Shorelines Planning Agency's Sea Level Rise Project*: A study by the joint powers authority, this project brings together stakeholders to address sea level rise threats to wetlands and levees along over 4 miles of shoreline.
- b. *Alameda County Santa Rita Jail Smart Grid*: Through a partnership with the county and Chevron Energy Solutions, the project ensures stored, renewable power in the event of a disruption from the Bay Area power grid, and builds on previous projects implementing solar panels and wind turbines.

2) Contra Costa County

- a. *Flood Control*: County staff and the Flood Control 2.0 Project have been working to raise awareness of the need for flood control planning, while providing environmental benefits and cost-savings.
- b. *Health Services Climate Leadership*: County Health Services has worked on a white paper concerning the connection between climate change and health, and the Planning Integration Team for Community Health (PITCH) interdepartmental team integrates public health considerations into land use and transportation planning and engineering activities.
- c. *U.S. Environmental Protection Agency (EPA) Small Cities Climate Showcase Grant*: El Cerrito is one of four small Bay Area cities (with Albany, Piedmont, and San Pablo) helped by the EPA grant to partner on activities such as purchasing joint solar by pooling resources.

3) Marin County

- a. *Marin Climate & Energy Partnership (MCEP)*: Partners, including 11 cities and towns, the County, the Transportation Authority, and the Municipal Water District, are working to both reduce GHG emissions and build resilience.
- b. *Collaborating on Sea Level Rise: Marin Adaptation Response Team (C-SMART)*: With a grant from the Ocean Protection Council, the team is looking at vulnerabilities to sea level rise and protection from both natural systems improvements and engineering solutions; this is one of many sea level rise projects in the county.

4) Napa County

- a. *Measure A Flood Protection Project*: This project provides environmental restoration and economic development for 100-year flood protection and includes a range of partners such as Napa County and its cities, Sierra Club, and the Chamber of Commerce.
- b. *Napa Green – Sustainability in the Wine Industry*: A program for wine production and sustainable land use, developed by vintners and grape growers, as well as local industry and environmental groups, its goals are to meet and exceed over 20 local, state, and federal best practices in water and energy conservation, healthy environments, and restoration of wildlife habitat.

- 5) San Francisco County
 - a. *SF Adapt*: Led by the Department of the Environment and the City Administrator, this is an inter-departmental effort to coordinate climate adaptation planning, including the Public Utilities Commission, port, airport, Transportation Agency, Public Health, and other agencies.
 - b. *Climate Ready Initiative*: This is a project of San Francisco's Department of Public Health funded by the U.S. Centers for Disease Control and Prevention, to develop public health capacity for climate change, focusing on at-risk populations.

- 6) San Mateo County
 - a. *Regionally Integrated Climate Action Planning Suite (RICAPS)*: With technical assistance and tools developed by the City and County Association of Governments for this project, each city develops its own Climate Action Plan (CAP), including a section on adaptation.
 - b. *Sea Level Rise/Adaptation Workshops*: The County has led two workshops to bring all 20 cities together to discuss climate risks and strategies with panelists from academia, local and state government, and federal agencies.

- 7) Santa Clara County
 - a. *Silicon Valley 2.0 (SV 2.0)*: Funded by the Strategic Growth Council, and working with local and regional agencies, private and nonprofit partners, the county has developed a climate adaptation plan and decision-making tool involving multiple sectors.
 - b. *Santa Clara Valley Water District (SCVWD) Projects*: The SCVWD works on a number of adaptation activities concerning flood control, water reuse, efficiency, and conservation, and saltwater intrusion prevention.

- 8) Solano County
 - a. *Multi-agency Climate Action Planning*: With funding from the Strategic Growth Council and Pacific Gas & Electric (PG&E), the county developed a CAP and implementation strategy, managed by the Solano Transportation Authority, focused mainly on GHG emissions reductions to date.
 - b. *Suisun Marsh Restoration Project*: Federal, state, and local government and private partners work together to address sea level rise and reduced Delta water flows, which impact water quality for people and wildlife.

- 9) Sonoma County
 - a. *Regional Climate Protection Authority (RCPA)*: Created by the legislature in 2009, the RCPA's goal is to improve cross-agency coordination and collaboration in the county on climate change issues.
 - b. *Sonoma County Adaptation Forum*: Last month, a group of nonprofits, agencies, and businesses presented the forum in order to increase awareness of climate impacts in the county and strategies for resilience.

City-Level

As of March 2014, over 40 cities in the Bay Area have completed Climate Action Plans. Many CAPs focus mainly on GHG emissions reductions and may or may not address adaptation and resiliency planning. In the absence of a specific CAP, climate planning (mitigation +/- adaptation) may be included in a city's hazard mitigation plan, local general plan, or other official planning process.

In December 2014, 16 communities across the U.S. were recognized as leaders in climate change by the White House, including two in the Bay Area: San Francisco for a wide-range of climate and sustainability targets and goals to measure progress, and the Sonoma County Regional Climate Protection Authority (RCPA), as the first local government agency created to address climate change specifically and work across "silos," as departments are sometimes referred to when they do not frequently coordinate activities, on climate change goals.

Many of the cities in the Bay Area are engaged in climate adaptation to varying degrees. In 2013, the Rockefeller Foundation, through its Resilient Cities Centennial Challenge, selected four cities in California, including three in the Bay Area—Berkeley, Oakland, and San Francisco—to receive technical support, tools, and funding for hiring a Chief Resilience Officer and developing a resilience strategy.

Engagement from the Business and Nonprofit Sectors

In some cities, cross-sector groups are coming together to work on climate action and make sure planning is effective and equitable. One example is the Oakland Climate Action Coalition (OCAC), which has brought together over 30 community, environmental, labor, and other organizations since 2009, aided in developing the city's Energy and Climate Action Plan (ECAP), and aims to be a model for community engagement. OCAC's Resilience and Adaptation Subcommittee, co-chaired by members of the Pacific Institute and the West Oakland Environmental Indicators Project, has been very engaged in informing the development of equitable adaptation planning by working with community-based organizations. Some of the member groups include the Asian Pacific Environmental Network (APEN), Bay Localize, Communities for a Better Environment, Environmental Defense Fund, Local Clean Energy Alliance, Roots of Change, and many more.

The Contra Costa County Climate Leaders (4CL) nonprofit is a network that assists the county and its 19 cities by facilitating countywide action for both GHG reduction and adaptation by helping to inform, support, and encourage climate strategies. In the wider Bay Area, organizations such as the Business Council on Climate Change (BC₃) help businesses prioritize "climate solutions that require cross-company or cross-sector collaboration" with a current focus on corporate leadership in the areas of carbon sequestration and energy.

Summary

Much work has begun on climate adaptation in the Bay Area, thanks to a wealth of climate leadership. This work is often carried out through collaboratives and partnerships that aim to address broad-sector impacts from climate change. There is more work to be done at the state level to provide support, expertise, and resources for climate change initiatives, and to work with stakeholders to address challenges and coordinate state, regional, and local projects in order to develop comprehensive approaches to climate adaptation.

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