

Watersheds and Climate Adaptation



Caitlin Cornwall, Sonoma Ecology Center






SONOMA
ECOLOGY
CENTER

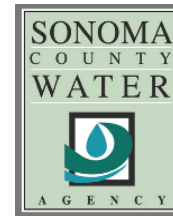
Science

Community

Ecological health in
Sonoma Valley



North Bay
**CLIMATE
ADAPTATION
INITIATIVE**



Creekside Center
for Earth Observation



Goal

...to foster an open conversation between technical experts, land managers, and policymakers in support of effective local scale climate adaptation strategies that preserve natural resources, biodiversity, and ecosystem services.

Watersheds and Climate Adaptation



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What watershed
workers do to
protect their
communities
against the 5
biggest impacts of
climate change



Flood

- Promote large volumes being available for water flows, on compatible land uses.
- Vegetate banks, ditches, and floodplains.
- Protect outfalls, and other stormwater management.
- Neighborhood communication systems.
- Protect movement corridors.
- Promote biodiversity.
- Promote long-term multi-sector cost-benefit analysis as part of emergency planning.

Drought

- Maximize infiltration and groundwater recharge.
- Outdoor water conservation.
- Wet-season water collection and use.
- Water re-use.
- Protect movement corridors.
- Protect permanent water sources, provide artificial water sources.
- Promote biodiversity.
- Promote long-term multi-sector cost-benefit analysis as part of drought preparedness planning.

Extreme temperatures

- Neighborhood communication systems.
- Protect refugia.
- Vegetate, re-forest.
- Protect movement corridors.
- Provide artificial water sources.
- Promote biodiversity.
- Promote long-term multi-sector cost-benefit analysis as part of emergency planning.

Fire

- Promote evidence-based fire frequency, fire prevention practices, and post-fire actions.
- Riparian forests as green shields.
- Neighborhood communication systems.
- Protect movement corridors.
- Promote biodiversity.
- Promote long-term multi-sector cost-benefit analysis as part of emergency planning.

Sea level rise

- Neighborhood communication systems.
- Habitat connectivity between sea and hills.
- Transition land uses respectfully.
- Promote biodiversity.
- Promote long-term multi-sector cost-benefit analysis as part of infrastructure planning.

1. The power of neighborhood networks

“Adaptation: how can cities be
climate-proofed?” Eric Klinenberg,
The New Yorker, Jan 7, 2013.

Creek stewardship groups

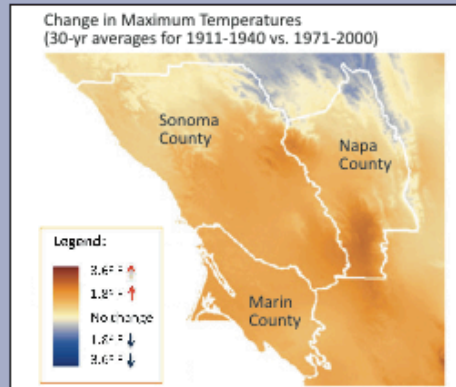
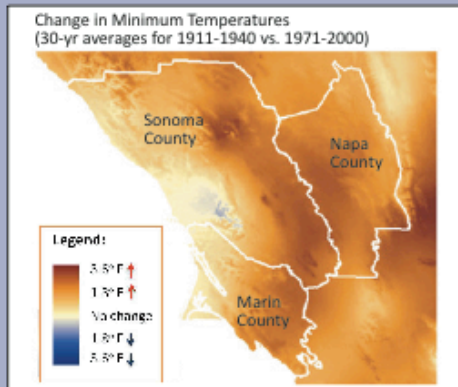
Cool Cities

Climate Change in the North Bay

information for residents of Marin, Sonoma and Napa Counties

As over the rest of the globe, the climate has already started changing in the North Bay region in response to greenhouse gas emissions.¹ By looking at long-term weather station data scientists have been able to confirm that our climate has warmed compared to the historical record.² Between 1911 and 2000 average maximum temperatures have increased approximately 1.0 °F while average minimum temperatures have increased approximately 1.7 °F.³ The maps below depict changes in monthly maximum and minimum temperatures averaged over the last 30 years (1971-2010) compared to a pre-climate change period of the same duration (1911-1940). While some parts of the region (in blue) have cooled over this time period, *the overall warming trend (in orange) is clear across the region.*

Recent climate trends in the North Bay



Change in 30-year averages of monthly temperature lows showing an average warming trend for the region of approximately 1.7 °F

Change in 30-year averages for peak monthly temperatures, showing a warming trend for the region of approximately 1.0 °F

Maps produced from California Basin Characterization Model data (Flint and Flint, USGS) available on the California Climate Commons.

Why should we care?

Changing temperatures are already starting to impact our communities in terms of personal health and energy, water and land use. This is because climate dictates:

- o The quantity and quality of our water supply and patterns of water demand
- o Rates and patterns of commercial and residential energy use
- o How and where farmers can grow crops
- o Health risks for vulnerable populations including the very young and elderly

By raising awareness in our community about the impacts of weather variability in our own region, we can prepare for the future through effective long-term planning.

¹ Hansen, J et al., 2001. A Closer Look at United States and Global Surface Temperature Change. *J. Geophys. Res.*, 106, 23947-23963, doi:10.1029/2001JD000354.
² Mitchell, L et al., 2012. Downscaling Future Climate Projections to the Watershed Scale. *San Francisco Estuary and Watershed Science*, 10(4), jmie_sflws_11170.
³ USGS. Flint, L and Flint, A 2011. California Basin Characterization Model (BCM) Downscaled Climate Surfaces. California Climate Commons, Petaluma, CA.

NBCAI fact sheet
1. What we know and don't know about climate change impacts



Rivers, Creeks and Climate Change

important information for people who live near waterways

The areas alongside streams, creeks, and rivers—riparian areas—make up only a small proportion of the North Bay's land base, but they provide a remarkable range of services to people and nature, services that are even more critical in a time of changing climate. A healthy network of streams creates watersheds that are more resilient to the impacts of climate change.

A Thriving Riparian Zone



Lush riparian plants of all sizes and forms, including grasses and sedges, shrubs, vines, and trees colonize floodplains.

Climate change will likely mean warmer and drier conditions overall and more extreme weather. In winter we can expect more frequent and higher floods and perhaps colder cold snaps. In summer we can expect longer droughts and hotter heat waves. One of the effects of high summer temperatures will be less water remaining in the ground by the end of the growing season.

Heat and Fire

Droughts lead to water shortages for people and nature. Droughts dry up streams, stunt or kill crops, harm wildlife, and cause people to pump more groundwater near streams. As the land gets drier, streamside forests and wetlands come under more pressure to provide water, recreation, and wildlife habitat. As the land dries out, the risk of fire increases. When it does rain in burned areas, more soil washes off the hills and into roads, ditches, and streams.

Floods

One of the projected impacts of climate change is the increased likelihood of extreme floods capable of destroying streamside land, buildings, roads, and crops. Floods can be especially severe near the coast and the bay shoreline, where higher tides caused by sea level rise can push flood levels even higher. In California, the North Bay's Sonoma County is already the top recipient of repetitive flood damage payments and, in fact, has losses greater than those of the next nine communities combined, making it the county with the highest number of properties suffering repetitive flood losses west of the Rockies. *In 2005, the most recent year for which data is available, 30% of Sonoma County's urban areas were in a high hazard area for flooding.²*

What Would Happen...

if your property experienced a severe flood?



The December 31, 2005 flood on Sonoma Creek in Glen Ellen, California

NBCAI fact sheet

2. What you should know as a streamside landowner

¹ Sonoma County Hazard Mitigation Plan, 2011. http://www.sonoma-county.org/prmd/docs/hmp_2011. Page 21.

² Sonoma County Hazard Mitigation Plan, 2011. http://www.sonoma-county.org/prmd/docs/hmp_2011. See Chapter 3.

Healthy Forests in a Changing Climate

important information for people who live near forests

Forests Define Our Home

Chances are that if you live in rural Sonoma County you live in or near a forest, whether a rolling oak woodland, a conifer canyon featuring Douglas fir and redwood, or a diverse mix of hardwoods typical of Sonoma's mountains.

Our forests provide shelter from wind and sun and serve as homes for wildlife. They provide wood and timber, serve a vital role in cleaning our air and water, and protect our landscape from erosion. Forests help reduce the impacts of climate change through absorption and storage of carbon dioxide, taking it out of the atmosphere where it otherwise creates the "greenhouse gas effect" causing climate change. But our forests are also at risk from the North Bay's changing climate.

This document provides tools to help you manage and preserve our forest in the face of a changing climate.

Weather Determines Where Plants Can Grow

Imagine a future Sonoma County without the iconic redwood tree. Multiple climate projections agree that sometime in the next century our weather is likely to be closer to Santa Barbara's than the relatively cooler conditions we experience today.¹ That means plants like redwoods (*Sequoia sempervirens*) that need extremely cool and moist conditions may struggle to survive in Sonoma by this century's end.

Plant ecologists estimate that over time that Sonoma County may lose woody forest vegetation as our landscape adapts to higher temperatures and more variable rainfall.²

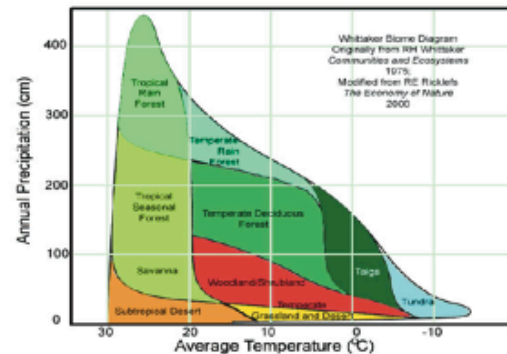
This means we may start seeing a process whereby our forests start to transition from tree cover to chapparral shrub cover, especially in the wake of potentially more frequent forest die-off events due to fire or disease.

Forests for the Future

Efforts to foster forest adaptation are important to both ecosystem values (such as wildlife habitat, watersheds and streams, clean air and water, and soils) and human values (such as property, safety, and wood products).

California Department of Forestry and Fire Protection, 2012

NBCAI fact sheet
3. What you should know as a non-commercial timber landowner



The figure to the right shows how vegetation communities around the world are adapted to specific combinations of temperature and rainfall.

¹ Micheli, L et al., 2012. Downscaling Future Climate Projections to the Watershed Scale. *San Francisco Estuary and Watershed Science*, 10(4), jmie_sfews_11170.
² Cornwell, W et al., 2012. Climate Change Impacts on California Vegetation: Physiology, Life History, and Ecosystem Change. California Energy Commission, CEC-500-2012-023.

Policy Issues in a Changing Climate

information for voters, elected officials, planners and policy makers

The North Bay's climate is already changing

Current research shows that weather patterns of the North Bay are already showing the signs of human-caused climate change. For example, long-term average air temperatures for the Marin-Sonoma-Napa region have steadily increased on the order of 1.0-1.7 °F over the last century.¹ Scientists predict that weather patterns of the future will be significantly different from those experienced over the past century. Rising temperatures and more unpredictable rainfall will put increased pressure on our limited water resources. There will likely be increased risks of drought, flood, fire, and heat-related health emergencies.² These changes will impact local agriculture, infrastructure, social systems, and natural systems.

Climate Change Impacts Agriculture



Flooding in Sebastopol, CA on December 31, 2005

Now is the right time to begin addressing policy, planning, and strategy implications for the North Bay.

What is Climate Adaptation?

Most work on climate change to date has aimed to reduce the rate of change and severity of impacts by reducing greenhouse gas emissions. It is essential to continue this work to limit future impacts from climate change. This strategy is known as climate mitigation.

Climate adaptation refers to strategies (policies, programs, and other actions) that seek to reduce our vulnerability and bolster community resilience in the face of the unavoidable impacts from climate change already underway.

Examples of impacts that will likely require an adaptation strategy are listed below

- Growing seasons and water availability for crops, including existing grape varietals, will change
- Russian River water and groundwater wells will have decreased reliability
- Major transit corridors, including Highways 101 and 37, will likely flood more frequently and more severely
- Farm levees along the edge of the North Bay will be subjected to greater stress from sea level rise and storms
- Mosquito hatch periods will be longer, increasing risks of mosquito-borne diseases, such as the West Nile virus
- Fire risk will be higher, especially in the eastern hills
- Extreme weather events will happen more often, with a corresponding increased demand on emergency services
- Native plant communities and wildlife may become more endangered

Climate Change Impacts Transportation



Flooding in Schellville, CA on March 24, 2011

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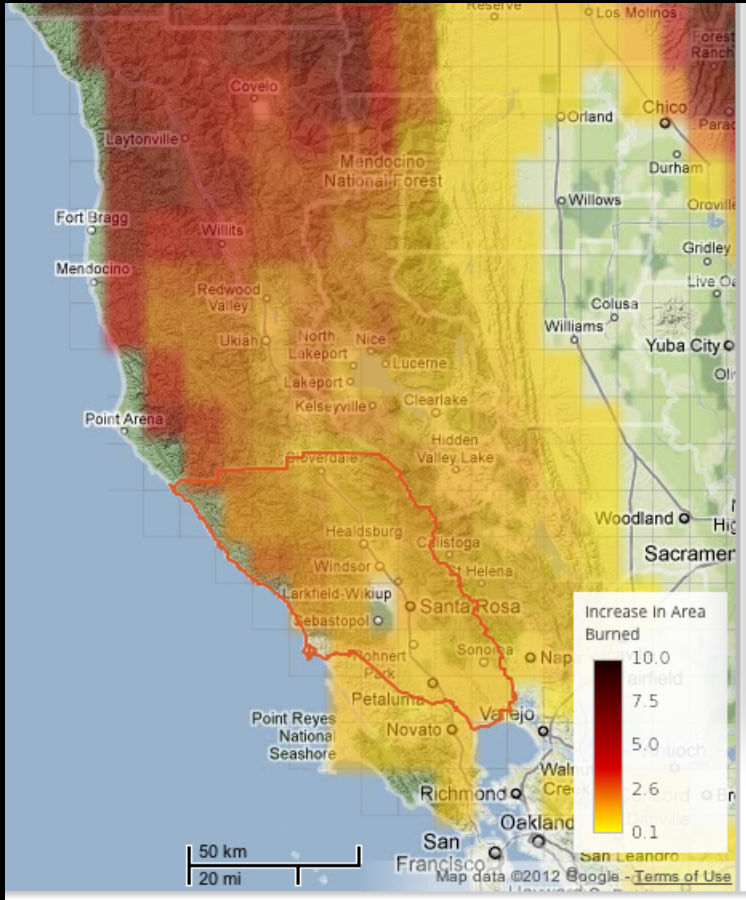
4. Resources for planners

¹ Michel, L et al., 2012. Downscaling Future Climate Projections to the Watershed Scale. *San Francisco Estuary and Watershed Science*, 10(4), jmie_sfews_11170.

² Michel, L, 2013. Climate Change in the North Bay. *Climate Ready North Bay*, Pepperwood Preserve, Santa Rosa, CA.

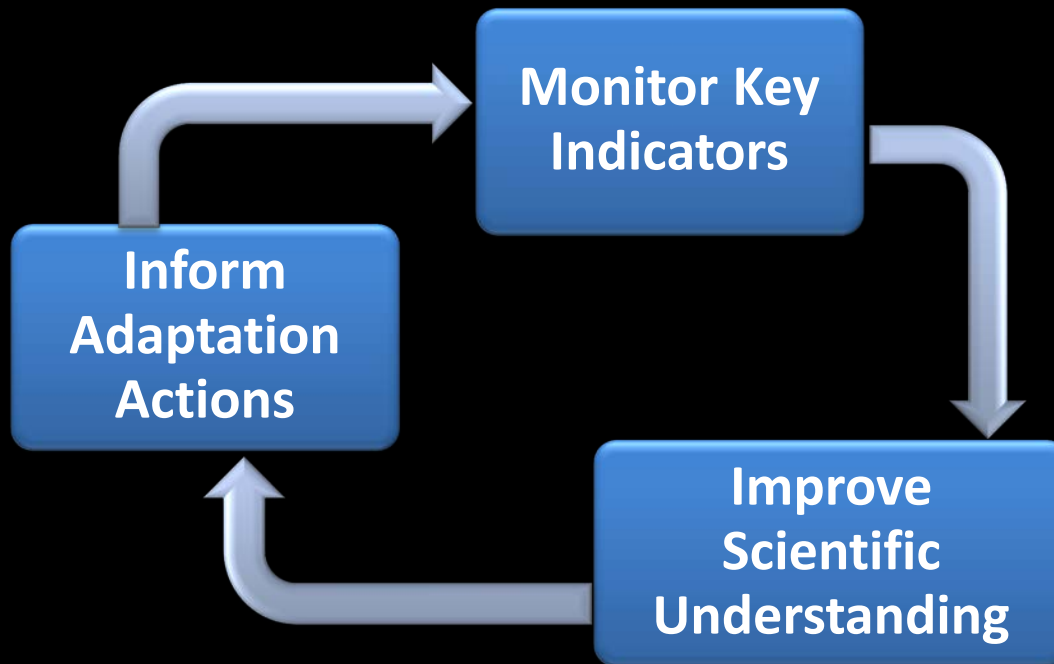
2. Planners and planning processes

3. Fire Risk and Intensity



Source: Cal-Adapt.org Fire Risk Scenario – GFDL Model

4. Monitoring and Targets



What is your latest insight into
how your work relates to
climate adaptation?



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