Appendix: Conservation Threats and Stewardship Challenges

The Conservation Lands Network 1.0 identified a number of threats to conservation, as well as stewardship challenges. See Chapter 9 in the CLN 1.0 report for details. Some progress toward better understanding some of these threats and challenges has been made since 2010. Where possible, summaries of such progress are shared here in this Appendix.

Climate and weather impacts on habitats and rare landscapes

The San Francisco Bay Area climate delivers highly variable annual weather that can lead to feast or famine conditions for local ecosystems and water supply, which can either dehydrate or drown the plants and animals that rely on healthy and stable habitats. Every year, seasonal rainfall totals and large runoff events are greatly affected by a few large "atmospheric river" events (known locally as "Pineapple Express"). Examining recent weather in the context of longer-term variability highlights the multiple values of functioning watersheds—and the stewardship challenges to keep them functioning.

This metric addresses the contribution of the Conservation Lands Network to water resources by answering the following questions:

- Within the water year (October-September), what are key water-year data points?
    - What is the average precipitation?
    - What is the maximum temperature?
    - What is the minimum temperature?

Annual water-year data for the San Francisco Bay hydrologic units were downloaded from Westmap. A 10-year running average is included to indicate decadal scale variability and to smooth the large interannual fluctuations.

Since 1895, precipitation has fluctuated between 9.2" (1924) and 48.0" (1983). There is no long-term trend in precipitation, only a high degree of interannual variability. Notable historic droughts occurred in the 1920s and 30s, 1976-1977 and 1987-1992. Notable wet periods occurred in the early 1940s, early 1980s, and 1990s.

The last decade saw two wet years in 2005 and 2006, followed by a three year dry spell from 2007-2009 (DWR 2010). Slightly above average precipitation in 2010 and 2011 provided drought relief. Drought returned in 2012 and 2013 and now extends into 2014, one of the most severe 3-year droughts in the historical record. Water resources are currently under great pressure, water allocations are being cut, ponds have not filled, fishing restrictions are in place, and early season fire danger is high.

Long-term trends in 10-year running average maximum temperature include a warming from 66.5°F in 1910 to 69.3°F in 1938 (2.8°F), slight cooling of 0.9°F to 68.4°F through 1950, with subsequent warming to 70°F by 2000. Over the past decade, annual average maximum temperature have varied between 71.1°F in 2004 and 67.8°F in 2010 and 2011. The cooler summers of 2010 and 2011 were notable for high frequency of coastal fog. 2012 and 2013 were close to the 30-year average. There has been a slight cooling over the past decade, a result of the cool phase of the Pacific Decadal Oscillation and a strong La Niña in 2011. Notable heat waves in the last decade include the record extended heat wave in July of 2006, and shorter heat waves in July of 2008, and August of 2010. Recent years have been relatively mild with few extended heat waves.

Minimum temperature exhibited large changes over the past century, rising from 45.1°F in 1910 to 46.9°F (+1.8°F) in 1939, a slight cooling to 46°F by 1952 (-0.9°F), followed by a relatively steady rise to 48.8°F in 2000 (+2.8°F), with a slight cooling trend (-0.5°F) in the last decade. The cooling trend is associated with the Pacific Decadal Oscillation regime shift around 2000. The last three years ranged from 48.2°F in 2012 to 48.6°F in 2013. Notable cold events in the last decade include March-April 2008 frosts and the December 2013 hard freeze.

The following graphs depict precipitation and temperature averages for the San Francisco Bay Hydrologic Unit, which encompasses those streams flowing into the San Francisco Bay, but not including the Delta and beyond.

Figure: Maximum Temperature for San Francisco Bay Hydrologic Unit

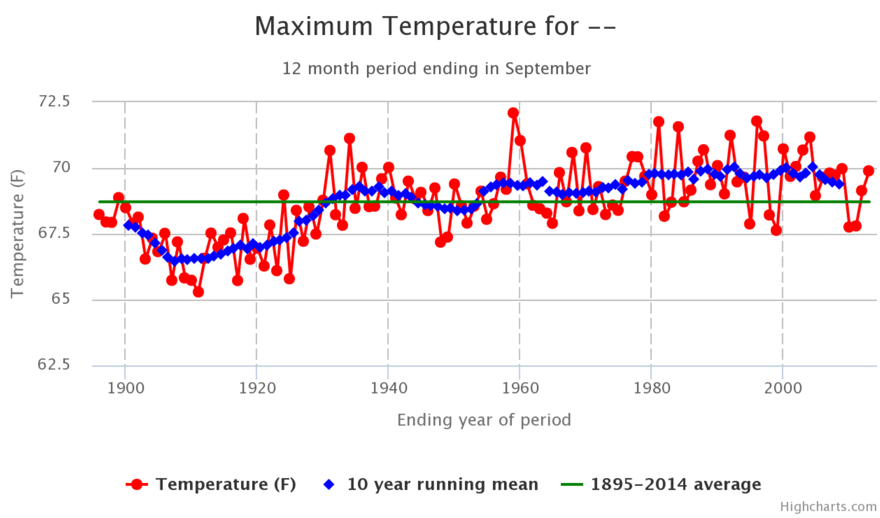


Figure: Minimum Temperature for San Francisco Bay Hydrologic Unit

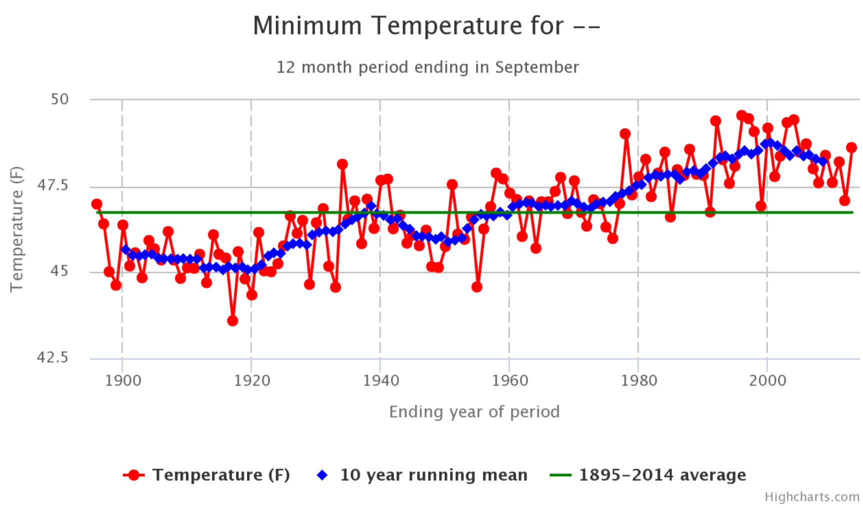


Figure: Precipitation for San Francisco Bay Hydrologic Unit

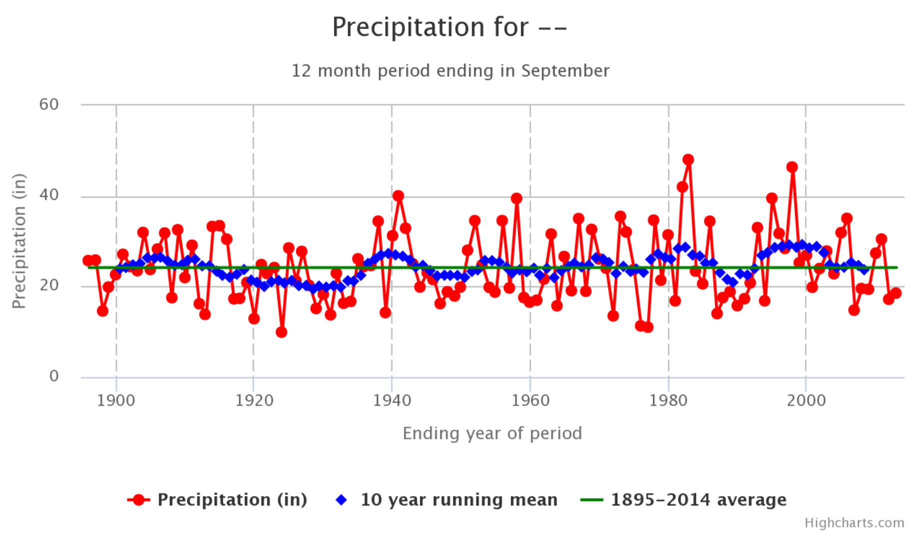


Figure: Precipitation map (from TBC3 – download at www.bayarealands.org map gallery)

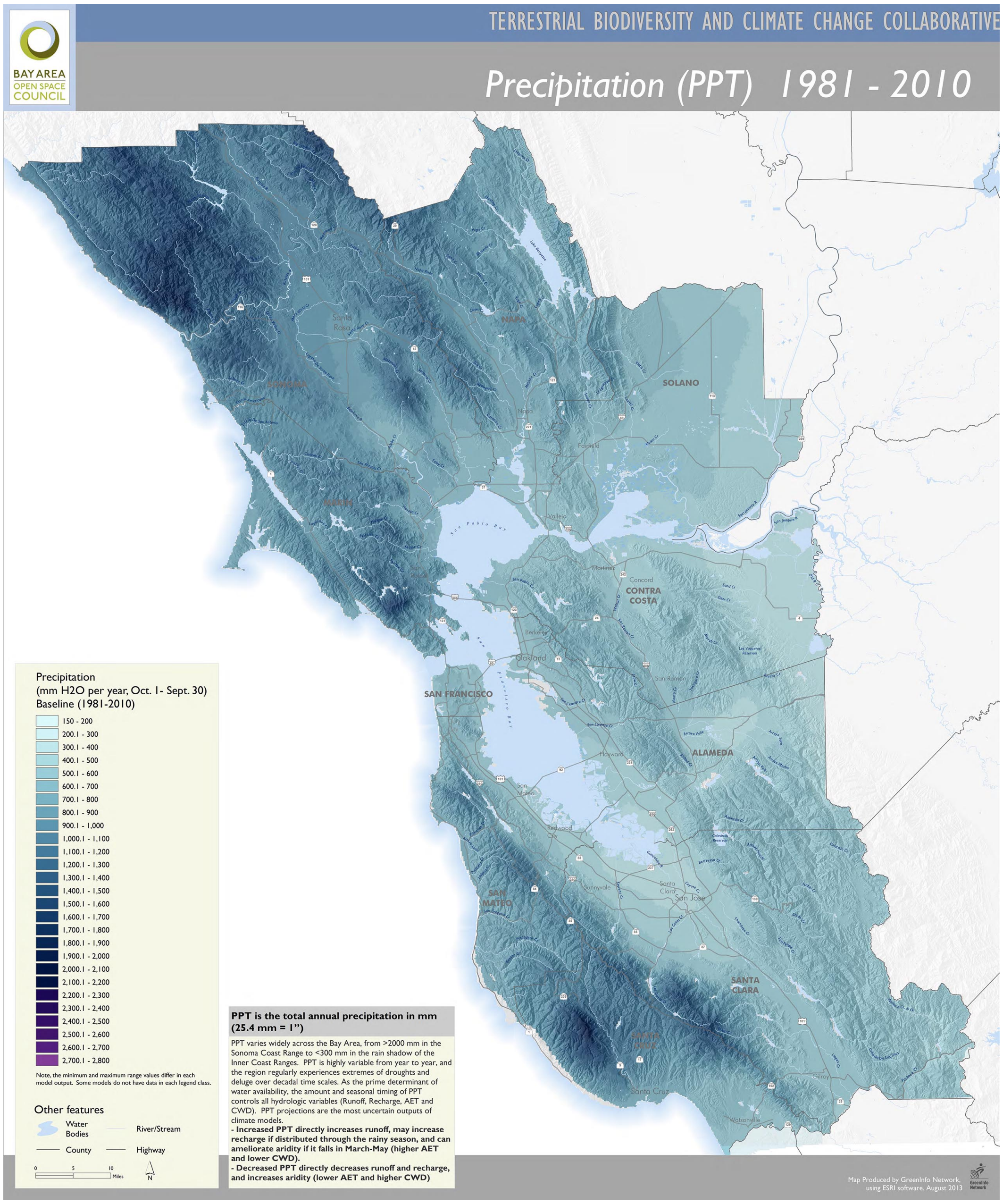
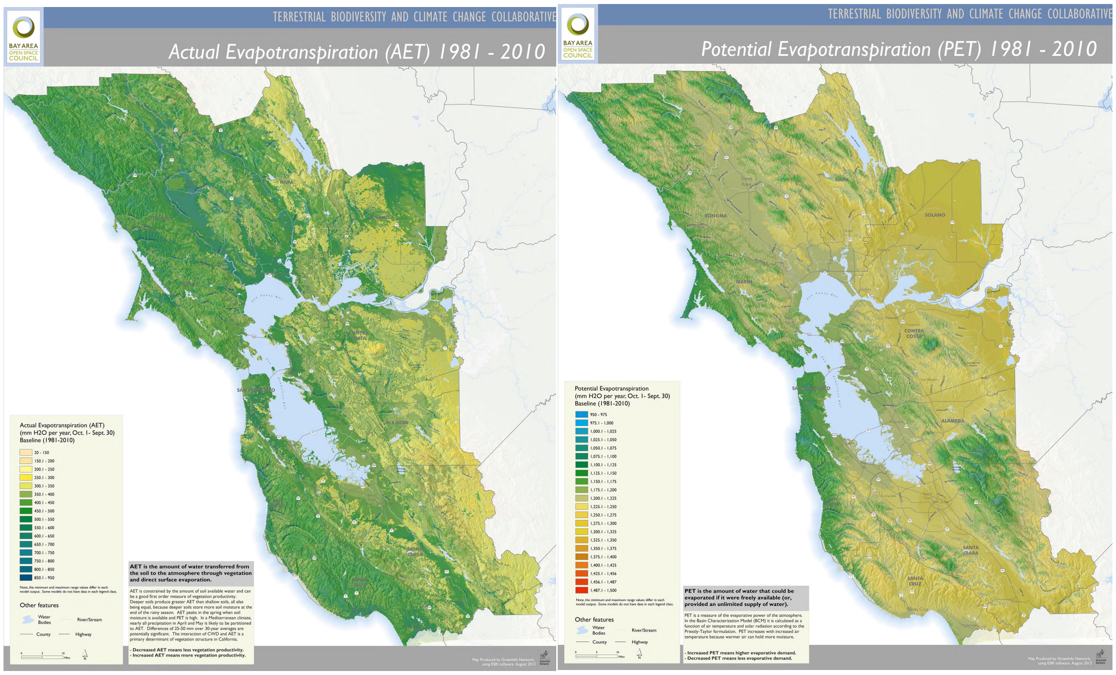


Figure: Actual (left) and Potential (right) Evapotranspiration maps (from TBC3 – download at www.bayarealands.org map gallery)



Fire Management

Fire is a natural and essential process that maintains the structure, function, and diversity of many California ecosystems, but in some ecosystems, it can be very destructive. The long, dry summers of the Bay Area's Mediterranean climate create flammable landscapes in which wildland fires are inevitable. In addition, increased annual grasses from nitrogen deposition build up fine fuel loads, significantly increasing fire extent and intensity in more arid areas (Fenn et al. 2003, 2010). As climate change increases the intensity of our dry seasons, fire is anticipated to become an even more transformative process. Increased fire frequency will likely bring more conversion of forests and woodlands to shrublands (Barbour et al. 2007, Sawyer et al. 2009).

Wildland fire management is complex, expensive, and dangerous. The stewardship challenge is balancing ecological benefits with public safety and expense to find the proper place for fire as a management tool in the Conservation Lands Network.

Burns

Figure: Number of fires and acreage burned, by decade. Data from CalFire

Decade	Acre burned	Number of fires
1950s	127,209	91
1960s	244,582	91
1970s	61,440	50
1980s	142,650	76
1990s	87,349	51
2000s	221,094	125
2010s	12,082	42
Total	896,406	526

Figure: Fires (greater than 1000 acres burned) since 2000

Name	**Acres**	**Year**	**LSU**	**County**
MCCABE	3506	2013	Northern Mayacamas	Sonoma
MORGAN	3108	2013	Mt. Diablo Range	Contra Costa
LOCKHEED	7783	2009	Santa Cruz	Santa Cruz
PACHECO	1689	2009	Mt. Hamilton	Santa Clara

WILD	4102	2008	Vaca Mtns. West	Napa
SUMMIT	4175	2008	Sierra Azul	Santa Clara/Santa Cruz
LICK	47748	2007	Mt. Hamilton	Santa Clara
MIDWAY	5540	2006	Mt. Hamilton	Alameda
CANYON	34218	2006	Mt. Hamilton (partial)	Santa Clara
TESLA	6440	2005	Mt. Hamilton	Alameda
KINCAID	1225	2004	Mt. Hamilton	Alameda
RUMSEY	38763	2004	Blue Ridge Berryessa	Napa
GEYSERS	12244	2004	Northern Mayacamas	Sonoma
CEMENT	1007	2004	Blue Ridge Berryessa	Napa
JUMP	4894	2003	Mt. Hamilton	Santa Clara
DEVIL	5444	2003	Mt. Hamilton	Alameda/Santa Clara
CROY	3007	2002	Sierra Azul	Santa Clara
VIEUX	1029	2002	Mt. Hamilton	Alameda
PINE	1024	2002	Northern Mayacamas	Sonoma
BERRYESSA	4860	2000	Blue Ridge Berryessa	Napa

Figure: Vegetation types burned in Morgan Fire

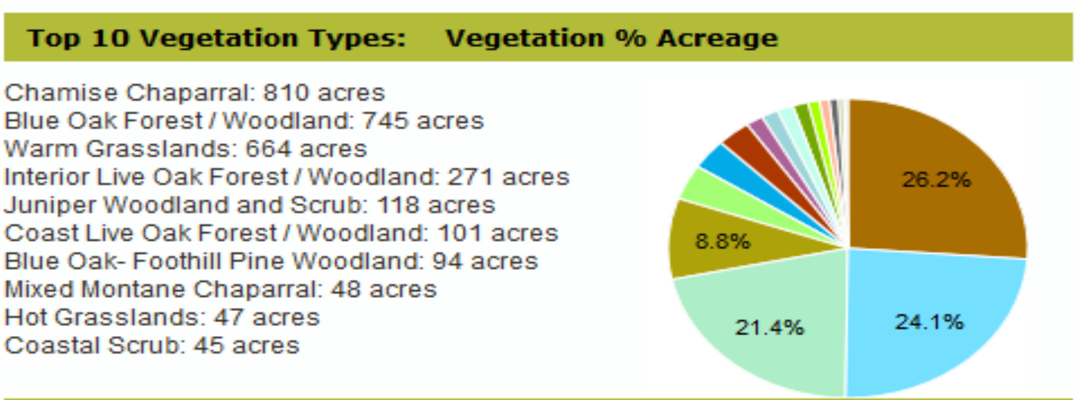


Figure: Vegetation types burned in McCabe Fire

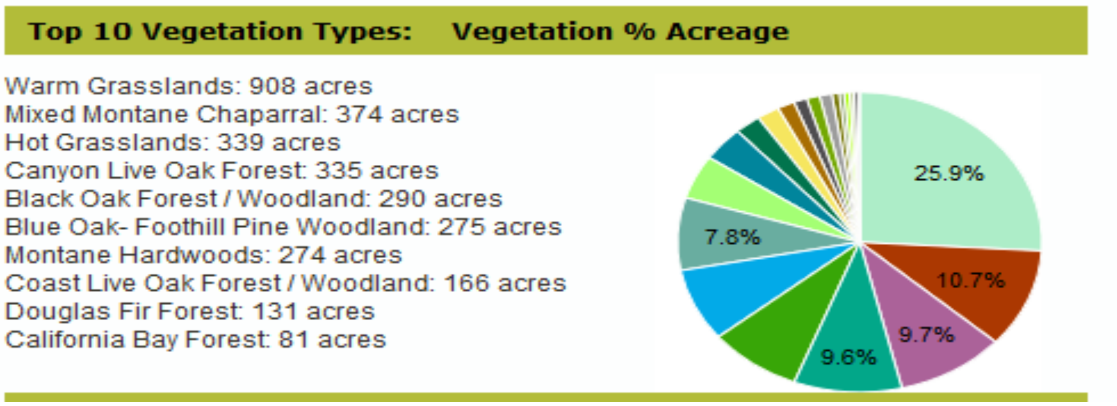
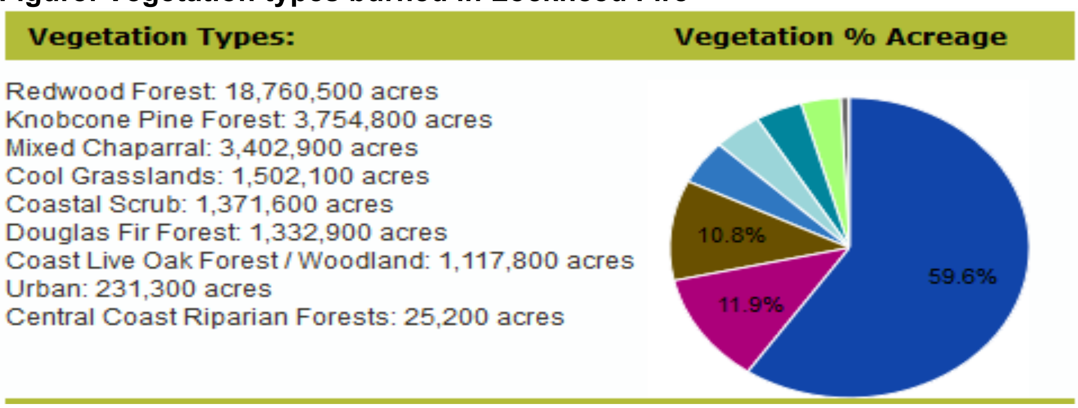


Figure: Vegetation types burned in Lockheed Fire



Prescribed Fires

Prescribed fire is an important and effective resource management tool, but many barriers prevent consistent use. Peak historical prescribed fires occurred in 1983 (8,081 acres), 1994 (6,933 acres), and 1995 (7,483 acres). In recent years, prescribed fires burned 3,012 acres in 2008, 3,005 acres in 2010, and 2,871 acres in 2011, but only 114 acres were burned in 2012 and 2013.

High fire danger from drought conditions, and air quality concerns have limited the use of prescribed fires as a management tool in recent years.

Figure: Prescribed Fires by Year

Year	Acres burned	Number of fires
2013	114	2
2012	0	0

2011	2871	6
2010	3005	9
2009	0	0
2008	3012	4
2007	542	2
2006	1272	4
2005	1201	12
2004	490	1
2003	0	0
2002	2097	4
2001	1209	6
2000	26	1

Nitrogen Deposition
Long term estimate emissions of NO_x and NH_3 show continued decreases in NO_x with a reduction of 46% from 2010 to 2025, and a leveling off beyond that. There is no historical or projected trend for NH_3.

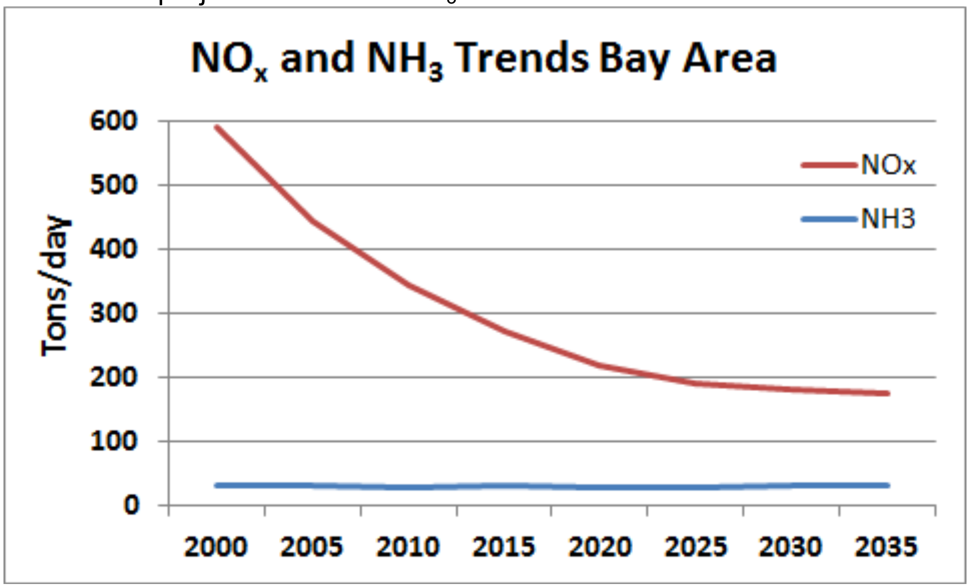
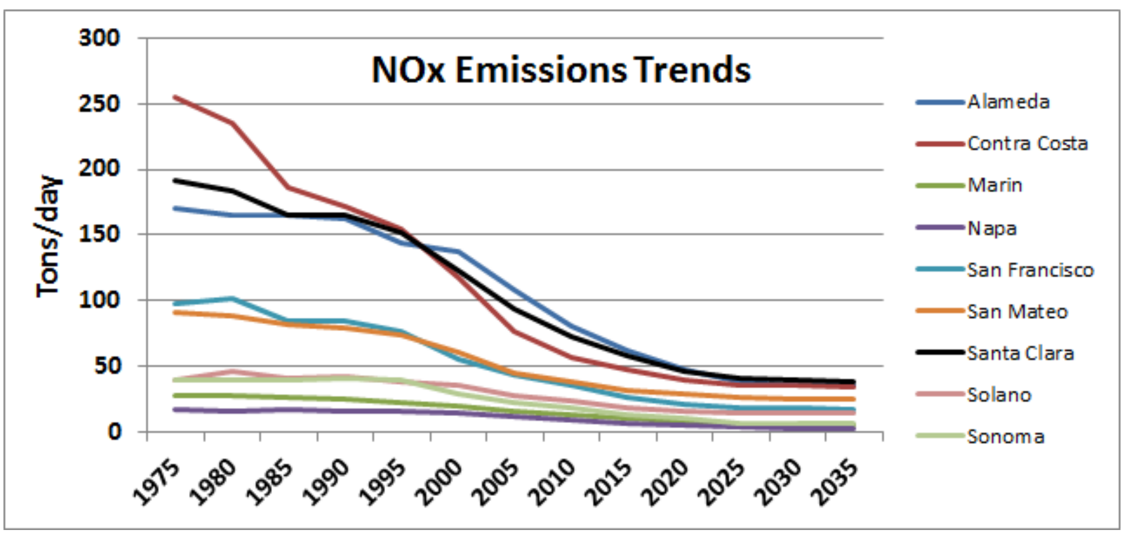


Figure: Trends in Nitrogen Deposition Emissions
Trends in estimated NO_x by county show the reductions in the context of population and vehicle miles traveled. N



These reductions in NO_x should be reflected in decreased oxidized N-deposition in coming decades, but the lack of trends in NH_3 means that reduced N-deposition will remain near current levels. It is estimated that many ecosystems will take several decades to recover from chronic deposition over the past 40+ years, and that sensitive systems will remain above critical loads going forward and require management (Fenn et al. 2010).

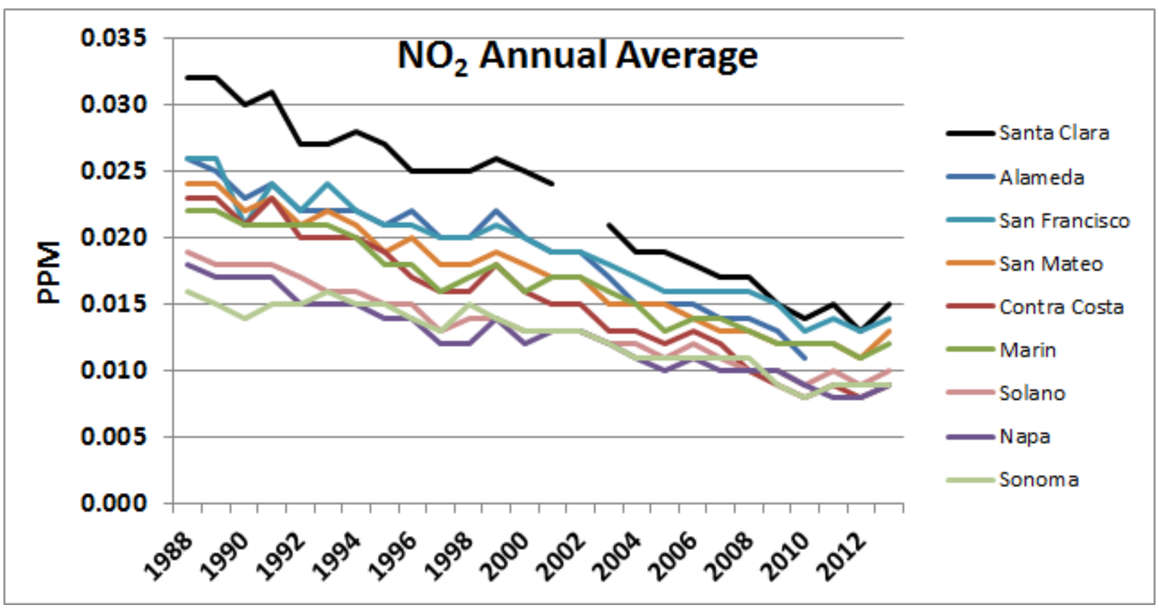
Exhaust from vehicles, urban and industrial facilities and emissions from agricultural fields and animal operations contain reactive nitrogen gases (nitrogen oxides and ammonia) that contribute to air pollution. The reactive nitrogen is blown downwind and deposited on the landscape, where it acts as a slow-release fertilizer. Because most terrestrial ecosystems are nitrogen-limited, nitrogen deposition causes a profound and unprecedented biogeochemical disruption (Fenn et al. 2010).

Dry deposition, which in coastal California predominates over wet deposition (by rain, snow, and fog), is a process by which nitrogen-based pollutants are directly absorbed by plant leaves or adsorbed onto surfaces and eventually washed into the soil where it is taken up by roots and microbes. Where air pollution is elevated, increased nitrogen availability drives growth of non-native annual grasses and other weeds, which then crowd out native species (especially forbs), change fire cycles that drive broad-scale vegetation type conversion, and threaten rare ecosystems and taxa on nutrient-poor soils such as serpentine (Weiss 1999) and in vernal pools.

NO_2 concentrations have decreased by ~44-60% since 1988. Concentrations have leveled off in the last three years, primarily because of winter drought with stagnant air. Also note a 23-40% reduction since 2002, which reduces the absolute value of N-deposition in the map, but not the spatial pattern.

Short-term and long-term changes in concentration of nitrogen dioxide (NO_2). Long-term NO_x and NH_3 emissions estimates. Data are from CARB Almanac of AIr Quality 2013.

Figure: Trends in Nitrogen Deposition
Following many years of decrease, concentrations of nitrogen dioxide have leveled off in the last three years, primarily because of winter drought with stagnant air. Data are from CARB Almanac of AIr Quality 2013.



Spatial distribution of Nitrogen Deposition

The N-deposition hotspots in the Bay Area are determined by emissions sources and prevailing winds. Places and high sensitivity ecosystems at risk include.

- Santa Rosa Plain, Sonoma Mountain, and Southern Mayacamas to the east, vernal pools in Santa Rosa Plain and serpentine grasslands in mountains
- Southern Napa County - vernal pools and serpentine grasslands
- East Bay Hills - serpentine grasslands
- Santa Clara Valley and surrounding foothills - serpentine grasslands
- Mt. Diablo - serpentine grasslands, vernal pools
- Livermore Valley/Altamont Pass - alkali sink and vernal pools
- Scotts Valley/Highway 17 corridor - Sand Hills at risk

All grasslands in high deposition areas (>6 kg-N/ha/year) are likely to have increased annual grass and weed growth to the detriment of native species, especially annual wildflowers.

Invasive Weed Management

Most land conservation organizations are deeply involved in managing invasive weeds, which accounts for a large fraction of stewardship budgets. Quantitative accounting of weed management across the region is nearly impossible, given the number and diversity of organizations involved.

The table below indicates that there are numerous invasive weed issues throughout the region. Focused attention on eradication of high rated weeds, where feasible, may be a high priority. Continued surveillance is a critical step; early detection and rapid response is a keystone of weed management.

Several qualitative highlights include:

- State funding for Weed Management Areas was terminated in 2011 during the budget crisis. Many county WMAs have continued to meet and provide invaluable forums for local land managers.
- The promise of the Bay Area Early Detection Network (BAEDN) has floundered because of lack of funding.
- There is a desperate need for long-term consistent weed management funding both internally in land conservation organizations and from external funding sources. Weed management funding needs to increase by an order of magnitude.

Figure: Weed management
Number of weed taxa that are under surveillance, have been eradicated, or are contained. Definitions:

- *Surveillance*: not yet reported, but within 50 miles
- *Eradication*: Isolated occurrences, two quadrangles away from other occurrences.
- *Containment*: Well established in many quadrangles, opportunities to slow or stop the spread.

In the first section, the total number of taxa in each category by county is reported. In the second section, county level reports are further broken down by Cal-IPC statewide rankings (High, Moderate, Limited). Identification of the species and other data are available in the full County reports, available at http://calweedmapper.cal-ipc.org/.

Data Source: Cal Weedmapper http://calweedmapper.cal-ipc.org/ (provides county level reports that provide standardized lists of surveillance, eradication, and containment opportunities at the USGS 1:25,000 quadrangle scale.)

Total Number of weed taxa by County and Rating			
County	**Surveillance**	**Eradication**	**Containment**
Alameda	29	7	156
Contra Costa	22	6	148
Marin	21	10	155
Napa	63	5	115
San Francisco	29	6	145
San Mateo	23	11	147
Santa Clara	45	8	130

Santa Cruz	35	15	132
Solano	30	10	129
Sonoma	25	8	148
Rating: High			
County	**Surveillance**	**Eradication**	**Containment**
Alameda	5	2	30
Contra Costa	6	12	30
Marin	6	2	30
Napa	10	2	25
San Francisco	8	0	27
San Mateo	7	3	25
Santa Clara	9	4	24
Santa Cruz	8	5	23
Solano	7	4	28
Sonoma	5	1	32
Rating: Moderate			
County	Surveillance	Eradication	Containment
Alameda	12	5	62
Contra Costa	16	3	61
Marin	8	2	68
Napa	26	0	52
San Francisco	16	1	60
San Mateo	8	4	65
Santa Clara	19	2	57
Santa Cruz	14	5	59
Solano	23	3	54
Sonoma	15	1	62
Rating: Limited			
County	Surveillance	Eradication	Containment
Alameda	12	0	57
Contra Costa	12	1	57
Marin	7	6	57
Napa	27	3	38
San Francisco	17	5	56
San Mateo	8	4	57
Santa Clara	17	2	49
Santa Cruz	13	5	50
Solano	20	3	47
Sonoma	10	6	54

Sudden Oak Death

Sudden Oak Death (*Phytophthora ramorum*) is a disease that was introduced into the region in the 1990s through nursery stock, and infects many species of native and introduced plants. Tanoak (*Notholithocarpus densiflorus*) and coast live oak (*Quercus agrifolia*) are particularly sensitive; tanoak in particular suffers nearly 100% mortality and shows no sign of resistance. California bay (*Umbellularia californica*) is a major carrier and vector that does not exhibit mortality. Spread of SOD is intermittent and depends on specific moisture and temperature conditions. More information can be found at www.suddenoakdeath.org.

Especially hard hit areas include the Santa Cruz Mountains and Marin. The mortality of oaks changes forest composition, creates hazard trees in recreation areas, and results in loss of acorns for wildlife food. In forested areas, the loss of individual trees leads to temporary openings and eventual replacement of canopy by adjacent trees and new recruits of resistant species. Open canopies can foster the spread of invasive species such as French and Scots broom (*Genista monspessulana* and *Cytisus scoparius*) where they are present.

Figure: Sudden Oak Death Map
The distribution of SOD is tracked by the UC Berkeley Forest Pathology and Mycology Laboratory.

Download the Google Earth map (.kmz) by visiting:
http://nature.berkeley.edu/garbelotto/english/sodmap.php.

SOD has spread along much of the outer coast range from the Santa Cruz Mountains, Marin Coast Range, and into the Sonoma Coast Range. Infected bay trees are found along the Russian RIver Valley, outliers are found north of Cloverdale and inland from Gualala. Infected tan oaks are known from 7.5 miles inland from Timber Cove. Water-born samples have been documented between Timber Cove and Stewarts Point.

To the east, SOD has spread into Sonoma Mountain, Southern Mayacamas, Northern Mayacamas, Vaca Mountains West (east of Napa and Yountville), and the Middle and Northern East Bay Hills. Most infections are in Bay trees. Fortunately for now, no infections have been reported in the Mt. Hamilton and Mt. Diablo Ranges and Blue RIdge-Berryessa.

SOD will continue to spread, but the rate of spreading can be slowed by best management practices. The key responses to existing infections include management of hazard trees, weed management in newly opened forest, and quarantines where feasible. Continued monitoring on the frontiers of the epidemic (interior Sonoma Coast Range, eastern fringes in East Bay and South Bay, Vaca Mountains West) is essential for early detection and rapid response where containment is feasible.