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Lake Almanor Watershed

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About Lake Almanor

The Lake Almanor Basin sits in the headwaters of the North Fork of the Feather River in Plumas and Lassen Counties, encompassing just under 32,000 acres. With a capacity of 1.1 million acre-feet, Almanor is the third largest reservoir in California. Almanor's idyllic mountain setting has made it a premier destination for recreationists and luxury homeowners due to the large trout fishery. [Almanor Watershed Map](#) (PDF)

The Feather River Watershed was recently evaluated by the Sacramento River Watershed Program as a result of the Sacramento River Watershed Management Plan and Watershed Health Indicators Program. [This report](#) provides an overview of the health of the Feather River Watershed to better understand some of the relationships between social, economic, and environmental conditions, and watershed management actions.



Current & Recent Issues

Cloud-Seeding

A Forum to Address Cloud-Seeding

The Almanor Basin Watershed Advisory Committee (ABWAC) hosted a community forum on PG&E's cloud-seeding operations in the Lake Almanor Basin on Wednesday, May 25th with a panel of six scientists in response to community concerns about cloud seeding in the Lake Almanor Basin.



For an in-depth look at what happened at the forum, [read more](#) of Kate West's article in the Chester Progressive, June 1, 2011.

What's next?

There are several outstanding questions / research needs that were identified during the panel for which ABWAC will create a subcommittee to review:

- Regarding silver iodide in nano form:
Is it toxic?
What is the status of contemporary research?
Can it be inhaled?
Why is the toxicity of silver iodide described differently by MSDS sheets and by PG&E?
How long has PF&E been cloud-seeding in nano form?
- Is there a correlation between nighttime inversion layers/plumes and dates/times of cloud-seeding?
- Are there any evidence-based studies anywhere regarding cloud-seeding and public health correlations?
- Is long-term monitoring required? If not, why not?
- EPA Guidelines?
Does the EPA regulate cloud-seeding?
Clarification needed as to whether or not nano-particles are regulated.
- Berkeley researcher described this as toxic. (Related to us by audience member citing a story from the internet - PG&E asked for the name of this person.)

PG&E Responds

PG&E has responded to the concerned citizens and ABWAC at the May 25th forum in a letter. [Read more.](#)

Why is ABWAC Addressing this issue?

ABWAC seeks to facilitate citizen concerns over issues brought to their attention and act as a conduit for information. At the March 2011 monthly meeting ([March Minutes](#) - pdf), many concerned citizens attended the meeting and outlined their concerns over the safety of cloud-seeding and the lack of information regarding its practice. It was determined that enough unanswered questions were presented to warrant further attention. It was decided that a public forum with experts to address toxicology, climate science, and public health would provide the public a chance to ask questions and get those questions answered.

FAQ

What Is Cloud-Seeding?

Cloud-seeding (also known as weather modification) is an activity used to change the amount or type of precipitation that falls from clouds. Cloud-seeding has been practiced in California for over 50-years. The practice is based on the dispersion of silver iodide as a seeding material. Typically, seeding 'generators' burn a solution containing silver iodide dissolved in acetone. The burning process produces a vapor of microscopic silver iodide particles (about 0.0001mm size), which then created additional ice crystals, then snow in winter clouds.

How is Cloud-Seeding Regulated?

PG&E's cloud-seeding program is addressed in the Water Use and Quality Report from the 2105 license application, as well as from the final EIS. The license application includes a description of the regulatory regime, which includes federal oversight by NOAA, state oversight by DWR, and public notice, record-keeping, and reporting requirements for PG&E. At the Federal level, the National Oceanic and Atmospheric Administration is the regulating agency for Public Law 92-205 (Weather Modification Reporting Act of 1972), which requires cloud-seeding sponsors to file periodic reports regarding their weather modification projects. For projects that operate on a long-term, on-going basis, the law requires an initial, interim, and final report be issued each year. At the State level, the California Department of Water Resources is the oversight body and Section 410 of the California State Water Code, governs cloud-seeding projects in California. It requires sponsors of a cloud-seeding project to publish a notice of intent regarding the project every 5-years in local newspapers of the counties in which the seeding equipment is located and where seeding effects are expected to occur. The law also requires the sponsor to retain records regarding the cloud-seeding activities.

Is Cloud-Seeding Harmful?

Questions about potential unintended impacts from precipitation enhancement have been raised and addressed over the years. Common concerns expressed are related to enhancing precipitation in one area at the expense of those downwind, and various, long-term effects of the chemicals used to conduct cloud-seeding, such as silver iodide. For more information, see the resources list below:

How Can I Find More Information?

State of California-Related Oversight:

1. [California Water Code Section 410-412](#)
2. [California Department of Water Resources 2009 California Water Plan Update](#)

NEPA-Related Documents

1. [County of Los Angeles Weather Modification Project Draft Mitigated Negative Declaration](#)
2. [EIS Supplement to the Environmental Impact Statement for the Prototype Project to Augment Snow Pack by Cloud-Seeding using Ground-Based Dispensers in Plumas and Sierra County \(Oct 1991\)](#)

This referenced document is a large .pdf file. This link takes you to the California Dept. of Water Resources publication listings where you can find and download the document.

3. [Upper North Fork Feather River Project, FERC No. 2105 Final Environmental Impact Statement \(2005\)](#)
4. [Upper North Fork Feather River Project, 2002 License Application; Volume 1 Report E2: Water Use & Quality](#)

5. **DRAFT Environmental Assessment for the Walker River Basin Cloud-Seeding Project**
Lahontan Basin Area Office Carson City, Nevada (Mid-Pacific Region) November 2010

Scientific / Research Papers

1. **Silver Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review by Ronald Eisler**
(Patuxent Wildlife Research Center, U. S. National Biological Service) 1986
2. **Optimizing Cloud-Seeding for Water and Energy in California:**
Prepared for the California Energy Commission - Public Interest Energy Research Program
3. **An Evaluation of Eleven Operational Cloud-Seeding Programs in the Watersheds of The**
Sierra Nevada Mountain - Bernard A. Silverman (Atmospheric Research 97 (2010)

Cloud Seeding In the News

<http://www.ktvu.com/video/17022143/index.html>

<http://www.pressdemocrat.com/article/20081228/NEWS/812280446?p=2&tc=pg>

NOTE:

This is NOT INTENDED to be an all-inclusive Bibliography
but rather to point out the major studies easily accessed on the Internet.

Water Quality

2010 Water Quality Report is Out

Dr. Gina Johnston has been collecting water quality data from Lake Almanor for the past two years. The **2009 Water Quality Report** (pdf) and the most recent **2010 Water Quality Report** (pdf) describe Lake Almanor as a fairly rich reservoir with a diverse assemblage of plankton. Dr. Johnston said that while the lake is healthy, there are some "nuisance" species of phytoplankton present (most common are *Lyngbya* and *Anabaena*) and their populations should be monitored. Several of the Cyanobacteria, commonly called "bluegreens," produce toxins that can affect humans and pets. To see where the monitoring stations are located, see the **Map of Monitoring Stations** (PDF).

So What Is Blue-Green Algae (Cyanobacteria) and What Does It Mean to You?

Blue-green algae are very small, structurally simple plants that occur naturally in aquatic environments. Also known as "cyanobacteria," there are many varieties, some of which can produce toxins potentially harmful to humans and other animals. Although cyanobacteria are a natural component of any aquatic ecosystem, a cyanobacterial bloom can be dangerous due to the possible toxicity. The concentration of the nutrients is largely what stimulates cyanobacterial blooms. Phosphorus availability is widely recognized as the main nutrient that limits algal growth, but nitrogen levels are also a determining factor. Sources of these nutrients include agricultural run-off, and untreated or inadequately treated sewage. Phosphorus also easily binds to soil particles and enters water bodies from surface run-off and erosion. Addressing sources of nutrient input is an important way to reduce the chances of an algal bloom.

Conditions that increase the chance of an algal bloom:

1. Little water movement, in terms of both horizontal flow and vertical mixing
2. High levels of nutrients (phosphorus and nitrogen)
3. Warmer water temperature

Effects

Cyanobacterial blooms can cause a health risk to water users as produced toxins can result in rashes, irritation, and gastrointestinal problems and potentially liver damage in the long run. Symptoms depend on how the water was contacted (swallowed, touched, immersed, et cetera) and the duration of exposure. Dogs have been known to become ill or die from licking their fur after swimming in water. Algal blooms are also stressful to organisms living in lakes as a dense bloom can block sunlight from penetrating to deeper depths and deplete dissolved oxygen in the water as they decay, which can stress or kill fish populations.

Presence of cyanobacteria in Lake Almanor

The Lake Almanor Water Quality Report 2010 showed that overall yearly populations of algae were similar to 2009. However, the seasonal distribution was different, with 2010 showing a larger amount of algae in July and a smaller amount in November. There also were more blue-green algae and less green forms in 2010. The most common nuisance species were *Anabaena* and *Microcystis*, both of which are potentially

toxic cyanobacteria, and the November population of *Microcystis* formed large colonies that were visible to the naked eye.

Continued Monitoring

It is important to monitor cyanobacteria to identify any possible trends of increasing concentrations. This need is augmented by documented regional changes towards increasing temperature and more precipitation falling as rain, in turn increasing run-off, both of which can create ideal conditions for an algal bloom. Understanding the sources of nutrients for Lake Almanor is also important to minimizing the risk of a cyanobacterial bloom.

The World Health Organization advises that in areas of high population density, sewage is usually the nutrient source to focus on, while less populated areas usually need to address run-off sources of nutrients.

The Lake Almanor area falls into a third category, "low population areas affected by tourism may increase temporarily several-fold and overload sewage treatment capacities. In temperate regions, the tourism season may coincide with the cyanobacterial growth season." Focused research and expanded monitoring may help identify sources of nutrients, and how to limit their entrance into Lake Almanor.

You can [Read More](#) for this at

http://www.who.int/water_sanitation_health/resourcesquality/toxiccyanobact/en/.



Photos of various cyanobacteria can also be viewed at
<http://www.wilsonlab.com/photos.html>.

Potential Changes to Lake Quality

The Lake Almanor Basin is potentially impacted by storm-water runoff, failing lakeside septic systems, and extensive residential development. However, larger scale sources have recently been identified as having the potential to change both the quality of Lake Almanor, as well as its biological and physical condition.

Temperature and Changing Precipitation Regimes

Lake Almanor has a natural stratification of water temperatures, so the lake offers an already small area for cold water fish. In addition to temperature, stratification causes differences of available oxygen to fish that is dictated by depth. Such low levels of dissolved oxygen in the summer can stress fish and although there is no loss of fish being recorded, optimal habitat for cold-water fish is quite limited in the summer. Within this already small margin of error is the growing body of evidence that Lake Almanor may be affected by precipitation regimes that could result in significant warming. For more information regarding higher water temperatures, see [2009 Lake Warming Trend - Geophysical Research Letters](#) (PFD).

Several recent studies by PG&E, the USGS, and the California Department of Water Resources all suggest that the Feather River basin as a whole, with the Almanor basin in particular, will experience declining flow in the foreseeable future. To read more about these trends, see

1. [Runoff Impacts of Climate Change on Northern California's Watersheds as Influenced by Geology and Elevation - a Mountain Hydroelectric System Perspective](#)
2. [Tracking the Impact of Climate Change on Central and Northern California's Spring Snowmelt Subbasin Runoff](#)
3. [Watershed-Scale Response to Climate change: Feather River Basin, California](#)
4. [Climate Change and California Water Management](#) This link will take you to the Agenda of the First Western Forum on Energy & Water Sustainability where you can select the link to John Andrew's Climate Change and California Water Management pdf located in Section Two Regional "Hot Spots".
5. [The Hydrology of Climate Change on Battle Creek and the North Fork Feather River](#)
6. [Temperature and Changing Precipitation Regimes](#)

Mussels

Although tiny, quagga and zebra mussels threaten California's waterways through infestation and once introduced proliferate to the point of causing a waterbody's food chain to collapse, and render water distribution systems useless because they plug infrastructure. Boats can easily transport microscopic mussel larvae and adult mussels can survive out of the water for up to one week, longer when the weather is warmer. Since arriving from Europe in 1980, these mussels have made their way west and in 2008 were found in the San Justo Reservoir in San Benito County, California. If mussels gained a stronghold in Lake Almanor, the region's economy would be devastated and mussels could infect the entire Feather River. The only defense from infestation is prevention because no eradication is possible.

Mussels in California

Mercury

Lake Almanor has been listed as 'impaired,' per Clean Water Act section 303d and scheduled for a TMDL for mercury by 2021 as a result of resource extraction. This decision was based on a small number of fish with just over .25 ppb of mercury, which just exceeded the USEPA fish tissue criterion for human health. Two size classes of smallmouth bass and one size class of brown trout were obtained from Lake Almanor near the dam. Tissue from the larger size class of smallmouth bass contained mercury at concentrations in excess of screening values and EPA criterion. The brown trout, though larger than the bass, contained much less tissue mercury. According to an EPA report, Lake Almanor had "only slight past gold mining activity" in its watershed.

USGS Mercury expert Dr. Charlie Alpers was contacted and in June 2010 came to Chester to discuss his perspective on Lake Almanor's listing. He provided information on mercury impacts in the Sierra Nevada's more heavily impacted waterbodies. He suggested the mercury in Lake Almanor was not at a level to warrant concern.

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