Great Basin Unified Air Pollution Control District

Governing Board Regular Meeting

Thursday, November 4, 2021, at 10:00 AM
Lee Vining Community Center,
296 Mattly Avenue Lee Vining, California 93541

Mono Air And Water Workshop Presentations

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Mono Air and Water Workshop

Great Basin Unified Air Pollution Control District

November 4, 2021

AGENDA	
Mono Basin History and Tribal Perspective	Charlotte Lange, Chairwoman, Mono Kutzadika Tribe
Mono Basin Overview and History	Geoff McQuilkin, Executive Director, Mono Lake Committee
Land Management and the Mono Lake National Forest Scenic Area	Lesley Yen, Forest Supervisor Stephanie Heller, Mono Lake District Ranger Inyo National Forest, U.S. Forest Service
State Lands and Public Trust	California State Lands Commission
Mono Basin Air Quality Monitoring	Chris Lanane, Air Monitoring Specialist Chris Howard, Senior Research Systems Analyst Great Basin Unified Air Pollution Control District
Fluctuations of Mono Lake, Past and Future	Dr. Scott Stine, Professor Emeritus Cal State East Bay, consultant to GBUAPCD
Mono Basin Hydrologic Modeling	Scott Warner, Principal Hydrogeologist BBJ Group, consultant to GBUAPCD
Air Quality Modeling for the Mono Basin	Dr. Grace Holder, Senior Scientist Great Basin Unified Air Pollution Control District


Mono Lake Kootzaduka'a Tribe
Mono Basin History and Tribal Perspective
Great Basin Unified Air Pollution Control District
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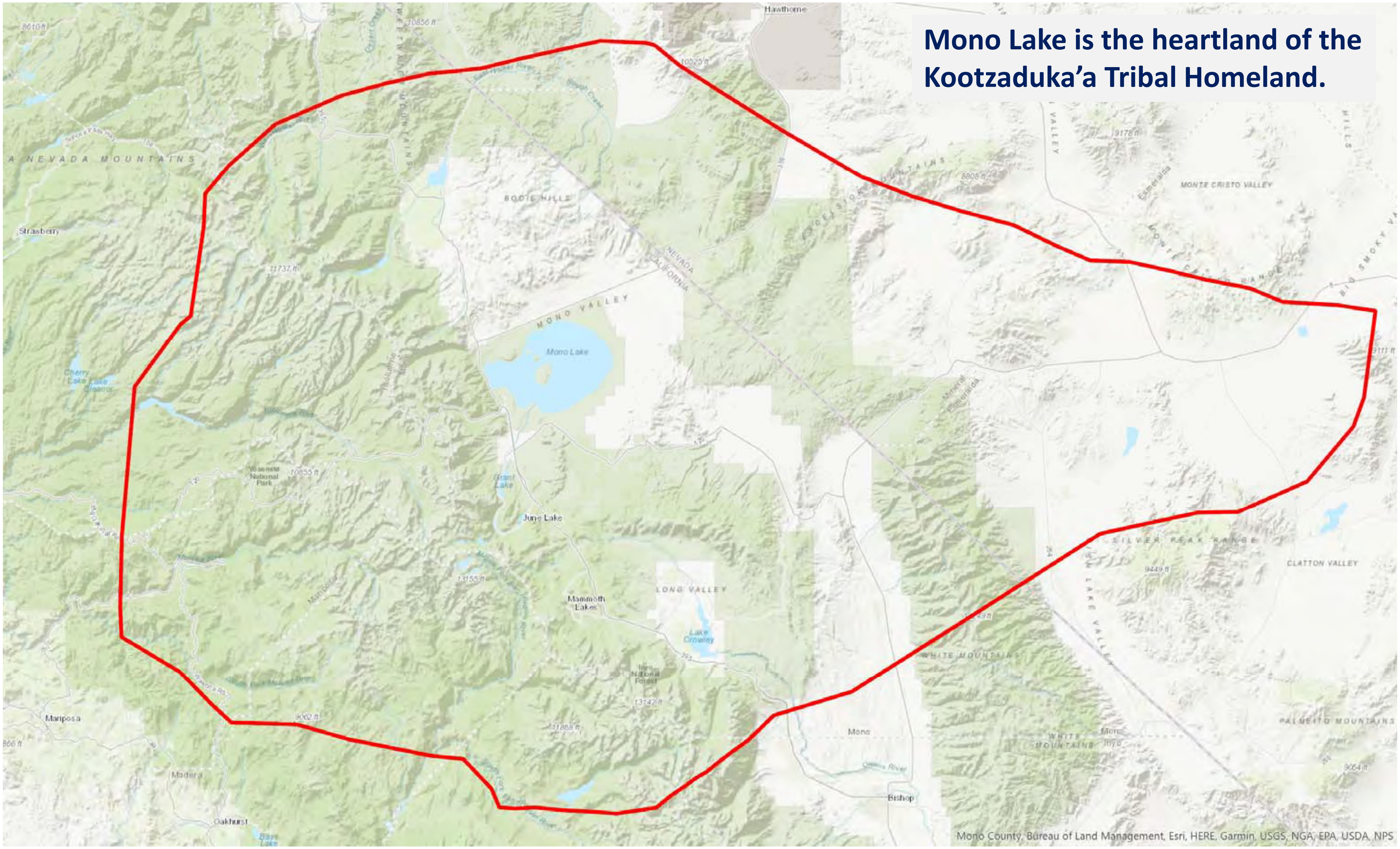
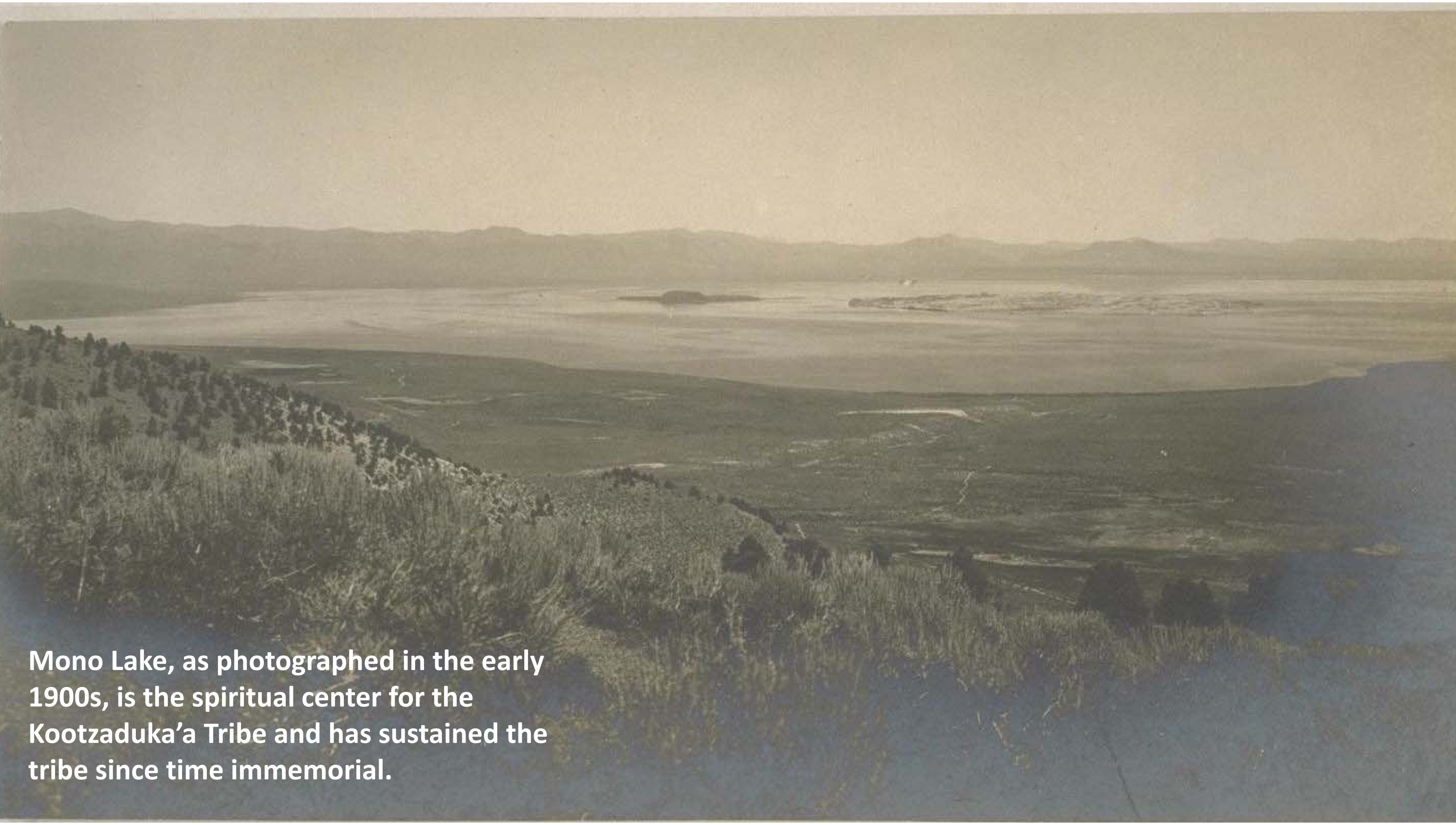

Mono Lake is the heartland of the Kootzaduka'a Tribal Homeland.
Hawthorne
BODIE HILLS
MONO VALLEY
Mono Lake
NEVADA
CALIFORNIA
MONTE CRISTO VALLEY
Strawberry
Yosemite National Park
June Lake
Mammoth Lakes
LONG VALLEY
Lake Crowley
SILVER PEAK RANGE
CLAYTON VALLEY
WHITE MOUNTAINS
PALMETTO MOUNTAINS
Mariposa
Madera
Oakhurst
Mono
Bishop
Mono County, Bureau of Land Management, Esri, HERE, Garmin, USGS, NGA, EPA, USDA, NPS

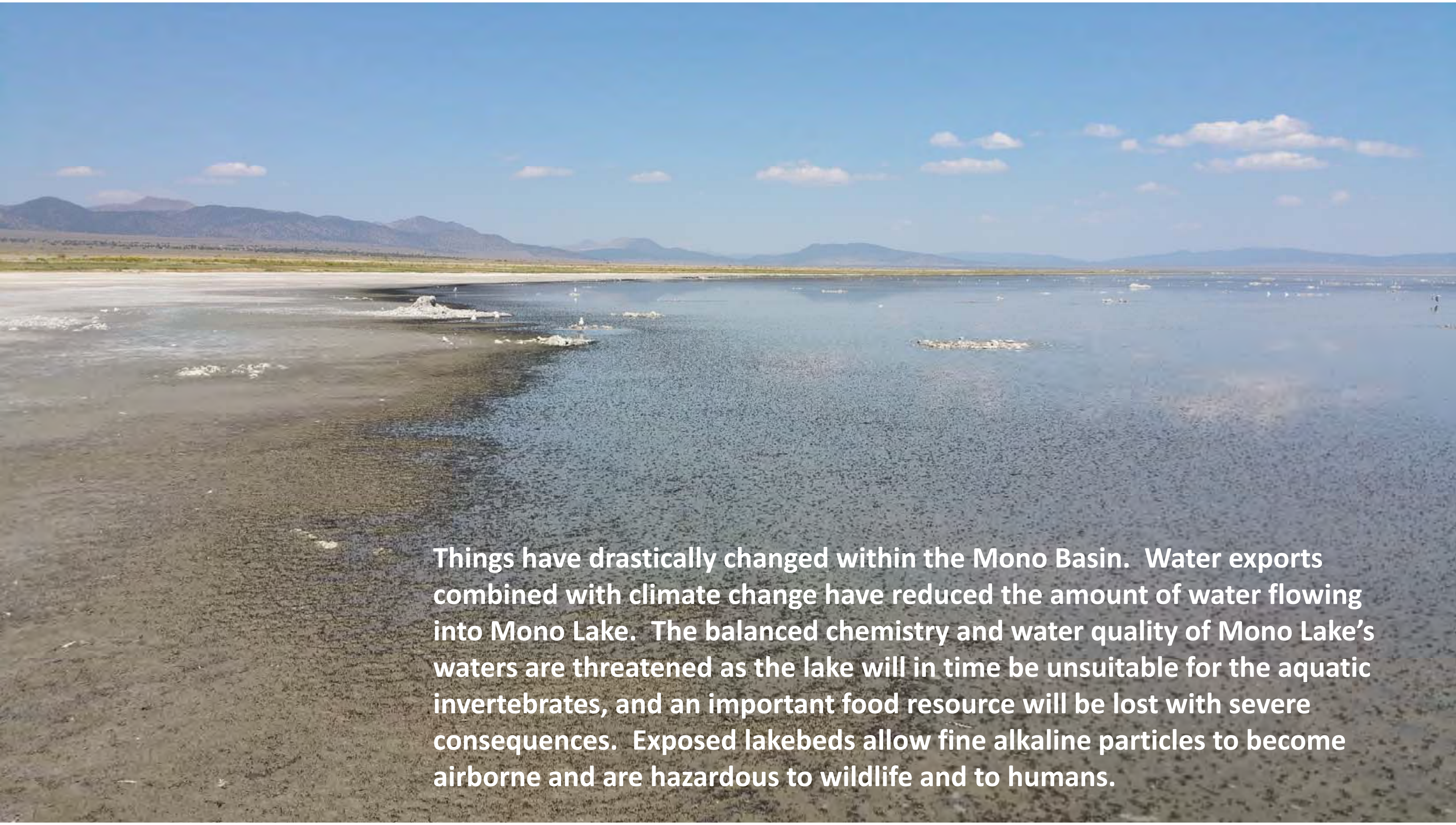

Mono Lake, as photographed in the early 1900s, is the spiritual center for the Kootzaduka'a Tribe and has sustained the tribe since time immemorial.


The Kootzaduka'a lived in simple houses throughout our homeland.


Over time the Kootzaduka'a lifeways changed as we adopted
housing, clothing, food and many other things from early settlers.

However, our grandparent’s generation kept our culture alive.


The balanced chemistry of Mono Lake's saline waters did not support fish but was habitat for the Brine Fly and Brine Shrimp which fed thousands of migratory waterfowl. The Brine Fly pupae were an important insect food source for the Kootzaduka'a Tribe.


Things have drastically changed within the Mono Basin. Water exports combined with climate change have reduced the amount of water flowing into Mono Lake. The balanced chemistry and water quality of Mono Lake's waters are threatened as the lake will in time be unsuitable for the aquatic invertebrates, and an important food resource will be lost with severe consequences. Exposed lakebeds allow fine alkaline particles to become airborne and are hazardous to wildlife and to humans.


Fire suppression has resulted in fuels accumulation and now with climate change, wildfires are more intense and create smoke-filled skies which add to the air pollution within the Mono Basin, creating known hazards to human health.

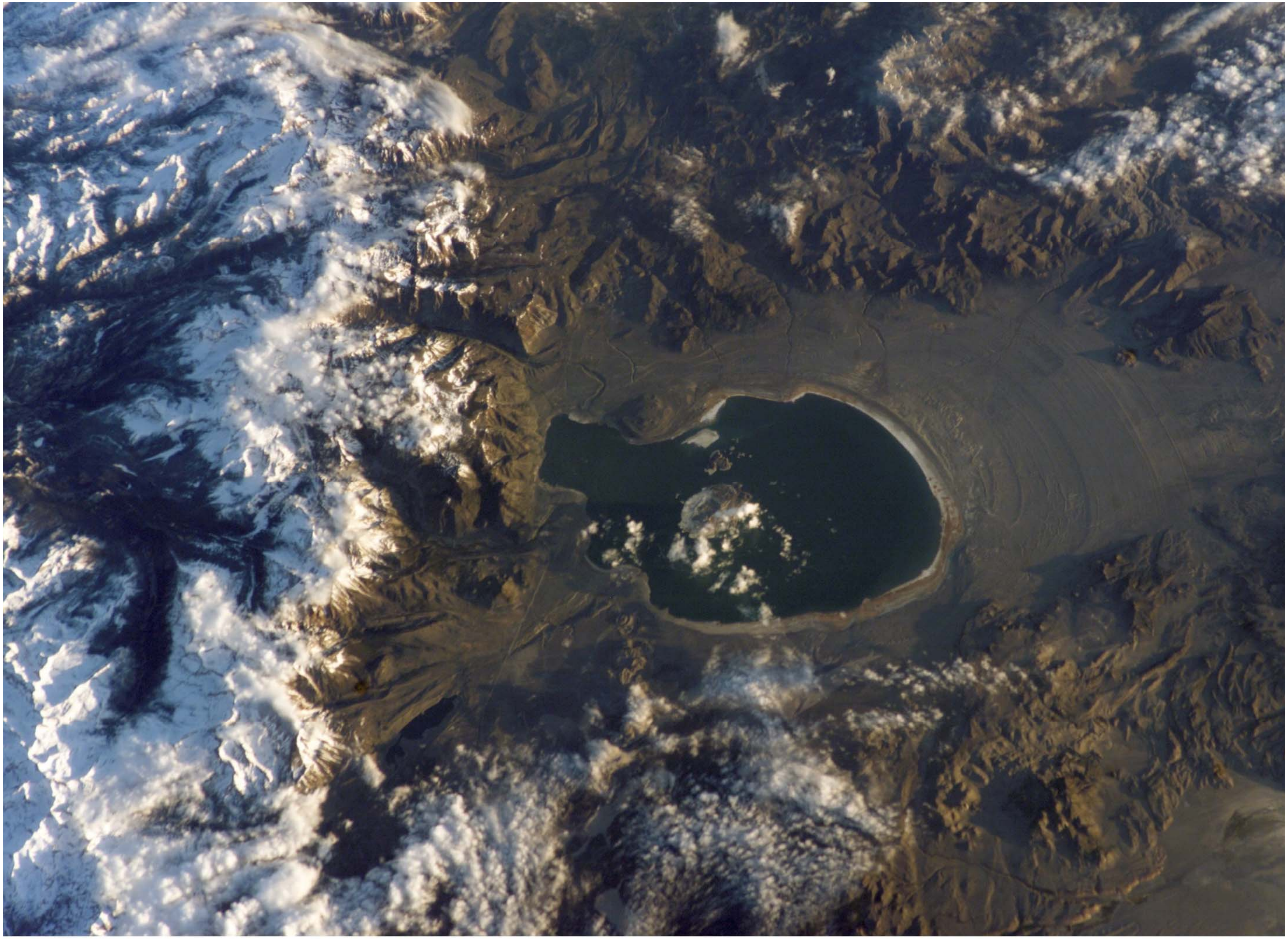
Threats to water and air quality are only going to get worse with climate change. The hazardous impacts to the health of our wildlife and to our people are irrefutable and irreversible. No one has the right to destroy us.

Action is needed now to protect our waterbodies, our air, our wildlife and our people. The Mono Lake Kootzaduka'a Tribe is here to offer assistance in finding solutions to the water and air quality crisis we face here in the Mono Basin.

Mono Lake & Basin

Water overview and history

Geoff McQuilkin
Executive Director
geoff@monolake.org
www.monolake.org



ISS004E12318 Sunrise, Mono Lake, Mono Basin, May 23, 2002, from the International Space Station.


Algae


Brine Shrimp


Alkali Flies


Critical habitat


Los Angeles
Riverside
Bakersfield
Owens Lake
Fresno
Merced
Mono Lake
395
6
140
132
120
108
49
101
© 2013 Google
Image Landsat
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2013 INEGI
Google earth
Imagery Date: 4/9/2013 37°20'21.13" N 119°33'07.10" W elev 4211 ft eye alt 88.59 mi

PART II—LOCAL SHEET: 12 PAGES

Los Angeles Daily Times

California del Sur.
CITY AND COUNTRY.

XXIVTH YEAR. SATURDAY MORNING, JULY 29, 1905. 5 CENTS

TITANIC PROJECT TO GIVE CITY A RIVER.

Thirty Thousand Inches of Water to be Brought to Los Angeles.

Options Secured on Forty Miles of River Frontage in Inyo County—Magnificent Stream to be Conveyed Down to the Southland in Conduit Two Hundred and Forty Miles Long—Stupendous Deal Closed.

THE Times announces this morning the most important movement for the development of Los Angeles in all the city's history—the closing of the preliminary negotiations securing 30,000 inches of water, or about ten times our present total supply, enough for a city of 2,000,000 people. In brief, the project is to bring this water to Los Angeles from Owens River in Inyo county, a distance of 240 miles, at a cost of about $23,000,000. Options on the water-bearing lands have been closed by the city's representatives and a series of bond issues will be asked of the voters. This new water supply, immense and unfailing, will make Los Angeles forge ahead by leaps and bounds and remove every specter of drought or ... enormous stream of the purest mountain water pouring in here, Los Ange... best supplies in the land; she will have water to sell to the San Fernan... San Diego: she will have assured her future for a century. There is no ... will be forthcoming.

INDEPENDENCE (Cal.) July 28.—[Exclusive Dispatch.] Agents representing Los Angeles city have secured options on about forty miles of frontage on the Owens River north of Owens Lake. Fred Eaton, ex-Mayor of Los Angeles, and the superintendent of the Los Angeles water works were in the valley in an automobile the early part of this week. Two days ago they closed the last outstanding options. The price paid for many of the ranches is three or four times what the owners ever expected to sell them for. Everybody in the valley has money, and everyone is happy.

Three months ago Eaton bought the holdings of the Rickey Cattle Company, comprising about 50,000 acres of water-bearing land. It was then thought that Eaton was going into the stock-raising business here, but it has since been learned that he was securing options for Los Angeles city. Eaton has made every option solid and secured all the land the city wanted. The deal is riveted.

THE cable that has held the San Fernando Valley vassal for ten centuries to the arid demon is about to be severed by the magic scimitar of modern engineering skill.

INDEPENDENCE SACRIFICED.

ENORMOUS SUPPLY.

U. S. GOVERNMENT CONCESSIONS.

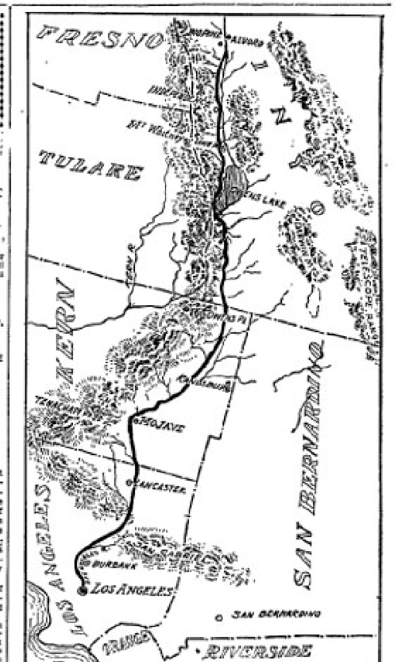
Thirty thousand inches of water means more to Los Angeles than all the gold hidden away in the California mountains.

SUPT. MULHOLLAND, of Waterworks.

LAST SPIKE IN, DEAL CLOSED.

SUPT. MULHOLLAND BRINGS THE GLAD TIDINGS.

Says Options are Fixed and Los Angeles Becomes Owner of Thirty Thousand Inches of Purest Snow Water—Would Give All the Credit to Others.



Showing route of 240-mile conduit from Owens River to Los Angeles.

FINANCIAL DARING IN GETTING OPTIONS.

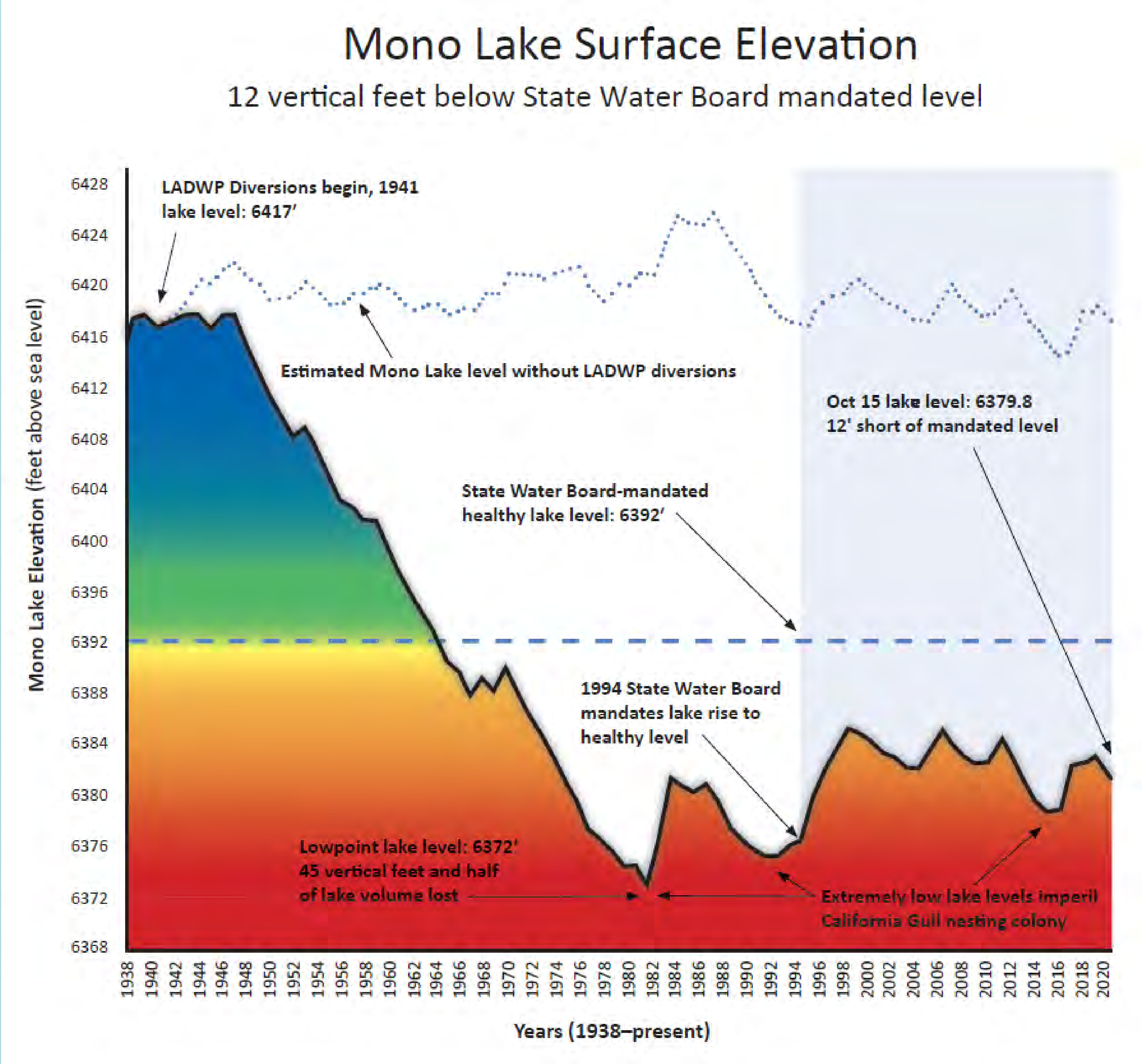
Los Angeles Water Board, which secures 30,000 inches of water for the city. From left to right, J. J. Fay, J. M. Elliott, M. H. Sherman, William Mead, Fred L. Baker.

Stream Diversions

Rush, Lee Vining, Parker, and Walker creeks

Groundwater inflow

into the Mono Craters Tunnel



Mono Lake Surface Elevation
12 vertical feet below State Water Board mandated level
Mono Lake Elevation (feet above sea level)
LADWP Diversions begin, 1941
lake level: 6417′
Estimated Mono Lake level without LADWP diversions
Oct 15 lake level: 6379.8
12' short of mandated level
State Water Board-mandated
healthy lake level: 6392′
1994 State Water Board
mandates lake rise to
healthy level
Lowpoint lake level: 6372′
45 vertical feet and half
of lake volume lost
Extremely low lake levels imperil
California Gull nesting colony
6428
6424
6420
6416
6412
6408
6404
6400
6396
6392
6388
6384
6380
6376
6372
6368
1938 1940 1942 1944 1946 1948 1950 1952 1954 1956 1958 1960 1962 1964 1966 1968 1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020
Years (1938–present)

Water Diversion Impacts

Mono Lake

Mono Lake dropped 45 vertical feet,
lost half its volume, and doubled in salinity

By the 1980s, Mono Lake was on verge of ecosystem collapse

Water Diversion Impacts
Mono Basin Streams

Lost 20 miles of fisheries, streams, streamside forests, and broad bottomlands habitats

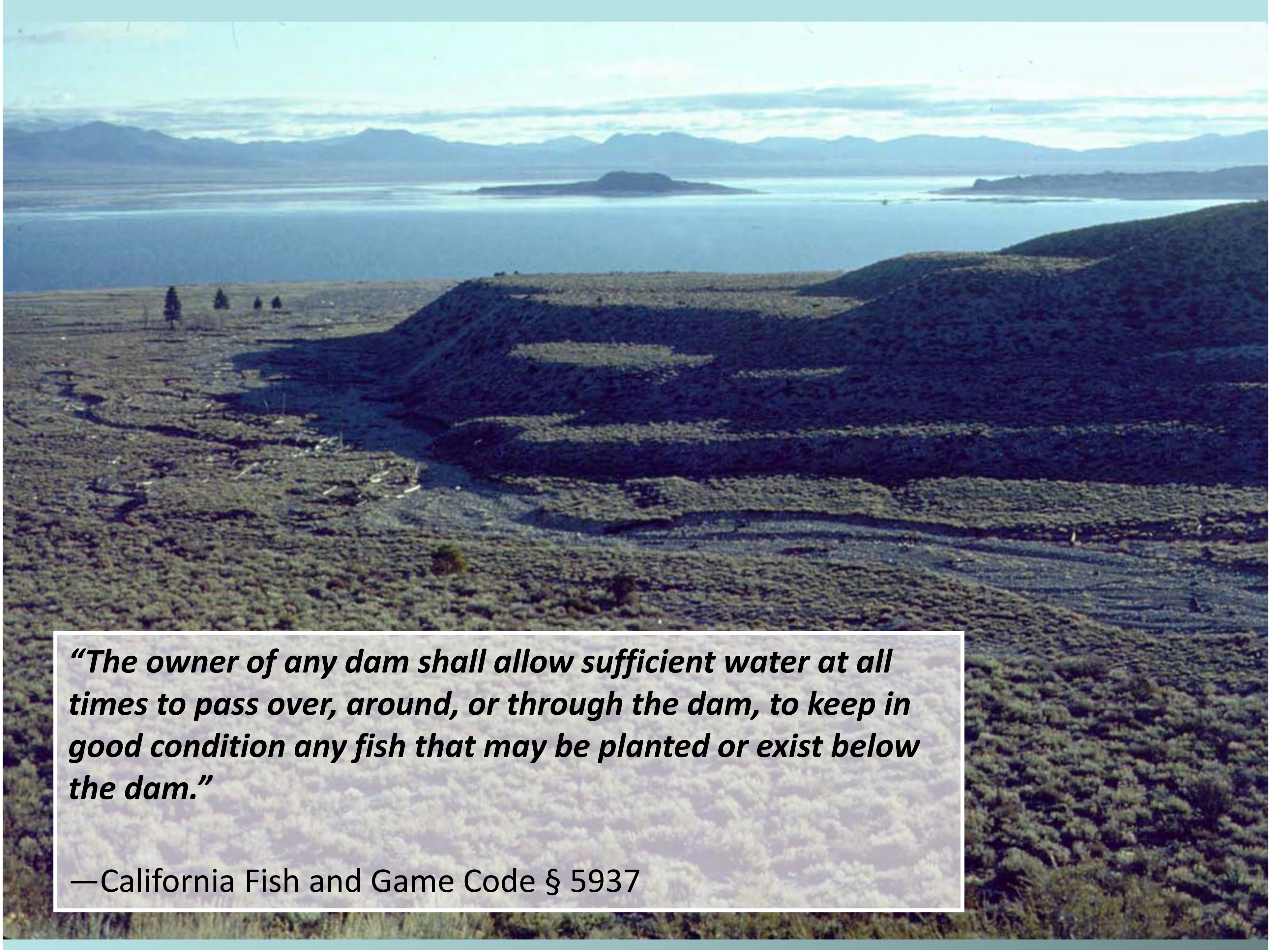
Lost premier Sierra trout fishery


SAVE MONO LAKE
ONE WATERSHED
NOT FOR SALE
MONO LAKE BELONGS ITSELF!
DONT OWENSIZE MONO
MONO IS FOR PEOPLE
SAVE THE BRINE SHRI
D.W.P.: WASTE NOT WANT NOT
REHYDRATE HERE


Water for MONO LAKE & LA !

"The public trust … is an affirmation of the duty of the state to protect the people's common heritage of streams, lakes, marshlands and tidelands…."

The Mono Lake Decision, Supreme Court of California, 1983


“The owner of any dam shall allow sufficient water at all times to pass over, around, or through the dam, to keep in good condition any fish that may be planted or exist below the dam.”
—California Fish and Game Code § 5937

“The water diversion criteria … restrict Mono Basin water exports in a manner that is intended to result in the water level of Mono Lake rising to an elevation of 6,391 feet in approximately 20 years.”

State Water Board, Decision 1631, pp.2-3

California State Water Resources Control Board
Provisions of license
authorizing Los Angeles to divert Mono Basin streams

Diversions are directly linked to lake level

Mono Lake level measured on April 1	Allowed stream diversions
Above 6,391 feet	Streamflow in excess of instream flow requirements
Between 6,380 and 6,391	Up to 16,000 acre feet
Between 6,377 and 6,380	Up to 4,500 acre feet
Below 6,377	0 acre feet
Forecast to fall below 6,377 April 1 – March 31	0 acre feet

“In the event that the water level of Mono Lake has not reached an elevation of 6,391 feet amsl by September 28, 2020, the State Water Board will hold a hearing to consider the condition of the lake and the surrounding area, and will determine if any further revisions to this amended license are appropriate.”

State Water Board, City of Los Angeles Right to Divert and Use Water 10191

"If future conditions vary substantially from the conditions assumed in reaching this decision, the SWRCB could adjust the water diversion criteria in an appropriate manner under the exercise of its continuing authority over water rights."

State Water Board, D1631, p. 159

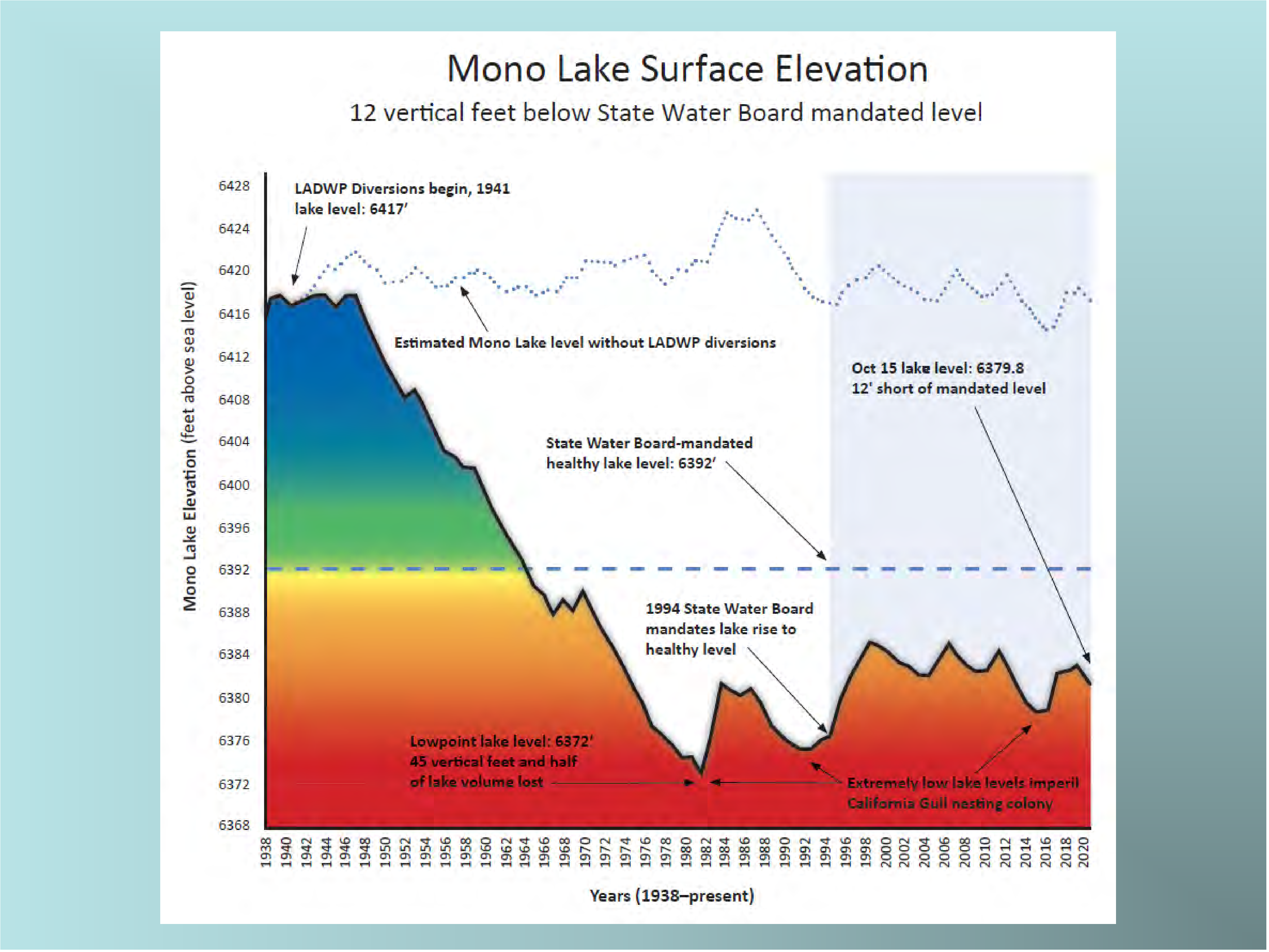

Ian Parker 2014

2021 Stream Restoration Order

State Water Board Order 2021-86

October 1, 2021

"As noted above, Mono Lake has not yet reached 6,391 ft amsl as of the trigger date for a lake level hearing (as identified in D1631 or as amended by this Order). Because the proposed changes and amendments to LADWP's licenses appear to have little-to-no direct bearing on the lake level criteria established by D1631, **this Order does not directly address any separate issues regarding target lake levels. The State Water Board will separately schedule appropriate proceedings to gather and consider pertinent information on this issue."**



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12 vertical feet below State Water Board mandated level
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Years (1938–present)


Spring 2014


Spring 2015


MONO LAKE
COMMITTEE
Geoff McQuilkin
Executive Director
geoff@monolake.org
www.monolake.org

Land Management and the Mono Lake National Forest Scenic Area

Stephanie Heller, District Ranger
Mono Lake Ranger District
Inyo National Forest

Inyo National Forest Land Management Plan
October 2019

3 Broad Goals:

- Fire Management and Smoke
- Ecological Integrity
  - Restore wildlife and plant habitat diversity and improve resilience of terrestrial and aquatic ecosystems to stressors…
- Sustainable Recreation and Designated Areas
  - Provide for sustainable recreation by addressing the high volumes of recreation use to provide a variety of visitor experiences, opportunities and settings while reducing impacts to resources and existing infrastructure.

Watershed Management – Forestwide

Desired Condition (WTR-FW-DC)

- 01 **Adequate quantity and timing of water flows support ecological structure and functions**, including aquatic species diversity and riparian vegetation. Watersheds are resilient to changes in air temperatures, snowpack, timing of runoff, and other effects of climate.

Goal (WTR-FW-GOAL)

- 01 Collaborate with Tribes; local, State and Federal agencies; adjacent landowners; and other interested parties on **watershed restoration across ownership boundaries**.

Watershed Management – Forestwide

Standards (WTR-FW-STD)

- 03 …ensure that special use permit language provides **adequate in-stream flow requirements to maintain, restore, or recover favorable ecological conditions for local riparian- and aquatic-dependent species**.

Guidelines (STR-FW-GDL)

- 01 **Minimize the effects of stream diversions** or other flow modifications on at-risk species as well as other beneficial uses…

Watershed Management - Forestwide

- Potential Management Approaches
  - **Implement restoration projects** that promote long-term ecological integrity and resilience and facilitate attainment of aquatic and riparian desired conditions
  - Consider using **natural ecological processes** to achieve desired conditions, when appropriate

Other Forestwide Desired Conditions

- Air Quality
- Animal and Plant Species
- Bi-State Sage-grouse
- Invasive Species
- Sustainable Recreation
- Rangeland Livestock Grazing
- Geology and Minerals
- Cultural Resources
- Tribal Relations and Uses
- Local Communities

- Terrestrial Ecosystems
- Volunteers, Interpretation, Partnerships and Stewardship
- Lands
- Infrastructure
- Conservation Watersheds
- Riparian Conservations Area
- **Mono Basin National Forest Scenic Area**

Mono Basin National Forest Scenic Area

1984

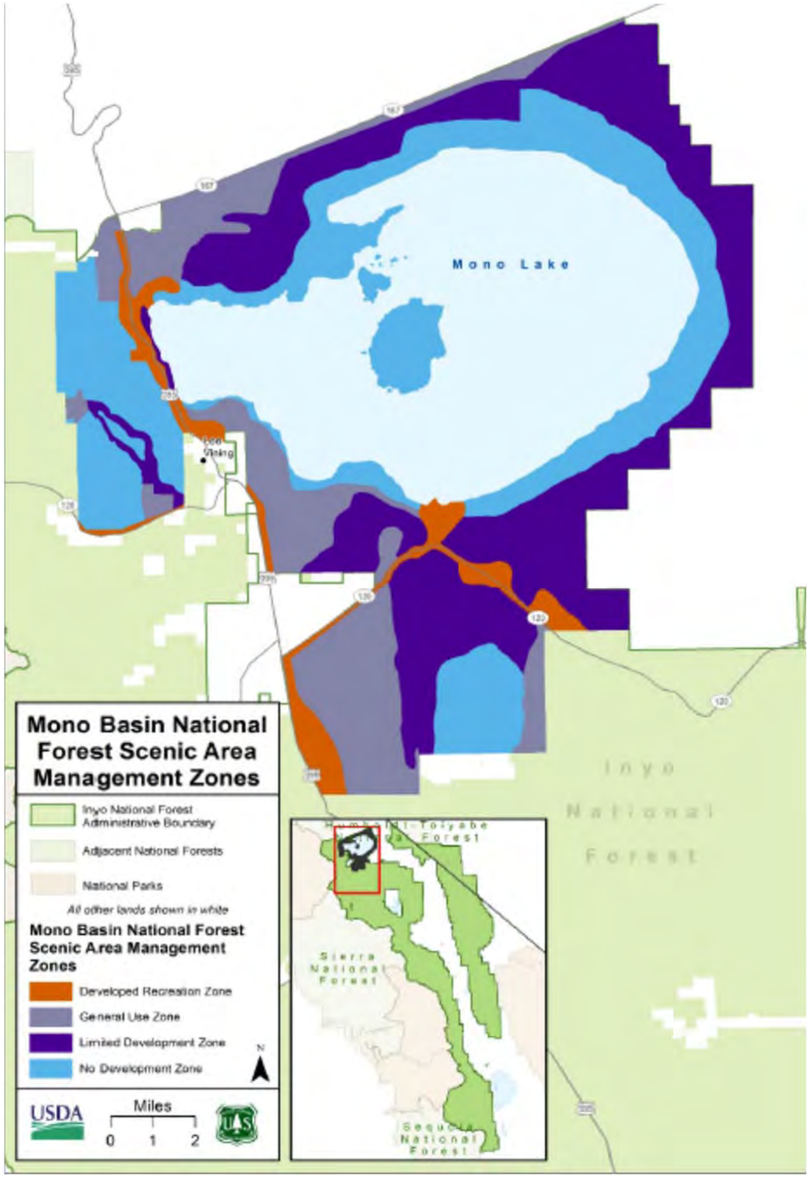
Congressionally designated in 1984 to protect the geologic, ecologic and cultural resources within the 116,274-acre scenic area surrounding Mono Lake

- Specified that management would provide for recreation use and interpretative facilities, permit full use for scientific study and other measures.

1989

Mono Basin Scenic Area Comprehensive Management Plan

- Provides specific management guidance, zoned management mapping and other management direction
- Four land use zones



MBNFSA Management Zones

Developed Recreation Zone

Manage to provide developed recreation facilities and opportunities that are compatible with the visual quality of the Scenic Area.

General Use Zone

Mange for a variety of resource uses and values including range, wildlife, recreation and visual.

Limited Development Zone

Mange to provide for relatively undisturbed land where human influence is limited and wildlife, visual and other natural values generally take precedence.

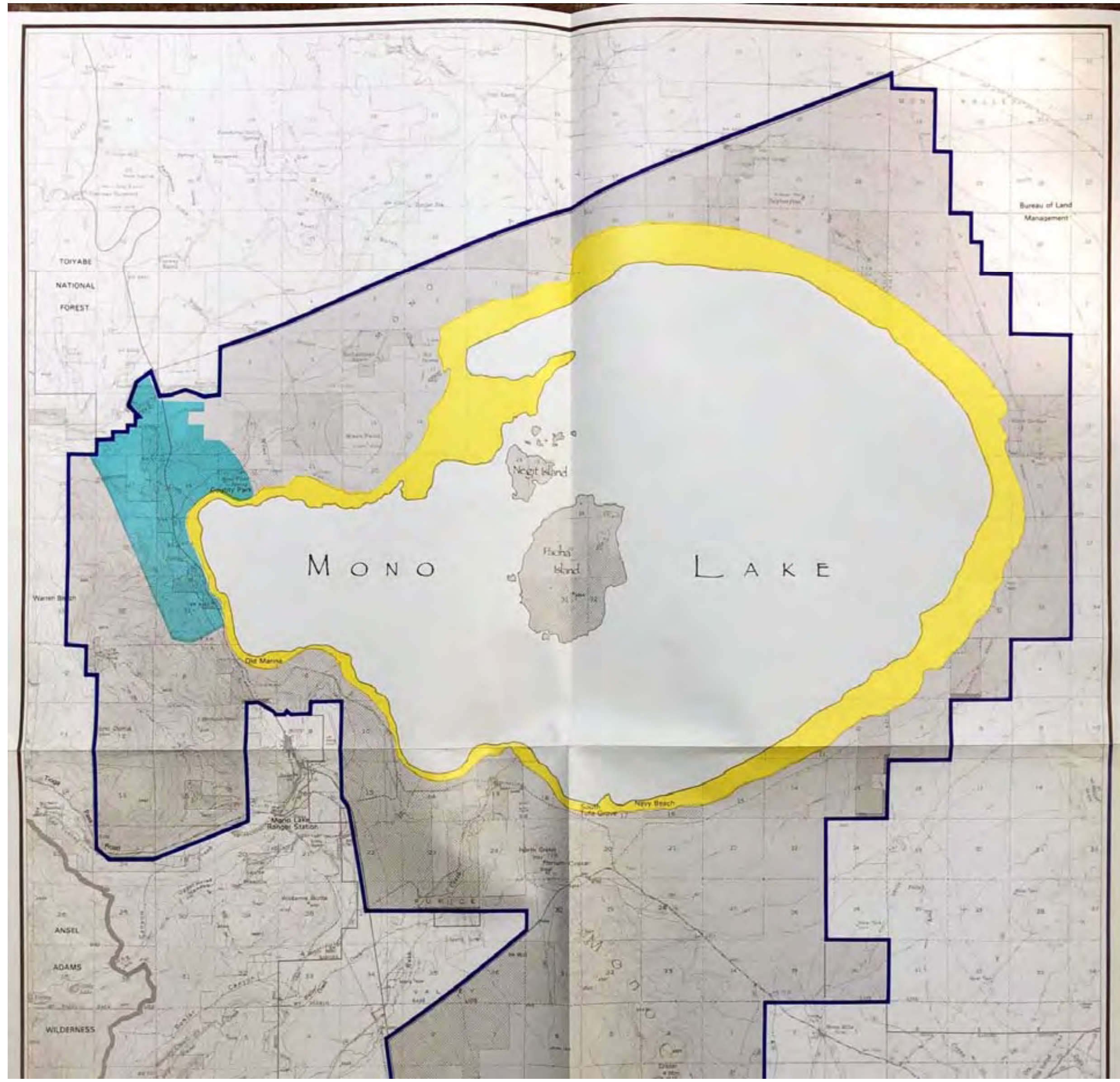
No Development Zone

Manage to prevent surface disturbance and to maintain cultural, geologic, ecological and visual values essentially natural conditions.

MBNFSA Management Direction – Relicted Lands

- Emphasize the protection and interpretation of natural ecosystems, cultural values, and outstanding geologic features while allowing recreational, interpretive, and research facilities and opportunities consistent with this protection.

- Consider land modification projects which contribute to soil stability. **Favor natural methods of stabilization**.



Summary

- The Inyo NF supports projects that enhance ecological diversity and promote ecological resilience within the Mono Basin Scenic Area using natural methods that are consistent with the Comprehensive Management Plan

CALIFORNIA STATE LANDS COMMISSION MONO LAKE FACT SHEET

Prepared for: Air and Water Quality Workshop, Nov. 4, 2021

Jurisdiction Overview

When California became a state in 1850, it took ownership and control of the beds of navigable waterways pursuant to a principle called the Equal Footing Doctrine; these lands are referred to as “sovereign” or “trust” lands. Established in 1938, the California State Lands Commission (CSLC) manages the State’s sovereign tidelands and submerged lands, in addition to the beds of California’s navigable lakes and waterways, for the benefit of all people of the State for statewide Public Trust purposes. On navigable non-tidal waterways, including lakes, the state holds fee ownership of the bed of the waterway landward to the ordinary low-water mark and a Public Trust easement landward to the ordinary high-water mark, except where the boundary has been fixed by agreement or a court of proper jurisdiction. Such boundaries may not be readily apparent from present day site inspections.

The Public Trust Doctrine

Historically, the Public Trust Doctrine has referred to the basic right of the public to use its waterways to engage in commerce, navigation, and fisheries. More recently, the Public Trust has been broadened by various landmark court decisions (including one at Mono Lake) to include the right to swim, boat, and engage in other forms of water-related recreation, and even to preserve lands in their natural state in order to protect scenic and wildlife habitat values. The Public Trust, as a common law doctrine, is not static but is continuously evolving to protect the public’s use and needs in California’s waterways.

Uses that do not protect or promote Public Trust values, are not water-dependent or oriented, and exclude rather than facilitate public access and use are not consistent with the trust under which the lands are held. The Commission has been given the responsibility, as trustee, to manage California’s waterways on behalf of the public. As trustee, the Commission acts as a fiduciary in protecting the public’s rights and needs associated with its trust lands. The Commission determines what uses are to be made of Public Trust lands on a case-by-case basis and in the State’s best interests, based upon the factual and legal circumstances involving a particular location and proposed use.

Mono Lake

In 1935, a California court took judicial notice that Mono Lake was navigable (*City of Los Angeles v. Aitkin*, 10 Cal. App. 2d 460 at 466), meaning that it is subject to the protections of the Public Trust, and under the management and care of the CSLC. In 1983 the California Supreme Court issued a decision regarding the City of Los Angeles' diversion of streams flowing into Mono Lake. This decision had important implications for the Public Trust Doctrine. In its decision, the Court found that agencies had an affirmative duty to consider the Public Trust when allocating water rights. The decision was important because it held that even though the diversions were taking water from *non-navigable* streams, those diversions had a deleterious effect on Public Trust lands and resources that the state had to consider (*National Audubon Society v. Superior Court of Alpine County* (1983) 33 Cal. 3d 419).

The boundary between State-owned public trust lands and upland owners, including private parties and local, state, and federal public agencies, has changed over time as Mono Lake's level has fluctuated. Generally speaking, "reliction" is a process where once submerged land becomes exposed due to the gradual and imperceptibly slow recession of water. Reliction at Mono Lake has occurred by both natural and artificial processes, such as by diverting water for agricultural or municipal uses. In 1986 a federal court of appeals applied federal rules to determine that reliction had occurred at Mono Lake and that, as a result, portions of the lakebed which abutted federally owned lands that had become exposed belonged to the federal government. (*State of Cal. ex rel. State Lands Com'n v. U.S.* (9th Cir. 1986) 805 F.2d 857, 866). While this ruling narrowly applies to areas of the lake that abut federally owned lands, it complicates the Lake boundary. Areas of the lake where the upland is not in federal ownership will follow California law, which may apply reliction differently, meaning that the boundary line will be at a different elevation and discontinuous around the Lake.

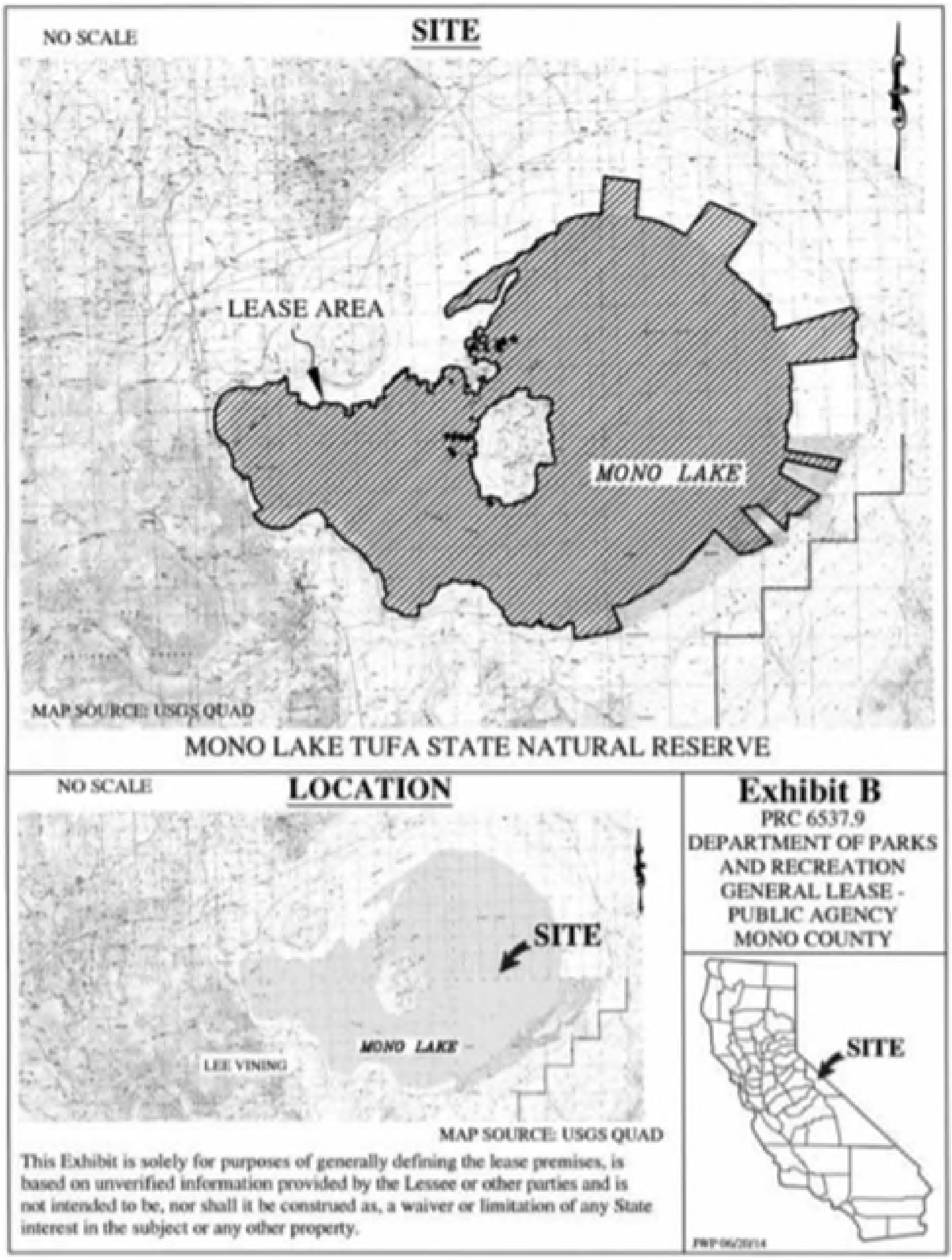
The law of water boundaries is complex and takes into account all the factors mentioned above. The result for CSLC's jurisdiction at Mono Lake is an unnatural looking boundary that does not correspond to the water's edge in many places. The diagram at the end of this fact sheet shows the general location of the Commission's trust lands at Mono Lake, as they were known at the time the lease for the Tufa State Natural Reserve was issued. This diagram is provided solely to illustrate how the interplay between state and federal law has created a complex boundary along Mono Lake and does not represent a full analysis of the boundary.

The CSLC, on behalf of the State, has authority to issue leases or permits for the use and development of sovereign land and resources. In issuing leases, the Commission balances competing Public Trust uses, which include but may not be limited to commerce, navigation and safety, fisheries, recreation, public access, and conservation. The Commission must also find the proposed use of State land is in the best interests of the State. In determining the best interests of the State, the CSLC has broad authority to impose terms or conditions on applicants/lessees in any leases it may issue. As the above boundary discussion makes clear, however, there are likely additional landowners who would be involved in planning, approving, and implementing measures designed to protect air and water quality at the Lake that may be imposed on the City of Los Angeles by relevant regulators.

Many lessons learned from dust mitigation activities at Owens Lake can be applied to potential dust management decisions at Mono Lake. For instance, the CSLC has long held that the widespread application of gravel cover does not protect or promote Public Trust uses and values; the loss of those values can in certain instances be ameliorated by integrating other features that offset the negative effects of gravel cover, as has been implemented in certain areas of the Owens Lake Dust Mitigation Project undertaken by the City of Los Angeles. Similarly, the CSLC has viewed chemical suppressants with skepticism and has not approved their use to date on Owens Lake.

Moving Forward

While the lake level at Mono has risen since its historic low of 6372 feet above sea level in 1982, it is still short of the prescribed management level of 6392 feet above sea level. Meeting the management level will protect Public Trust uses and values at the Lake by reducing dust emissions (protecting air quality), reducing salinity (improving water quality), and protecting environmental and recreational values. Maintaining a healthy environment, which is a foundational Public Trust principle, is critical for the use, enjoyment, and economic well-being of local communities. As stated in the CSLC's 2021-2025 Strategic Plan, the CSLC seeks to recognize relationships among projects, lands, and the communities in which they occur, and strives to ensure affected communities are meaningfully engaged in decision-making processes. Given the CSLC's responsibilities, which often require careful balancing among competing Public Trust uses, the CSLC is committed to supporting meaningful and inclusive engagement as Mono Lake planning and management proceeds to ensure these actions incorporate Public Trust considerations and avoid deleterious effects to the extent feasible.



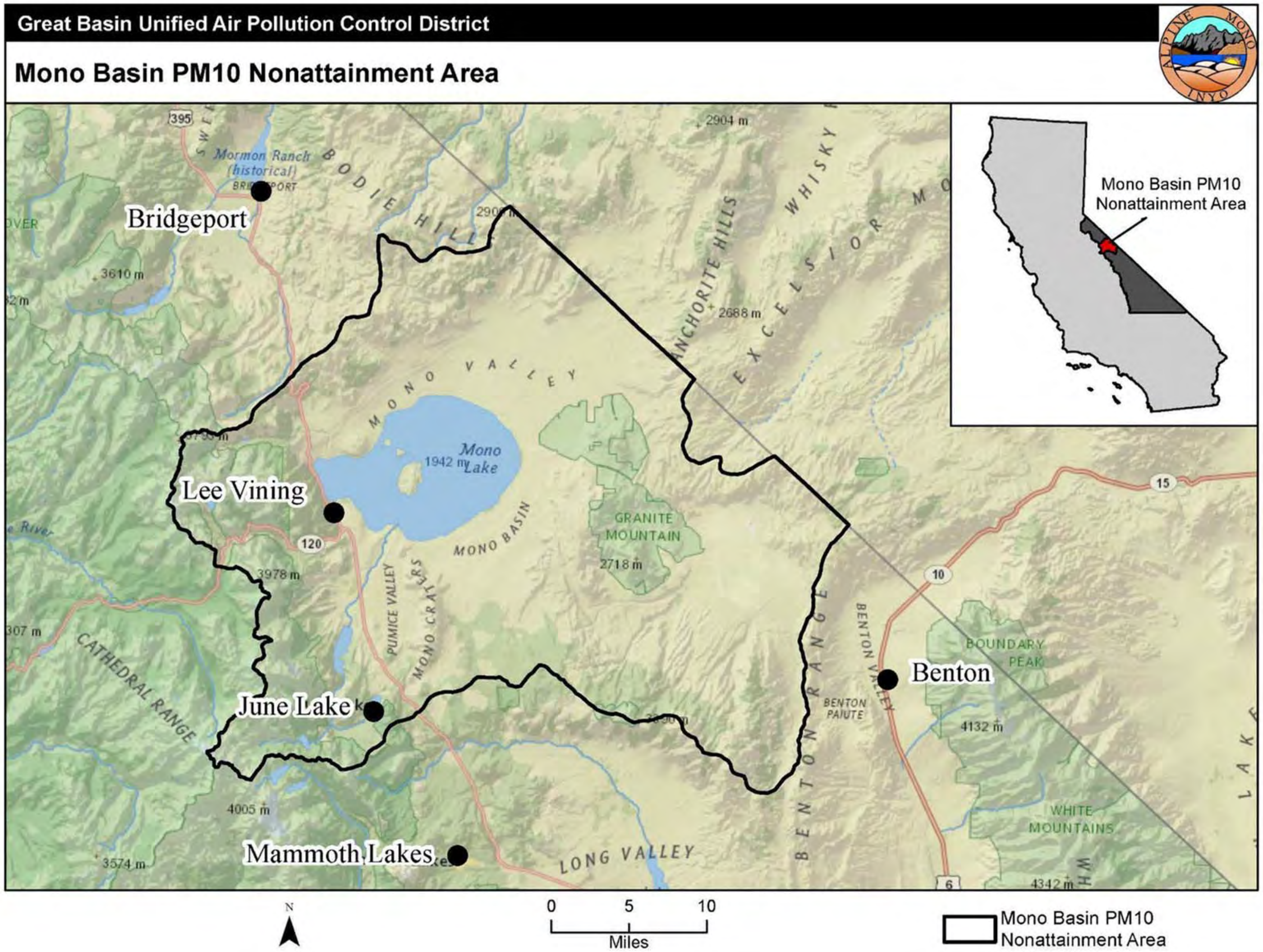
*For illustration purposes only. Source: CSLC Staff Report
https://www.slc.ca.gov/Meeting_Summaries/2014_Documents/08-15-14/Items_and_Exhibits/C45.pdf

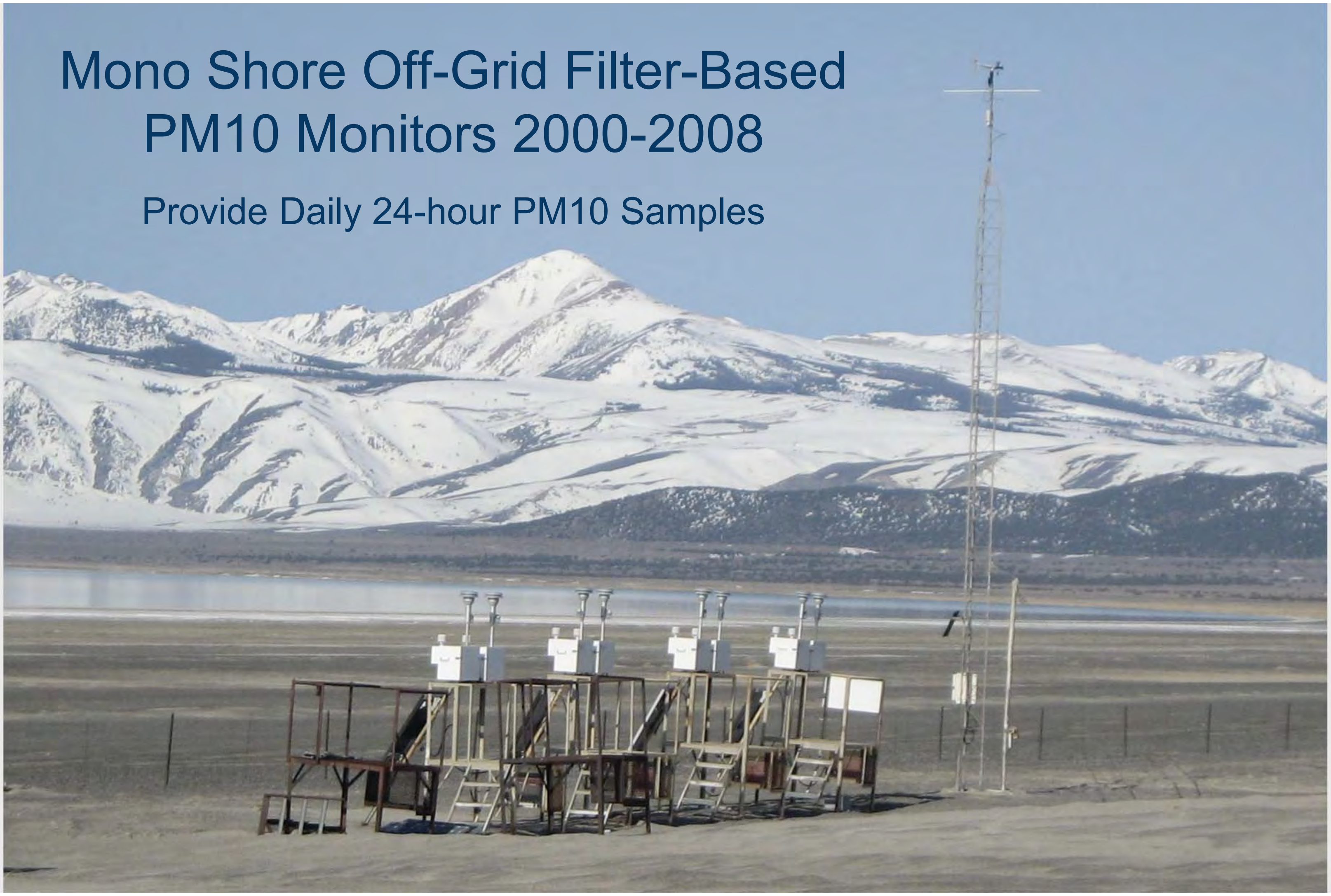
Mono Basin Air Monitoring

Chris Lanane and Chris Howard
Great Basin Unified Air Pollution Control District
Mono Air and Water Workshop
November 4, 2021

Mono Particulate Matter (PM) Monitoring History

- 1982 PM Monitoring begins at Simis Ranch
  Additional episode monitoring at Warm Springs and Cedar Hill
- 1993 Mono Basin designated nonattainment for the PM10 Federal Standard
- 1994 Mono Basin State Implementation Plan
- 2000 PM Monitoring begins at Mono Shore Site, modeled to be site of maximum impact
- EPA determined that National Ambient Air Quality Standards must be met everywhere public has access. It is the District's responsibility to enforce these standards.


Great Basin Unified Air Pollution Control District
Mono Basin PM10 Nonattainment Area
Bridgeport
Lee Vining
June Lake
Mammoth Lakes
Benton
Mono Lake
1942 m
MONO VALLEY
MONO BASIN
GRANITE MOUNTAIN
2718 m
BODIE HILLS
ANCHORITE HILLS
EXCELSIOR MO
WHISKY
BENTON RANGE
BENTON VALLEY
BENTON PAIUTE
BOUNDARY PEAK
4132 m
WHITE MOUNTAINS
4342 m
LONG VALLEY
CATHEDRAL RANGE
PUMICE VALLEY
MONO CRATERS
Mormon Ranch (historical)
2904 m
2688 m
3610 m
3978 m
4005 m
3574 m
395
120
10
6
15
Mono Basin PM10 Nonattainment Area
0 5 10
Miles
N
Mono Basin PM10 Nonattainment Area


Mono Shore Off-Grid Filter-Based
PM10 Monitors 2000-2008
Provide Daily 24-hour PM10 Samples

Mono Shore Monitoring Station

Off-grid Monitoring Station: 2007 - present

Provide Hourly PM10 Concentrations

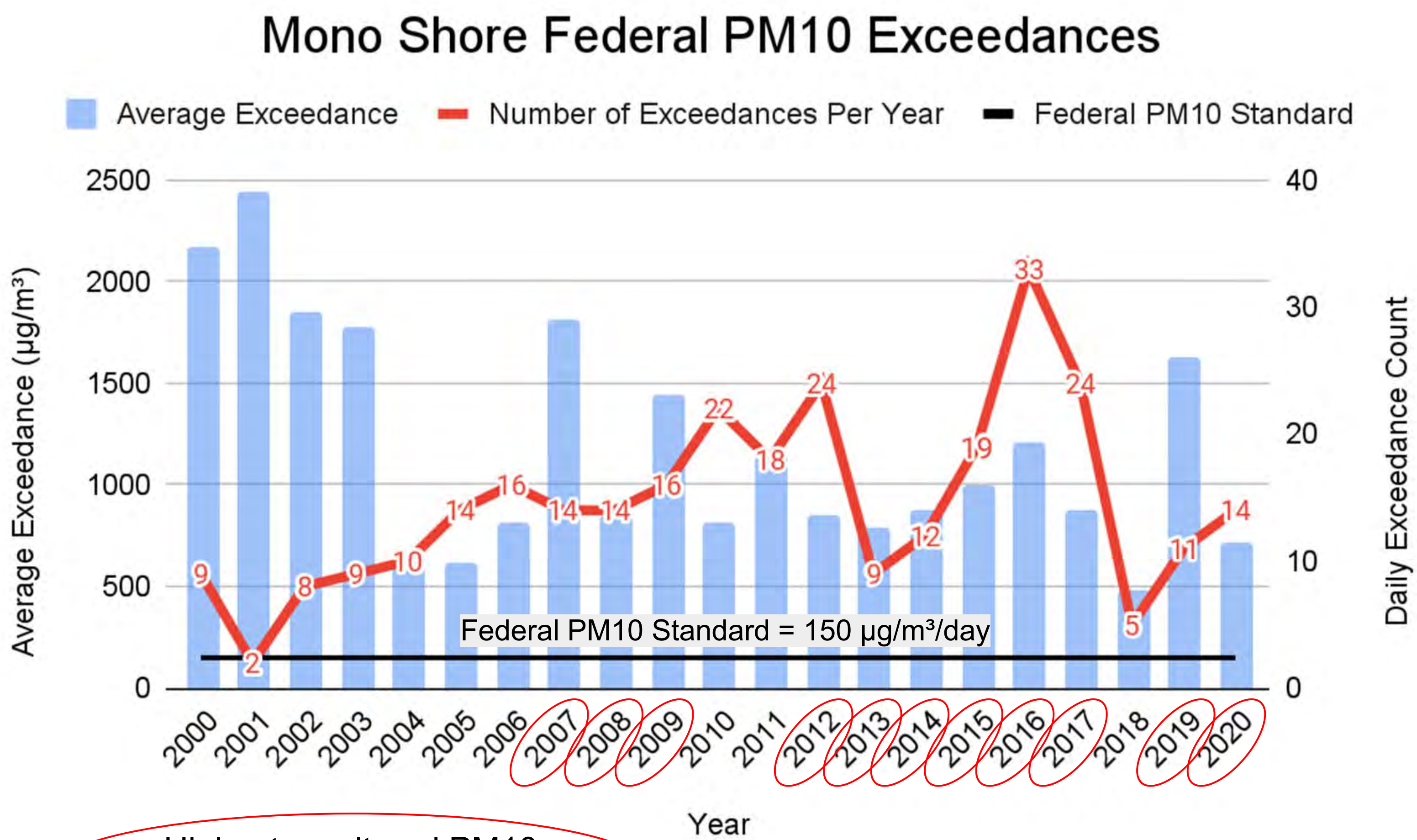
Real-time hourly data at https://www.gbuapcd.org/

Lee Vining Monitoring Station

1981 Monitoring Begins with filter-based 24-hour sampler operating on 1-in-6-day schedule

2017 PM10/PM2.5 Continuous Monitor Measuring Hourly Concentrations begins

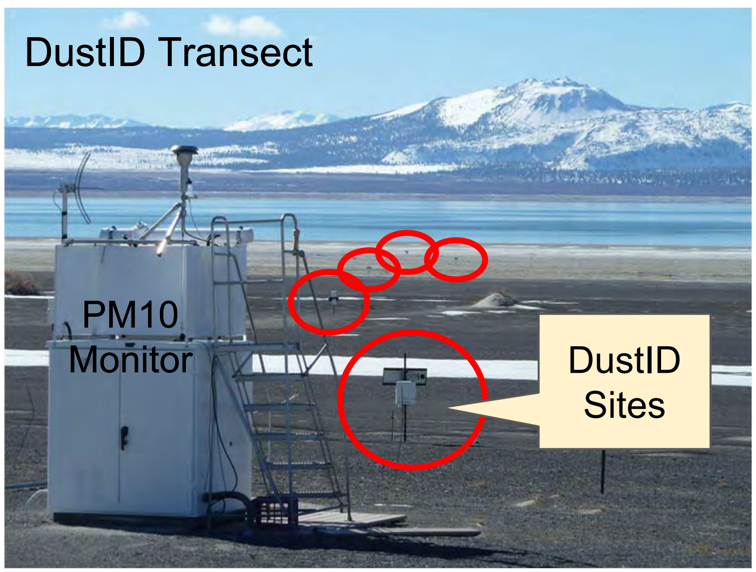
Real-time data at https://www.gbuapcd.org/

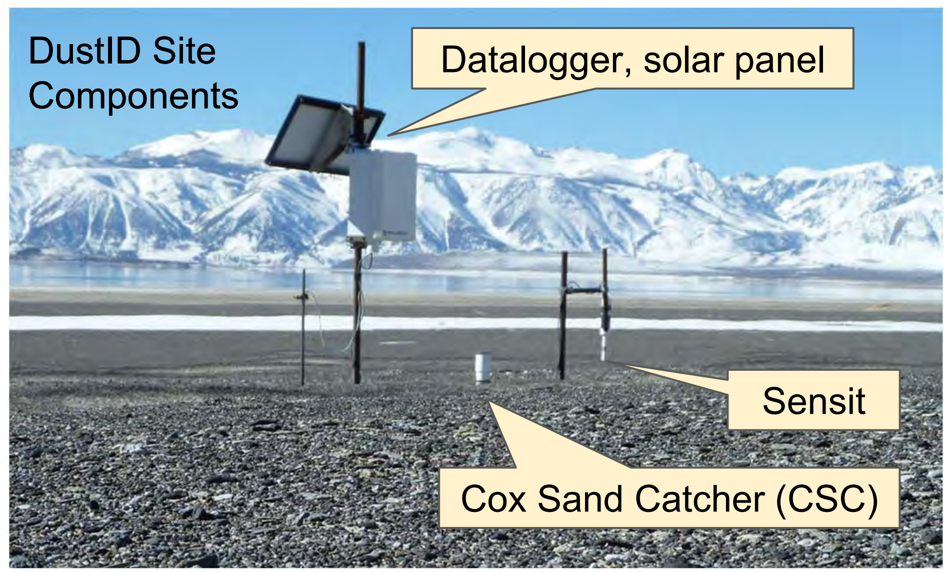


Highest monitored PM10 concentration in US

*excludes wildfire smoke events

Mono Shore Sand Flux Monitoring

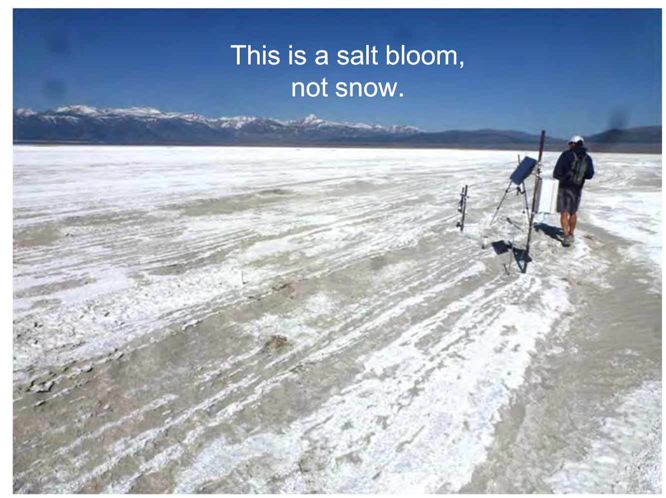




Mono Shore Sand Flux Monitoring

DustID method identical to Owens Lake:

- CSC sand masses are manually weighed
- Sensits record timing and magnitude of saltation
- Sand Flux calculated by time resolving sand masses with Sensit data

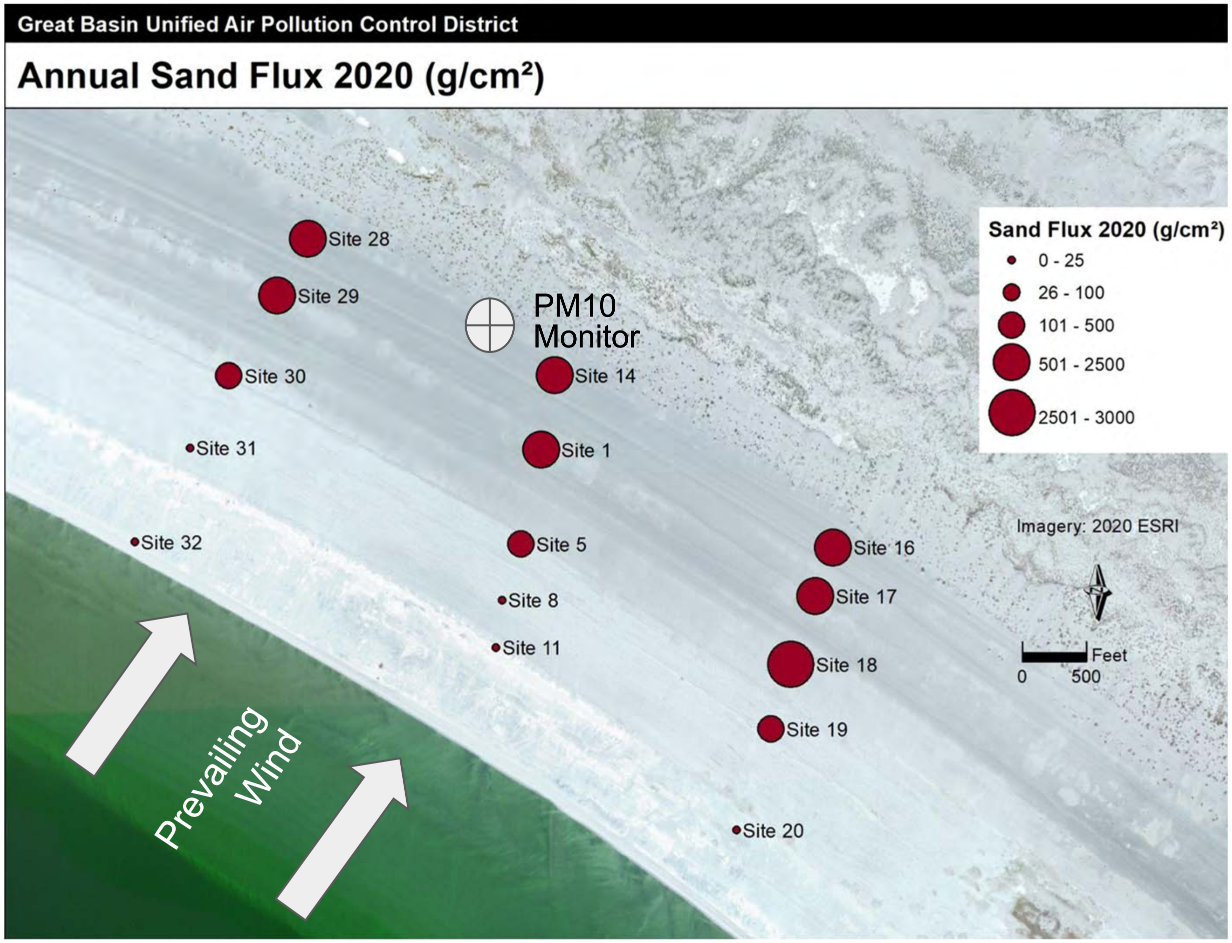


Mono Lake Sand Flux Monitoring Network

- Initial configuration installed 2005
- Currently 15 Sites
- Prevailing wind direction SW
- Upper tiers have higher sand flux
- Lower tiers have higher emission rates due to fine sands and salts

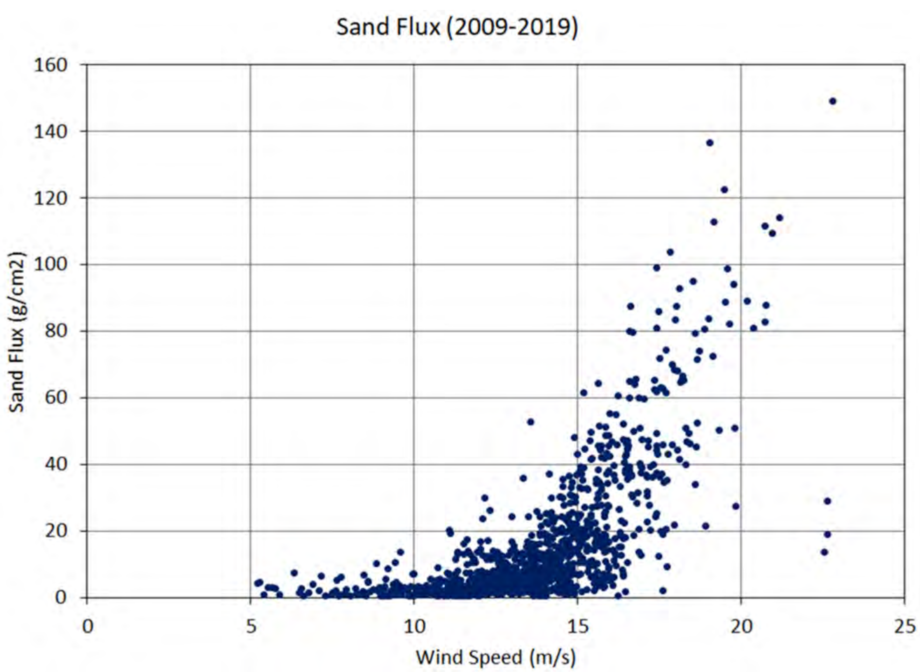
Upper Tiers: Sandy, Coarse Sands

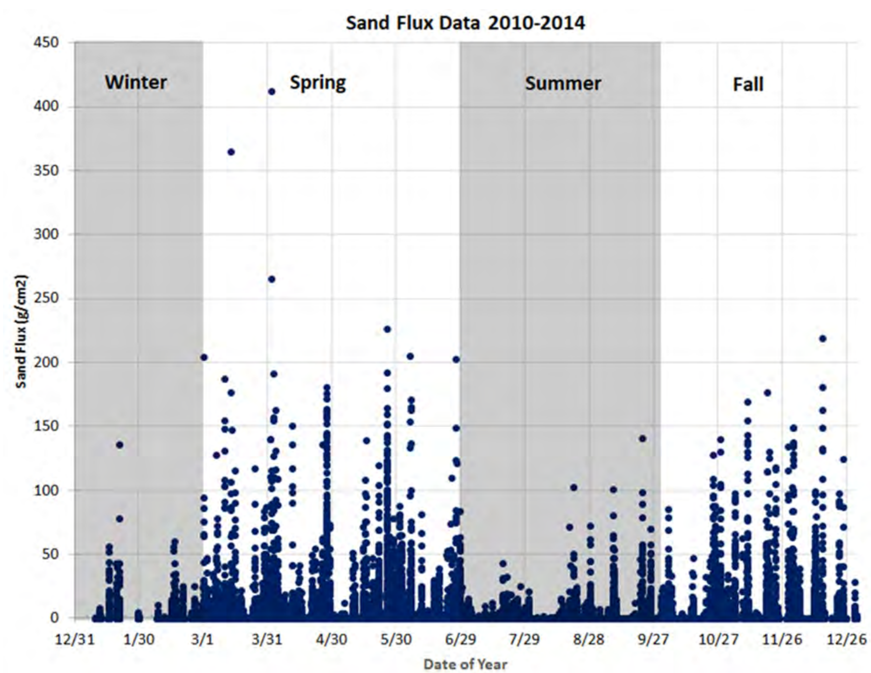
Lower Tiers: Silty and Fine Sands

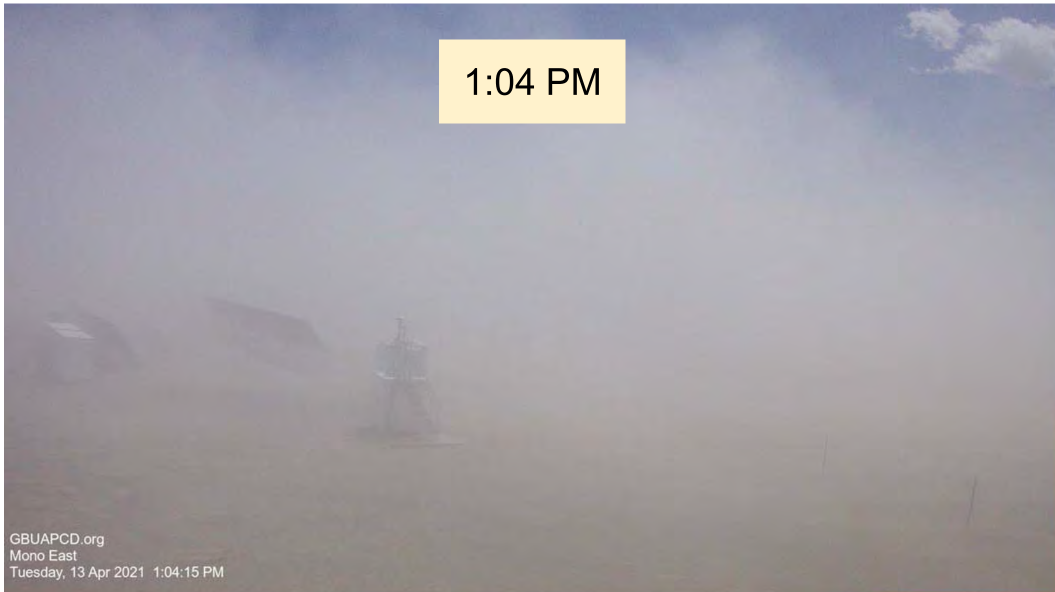


Mono Shore Sand Flux Monitoring Data

- Sand flux and PM10 emissions increase with increasing wind speeds
- Fall and Spring have higher sand flux than summer and winter



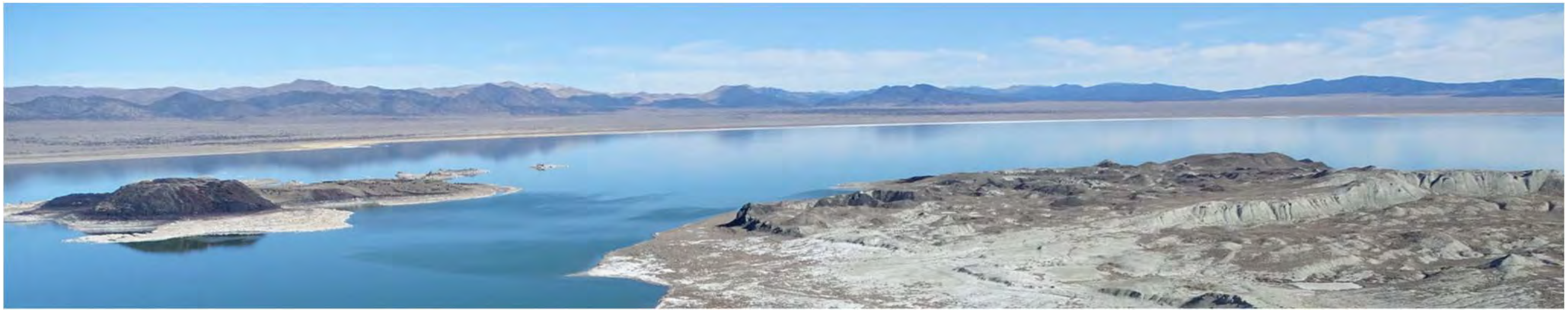




April 13, 2021
east-facing camera

Air Quality Cameras at Mono Shore

- 30-second image captures during daylight hours
- west-facing and east-facing cameras



Mono Basin Air Monitoring

Going forward the District will continue to monitor Mono Basin air quality in order to:

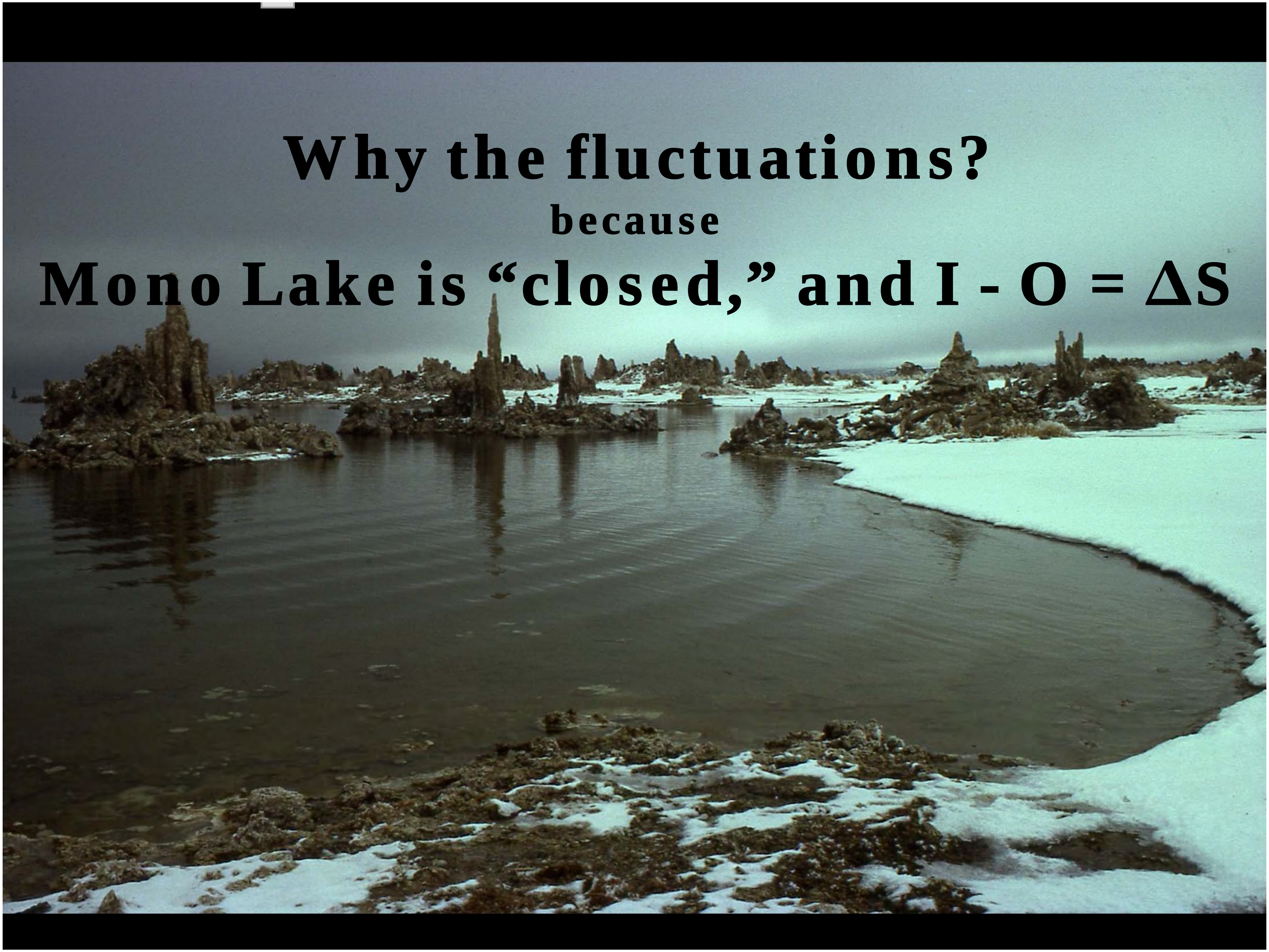
1. Document violations of the PM10 Federal Standard
2. Quantify PM10 emissions
3. Assist with air quality modeling efforts necessary for planning efforts
4. Inform the public
5. Track progress toward and determine when the Mono Basin reaches attainment
6. Ensure the PM10 standard is maintained after reaching attainment

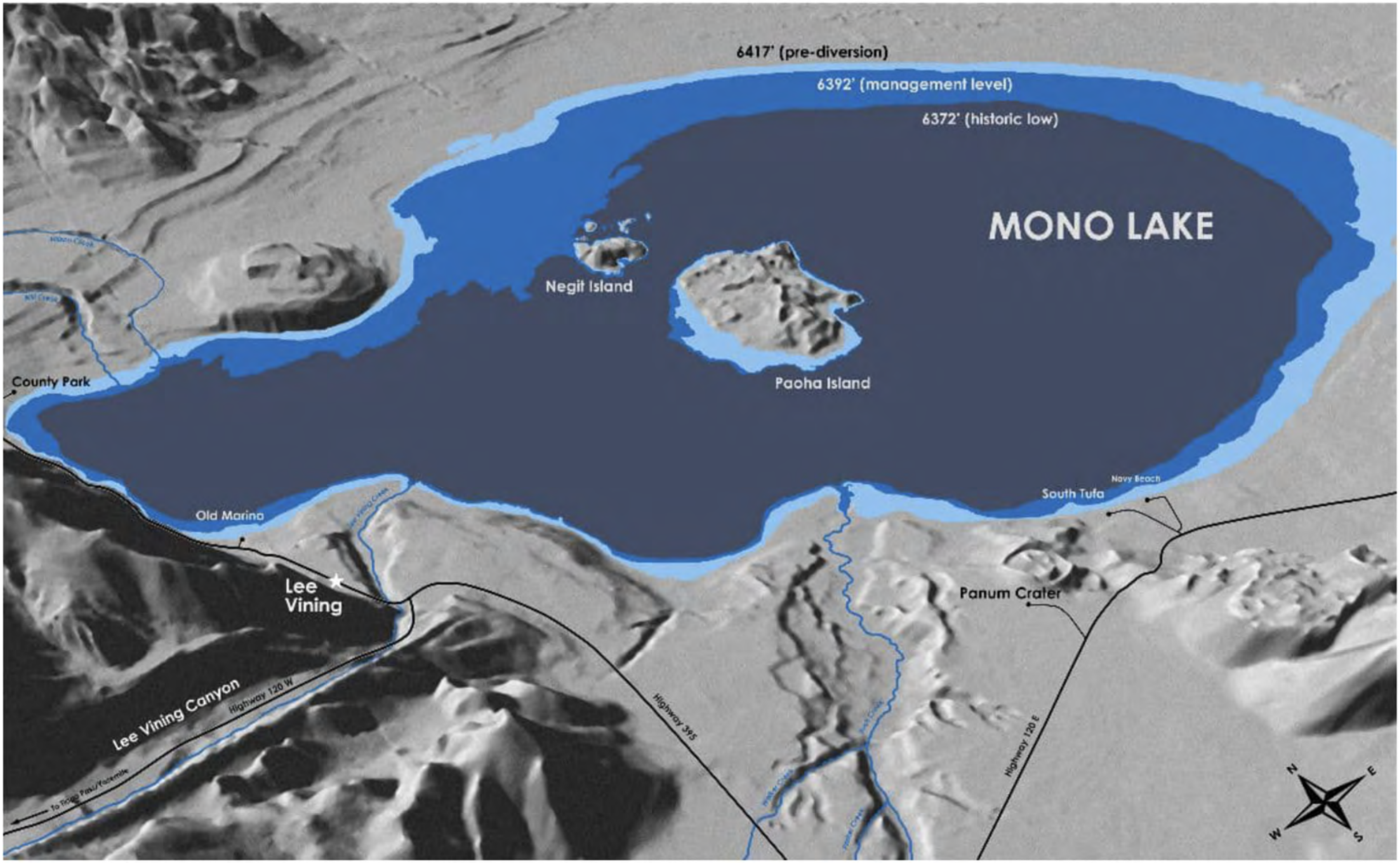
Questions?

Past and Future Fluctuations of Mono Lake

Presentation to the Governing Board
of the
Great Basin Unified Air Pollution Control District

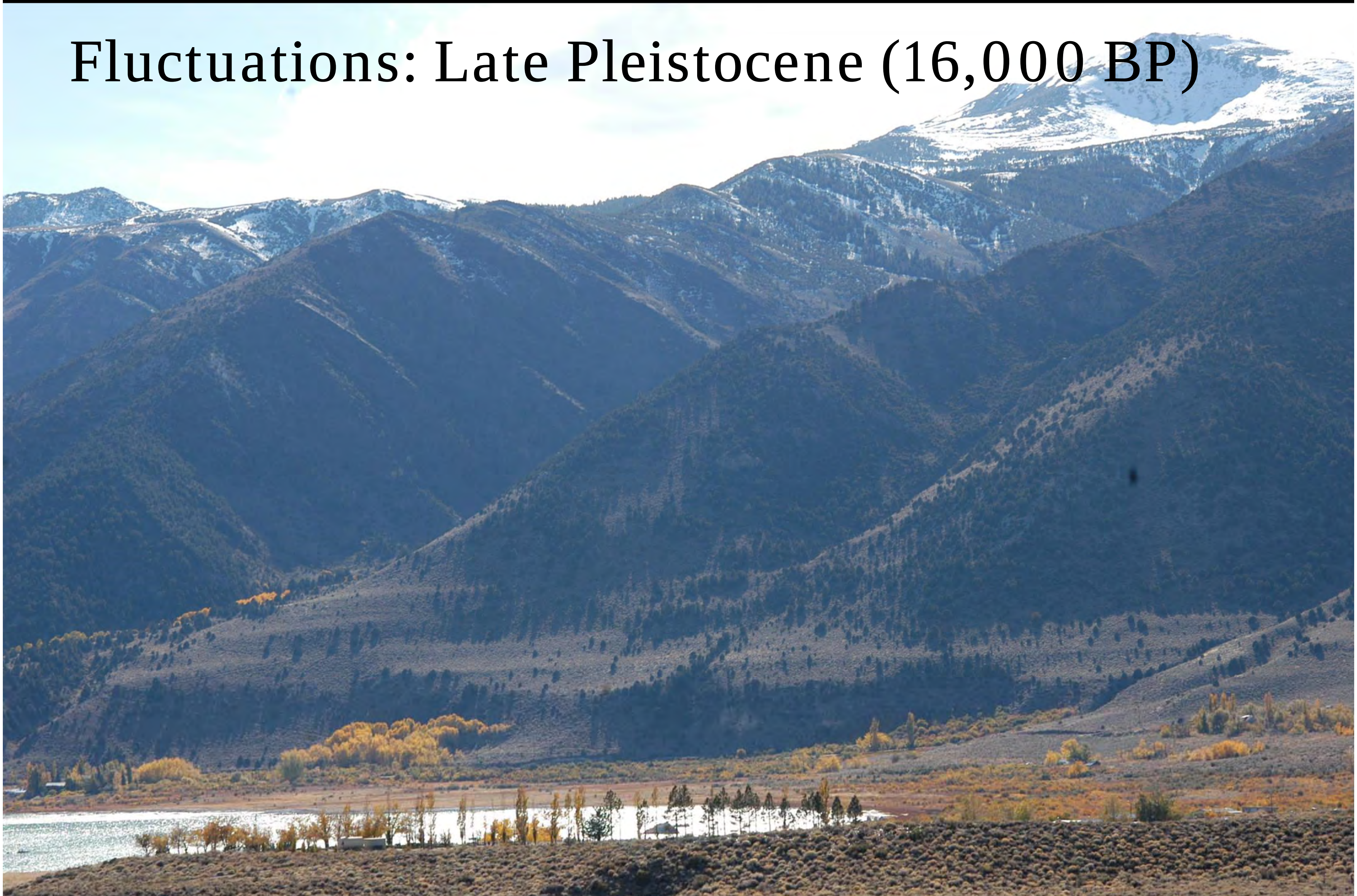
by Scott Stine, Ph.D.
Consultant to Great Basin Unified APCD
November 4, 2021, Lee Vining, CA

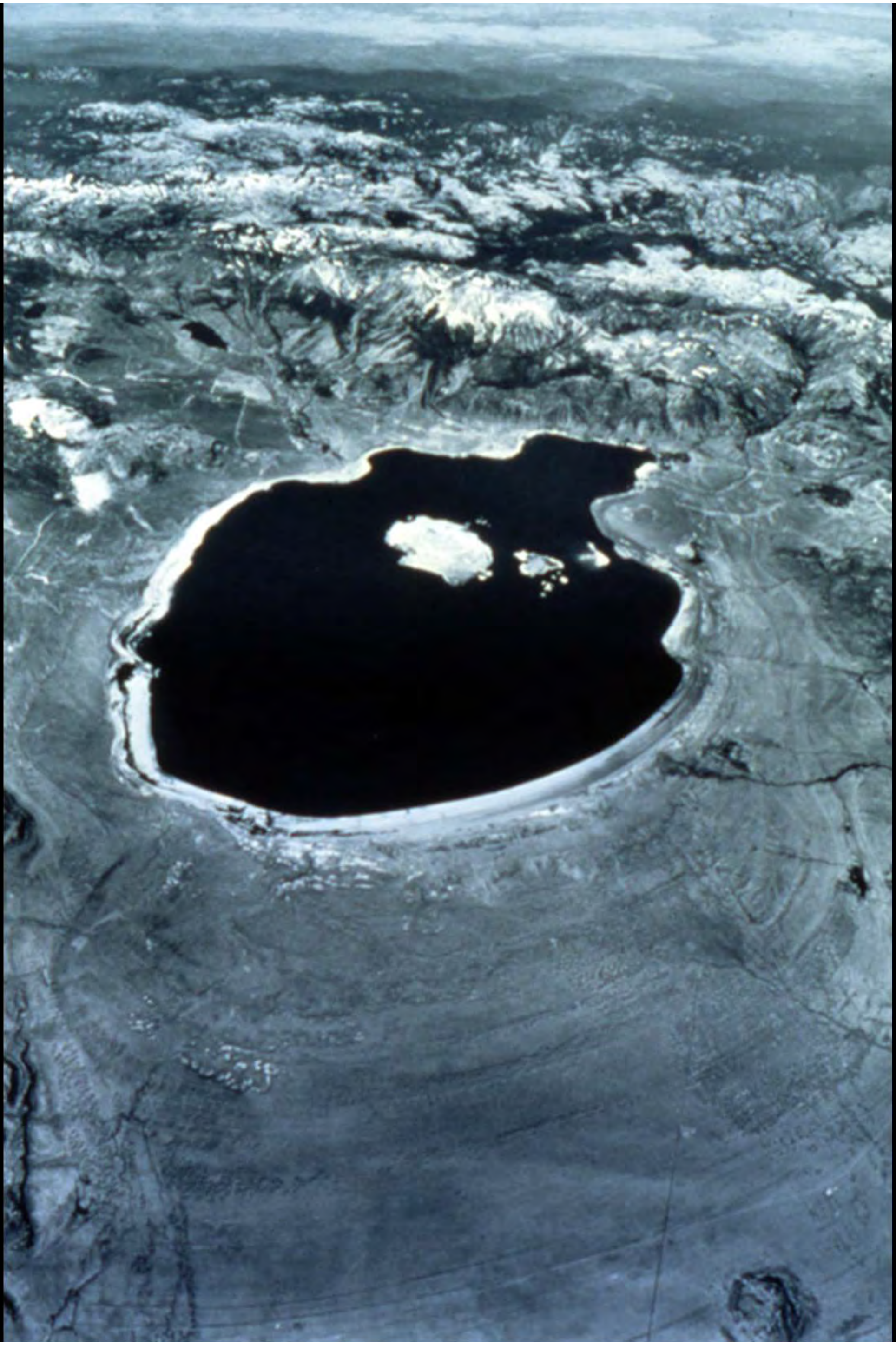

Why the fluctuations?
because
Mono Lake is "closed," and I - O = ΔS



6417' (pre-diversion)
6392' (management level)
6372' (historic low)
MONO LAKE
Negit Island
Paoha Island
County Park
Old Marina
South Tufa
Navy Beach
Lee Vining
Panum Crater
Lee Vining Canyon
Highway 120 W
Highway 395
Highway 120 E
N
E
S
W

Fluctuations: Late Pleistocene (16,000 BP)





Oblique air photo from 1968

Fluctuations: The Holocene (11,000 BP-Present)

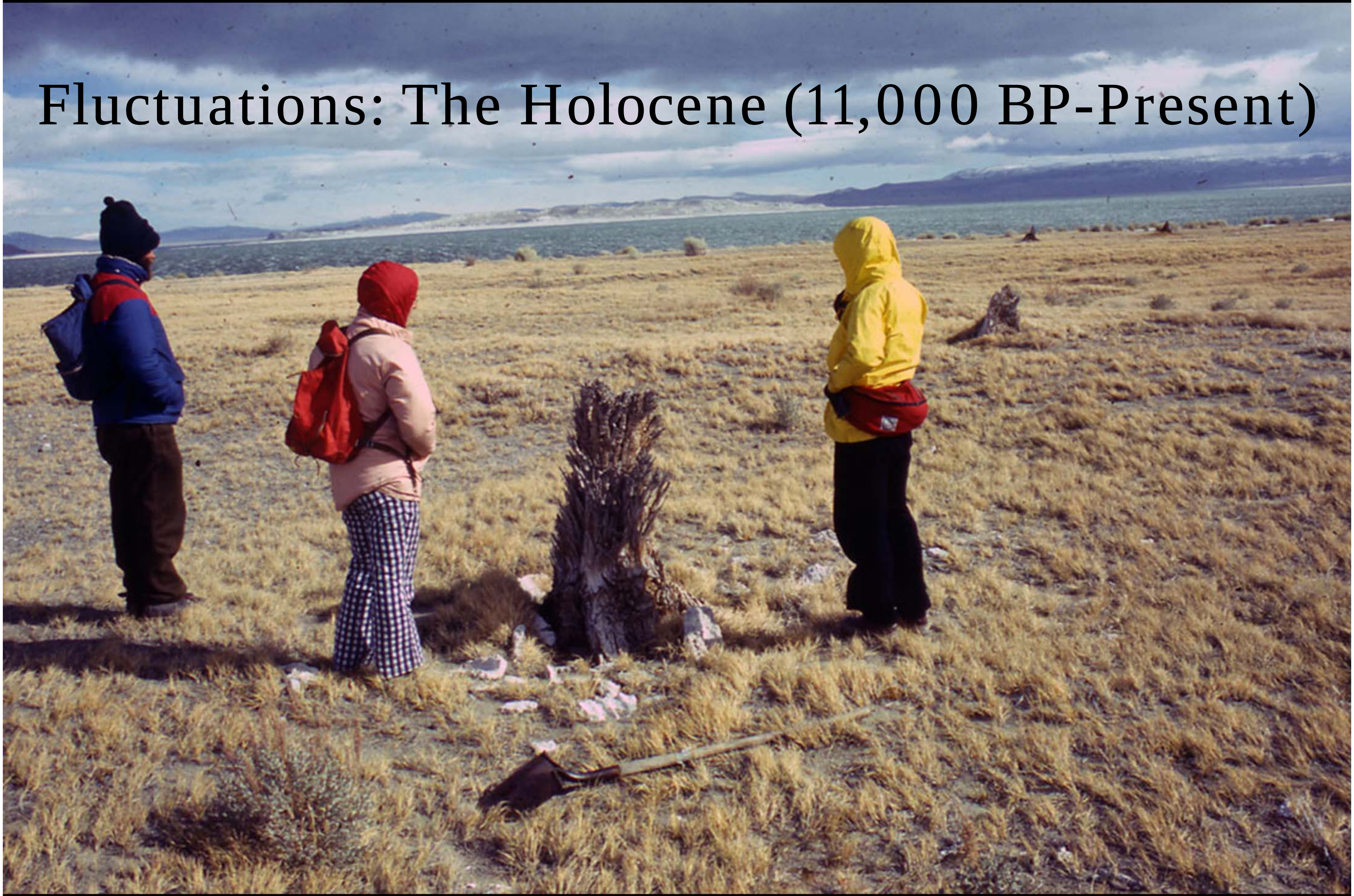


Photo from 1979

Extreme and persistent drought in California and Patagonia during mediaeval time

Scott Stine

Department of Geography and Environmental Studies, California State University, Hayward, California 94542, USA

STUDIES from sites around the world[1–5] have provided evidence for anomalous climate conditions persisting for several hundred years before about AD 1300. Early workers emphasized the temperature increase that marked this period in the British Isles, coining the terms 'Mediaeval Warm Epoch' and 'Little Climatic Optimum', but many sites seem to have experienced equally important hydrological changes. Here I present a study of relict tree stumps rooted in present-day lakes, marshes and streams, which suggests that California's Sierra Nevada experienced extremely severe drought conditions for more than two centuries before AD ~1112 and for more than 140 years before AD ~1350. During these periods, runoff from the Sierra was significantly lower than during any of the persistent droughts that have occurred in the region over the past 140 years. I also present similar evidence from Patagonia of drought conditions coinciding with at least the first of these dry periods in California. I suggest that the droughts may have been caused by reorientation of the mid-latitude storm tracks, owing to a general contraction of the circumpolar vortices and/or a change in the position of the vortex waves. If this reorientation was caused by mediaeval warming, future natural or anthropogenically induced warming may cause a recurrence of the extreme drought conditions.

The Sierra Nevada is a high-elevation (to 4,400 m), 600-km-long fault block which trends northwest–southeast. Frontal passage between November and May accounts for >85% of the Sierran rain- and snowfall. Precipitation increases towards the east as the range crest is approached, at which point the average annual total approaches 2,000 mm. It decreases abruptly to the lee, averaging ~250 mm along the base of the eastern front. Runoff at middle and high elevations is very seasonal, reaching a sharp peak during the months of greatest snowmelt (typically May–July). The Sierra is California's most important catchment area, providing two-thirds of the state's developed surface-water supply to its huge urban and agricultural systems.

Until recently, the most severe and persistent drought of California's instrumental record occurred between 1928 and 1934 (the 'Dust Bowl period'), when Sierran runoff averaged ~70% of normal. That interval was matched in severity during the 6 years 1987–1992, reinforcing the notion of a maximum 6- to 7-year dry spell. Evidence of mediaeval droughts that were of greater severity, and far greater duration, than either the Dust Bowl or the modern periods, appears at four sites in and adjacent to the central Sierra: Mono Lake, Tenaya Lake, the West Walker River and Osgood Swamp (see Table 1 for locations).

Mono Lake is a large (~18,000 ha) body of saline-alkaline water that abuts, and receives inflow from, the eastern front of the central Sierra. Because it lacks an outlet the lake fluctuates in response to climatic changes. Since 1940 the City of Los Angeles has diverted the influent streams for municipal supply, forcing a 14-m drop in lake level to an elevation of 1,942 m. But for diversions, today's 'natural level' would be ~1,957 m (ref. 6).

Two generations of relict stumps (of *Pinus jefferyi*, *Populus trichocarpa*, *Chrysothamnus nauseosus* and *Artemisia tridentata*) are rooted at low elevations on Mono Lake's artificially exposed shorelands. The oldest generation ('G-1 stumps') includes eight ^{14}C-dated individuals with basal elevations as low as 1,941.5 m (15.5 m below today's 'natural level', and slightly below the artificially depressed surface). Dates on outermost (death-year) wood from these eight are given in Table 1. When plotted with error bars (Fig. 1), the calibrated G-1 death-year dates overlap in a 96-year interval centred on AD 1112.

The second generation of Mono stumps ('G-2 stumps'), represented by five ^{14}C-dated individuals, stands rooted on the shorelands at elevations as low as 1,946 m (11 m below the 'natural level'). Calibrated ^{14}C dates on outermost rings from these five (Table 1), when plotted with error bars (Fig. 1), share a 46-year interval centred on AD 1350.

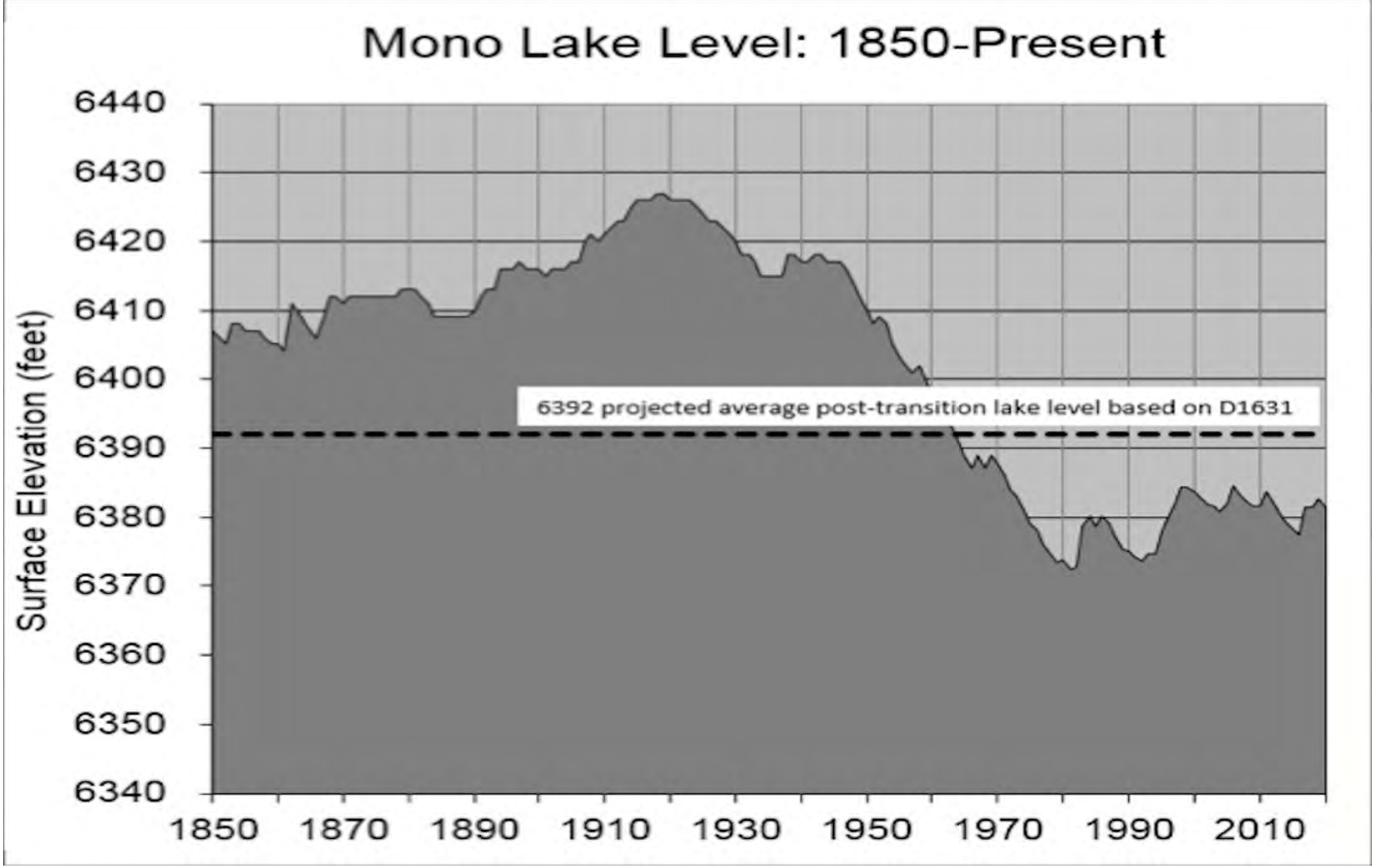
The G-1 and G-2 stumps provide evidence that Mono Lake fell to exceptionally low levels on two occasions during mediaeval time. The first of the lowstands, which persisted at least 50 years (the number of growth rings in the largest of the G-1

Photo of Chris Flat, West Walker River

Photo of Chris Flat, West Walker River

Photo of Chris Flat
West Walker River

Fluctuations: Impact of the DWP



Future Fluctuations

A Key Question:

Is our modern climate wet enough
to raise Mono Lake to the Water Board's
management level of 6392 feet?

Answer: Yes, IF…

These provisional results were generated using version *DYN-EQ Vorster Model 2020-4-2* on 4/29/2020 by M. McGlinchy of the Mono Lake Committee. Starting lake level 6382.5 ft ASL; calibration v2.1.

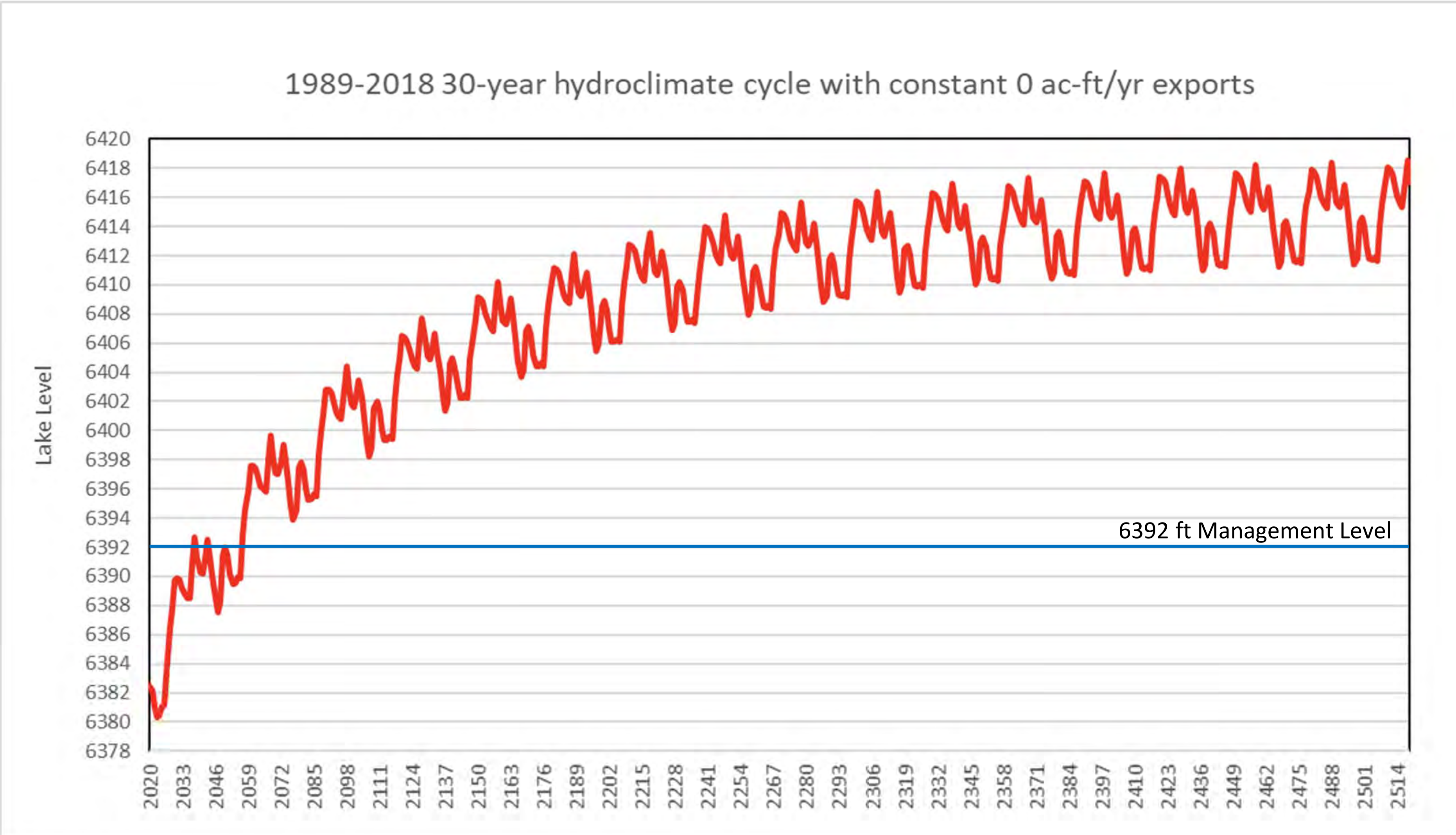


Figure A-1: Time to dynamic equilibrium, zero allotment

These provisional results were generated using version *DYN-EQ Vorster Model 2020-4-2* on 4/29/2020 by M. McGlinchy of the Mono Lake Committee. Starting lake level 6382.5 ft ASL; calibration v2.1.

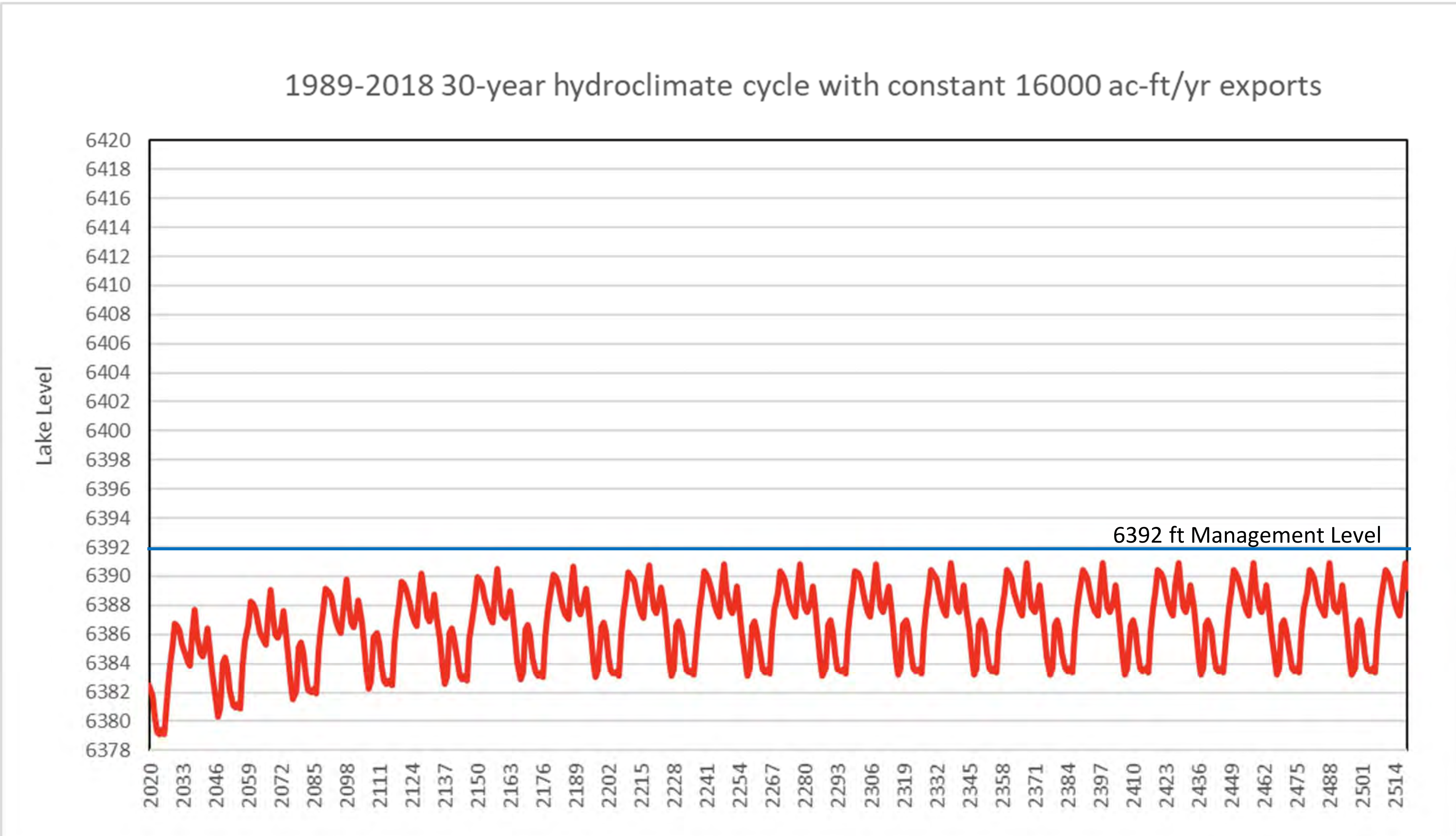
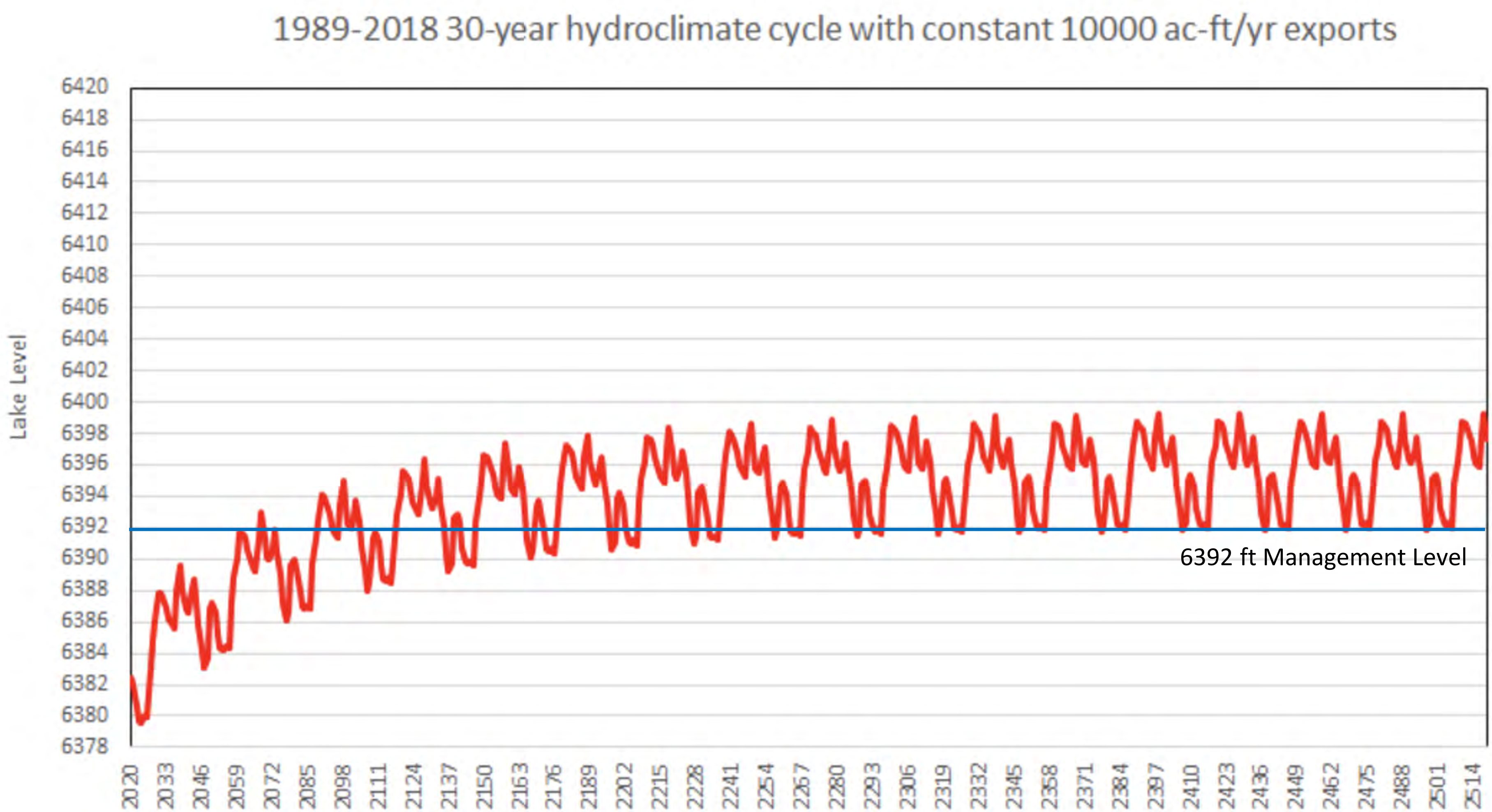


Figure A-5: Time to dynamic equilibrium, 16000 ac-ft/yr

[redacted]


1989-2018 30-year hydroclimate cycle with constant 10000 ac-ft/yr exports
Lake Level
6420
6418
6416
6414
6412
6410
6408
6406
6404
6402
6400
6398
6396
6394
6392
6390
6388
6386
6384
6382
6380
6378
2020 2033 2046 2059 2072 2085 2098 2111 2124 2137 2150 2163 2176 2189 2202 2215 2228 2241 2254 2267 2280 2293 2306 2319 2332 2345 2358 2371 2384 2397 2410 2423 2436 2449 2462 2475 2488 2501 2514
6392 ft Management Level

[redacted]

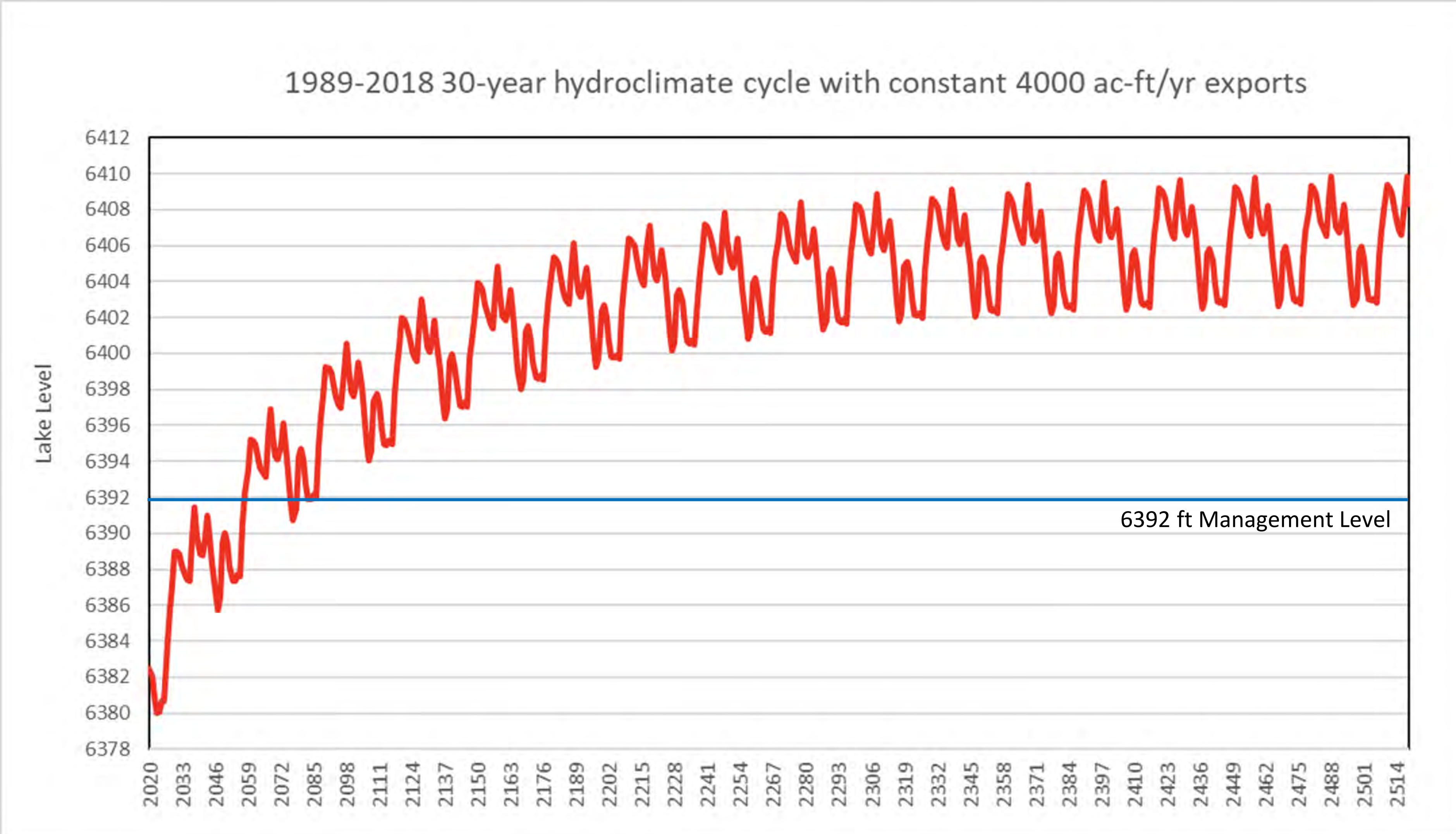


Figure A-2: Time to dynamic equilibrium, 4000 ac-ft/yr allotment

[redacted]

Is Mono Lake rising more slowly than the Water Board anticipated?

No—the Board did not so anticipate. It was well aware that its lake-level projections, based as they were on assumptions about future hydroclimate, were at best speculative.

Their words:

From the State Water Board's D-1631 (1994), p. 15-16, with emphases added:

“Computer models can be used to... estimate future conditions or effects that would be expected to occur *under various <u>assumed</u> [hydroclimatic] conditions*.”

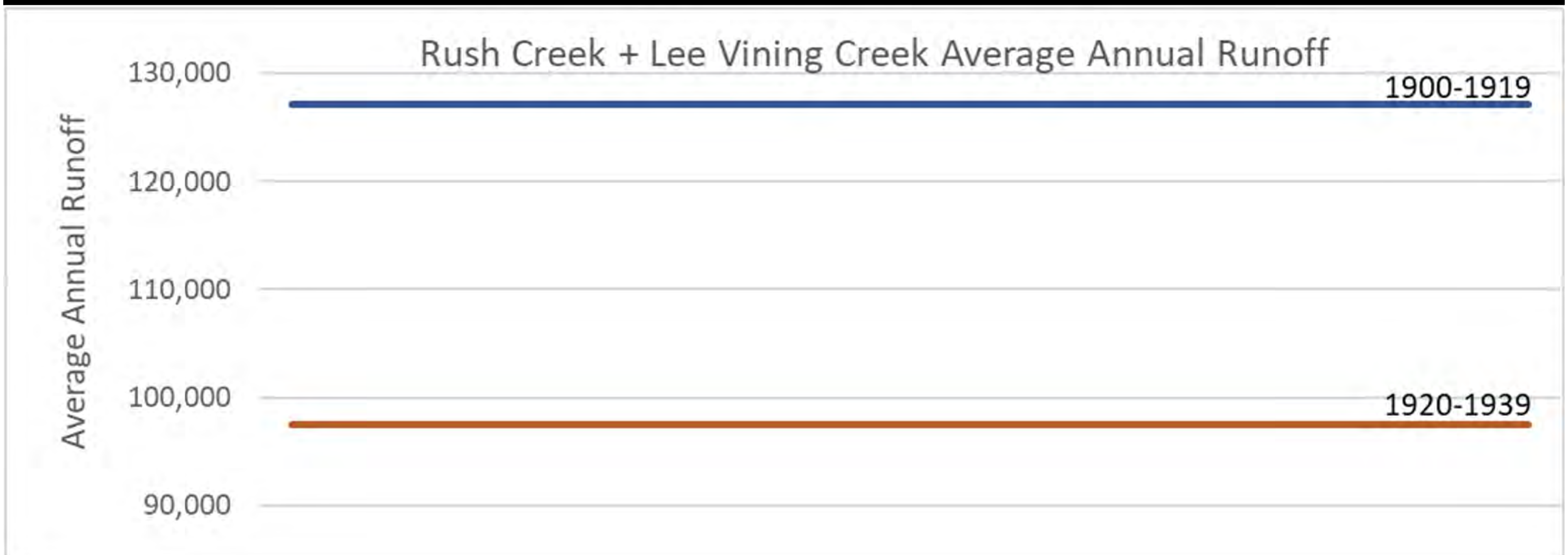
From the State Water Board's D-1631 (1994), p. 159, with emphases added:

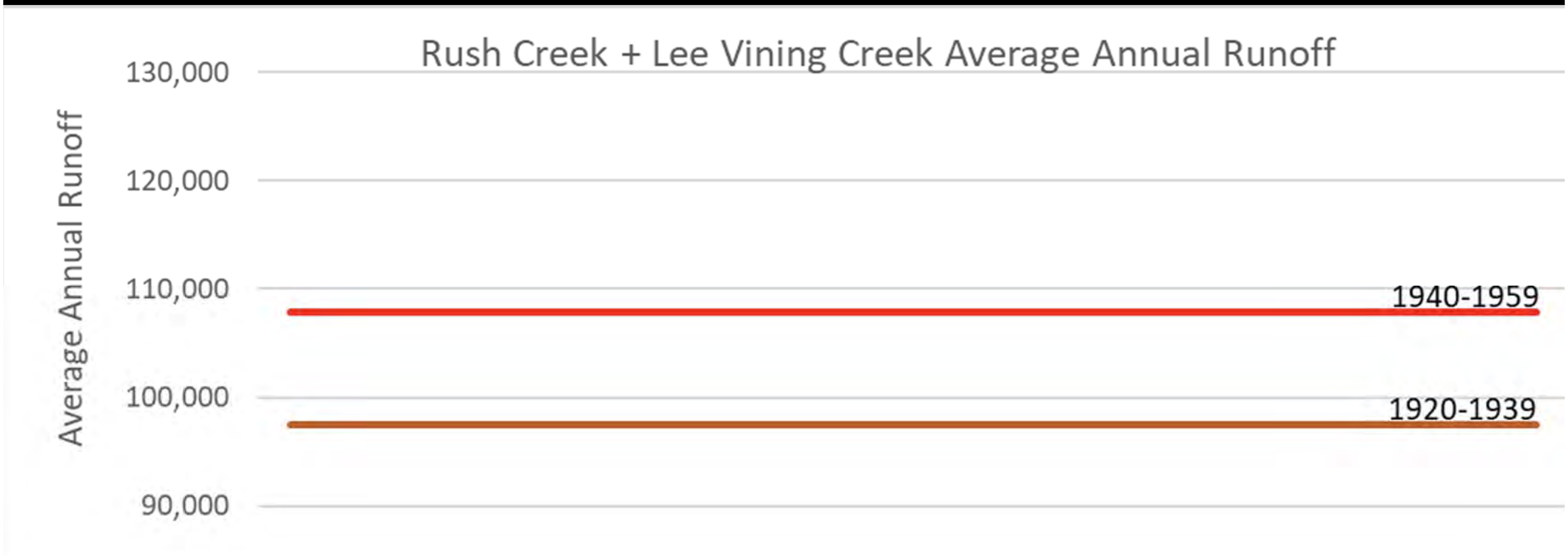
"[T]he SWRCB is keenly aware of the limitations of computer modeling [of] hydrologic systems and the *<u>probability</u>* that future hydrologic conditions may differ significantly from historical conditions... Under the circumstances, there is limited value in attempting to fine tune computer model projections of *<u>inherently uncertain conditions many years in the future</u>*. If future conditions vary substantially from the conditions assumed in reaching this decision, the SWRCB could adjust the water diversion criteria in an appropriate manner under the exercise of its continuing authority over water rights."

Q: Why are multi-year, multi-decade projections of lake fluctuations so “inherently uncertain” (to use the Water Board’s phrase)?

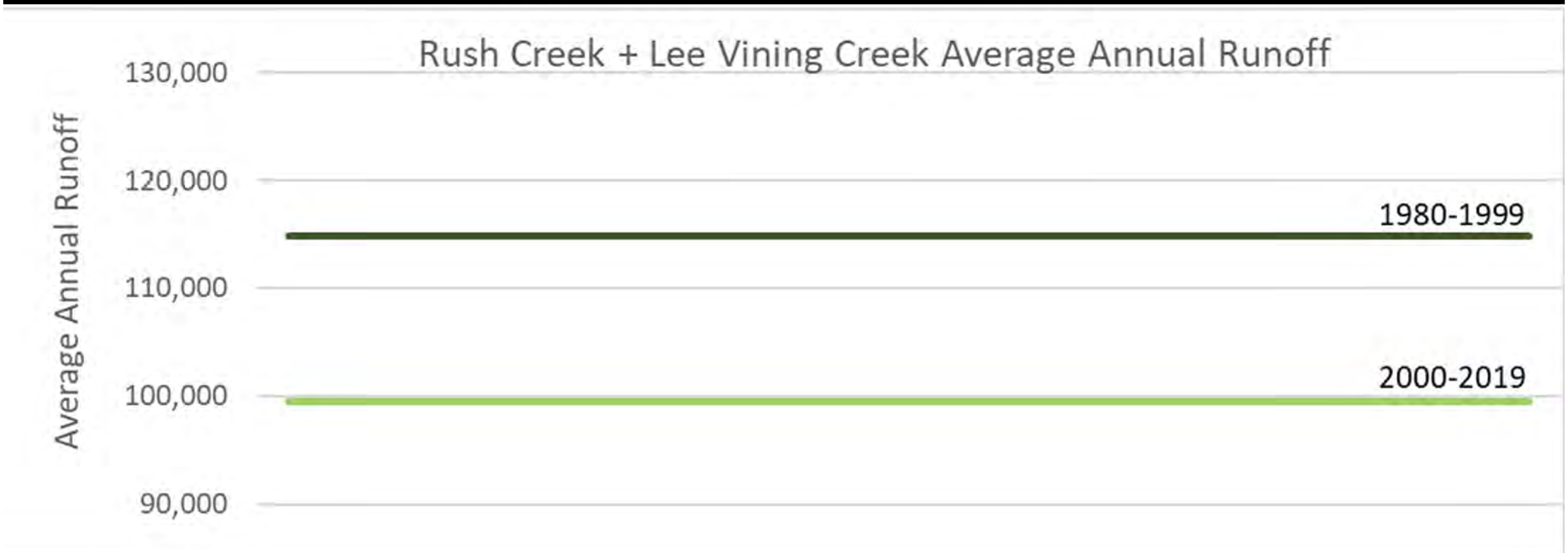
A: Because, even independent of anthropogenic climate change, the linked ocean/atmosphere system that determines climate—which in turn drives lake-level fluctuations--is itself so inherently variable.

Consider some recent examples of multi-decadal variability in the hydroclimate of the Mono Basin:


Rush Creek + Lee Vining Creek Average Annual Runoff
Average Annual Runoff
130,000
120,000
110,000
100,000
90,000
1900-1919
1920-1939


Rush Creek + Lee Vining Creek Average Annual Runoff
Average Annual Runoff
130,000
120,000
110,000
100,000
90,000
1940-1959
1920-1939

[redacted]



[redacted]

Due to the inherent unpredictability of Mono Basin hydroclimate there is uncertainty in when the SWRCB's management level of 6392 feet can be met.

But recognizing that fact, and remembering that we are now in year 27 since the State Board issued D-1631, I hope Great Basin Air can find guidance in the following three truisms, none of which are dependent on modeling:

Three Guiding Truisms:

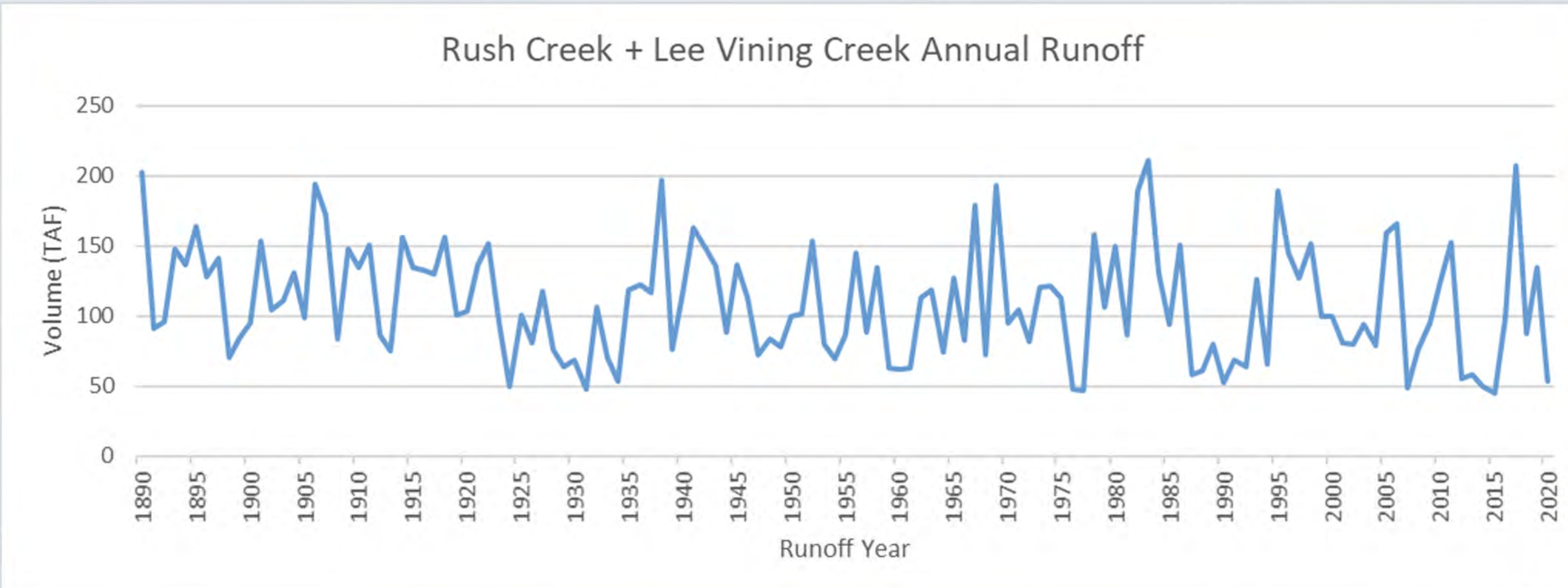
1. The less water DWP exports, the larger will be the lake rises during wet periods;

2. The less water DWP exports, the smaller will be the lake drops during dry periods;

and therefore,

3. The less water DWP exports, the faster the lake will rise toward the management elevation, with incremental improvements in air quality occurring along the way.

Long-term variability of Mono Basin runoff



1935 -2020 runoff are based on measured values; 1890-1935 values are estimates based on occasional measurements and regressions.
Source: Vorster Center, M. McGlinchy

Mono Basin Hydrologic Modeling

Scott D. Warner, PG CHG CEG

Principal Hydrogeologist
BBJ Group, Larkspur, California

Consultant to Great Basin Unified Air Pollution Control District

Mono Air and Water Workshop
Governing Board Meeting
November 4, 2021

Photo by S. D Warner, October 2020

Presentation and Discussion Items

Overview of Mono Basin Hydrologic System and Lake Forecast Models

Model Comparisons using Historical Data

Projections of Lake level with / without Stream Diversions

Photo by S. D Warner, October 2020

Modeling Results Provide Confidence that Diversions Substantially Slow Lake Level Recovery

Photo by S. D Warner, May 2019

Uncertainty is inherent in predicting future conditions based on computer modeling, available data, and climatic variability.

Model results using past observations, however, can be used to calculate a range of potential future conditions.

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Different Models Achieve Similar Results

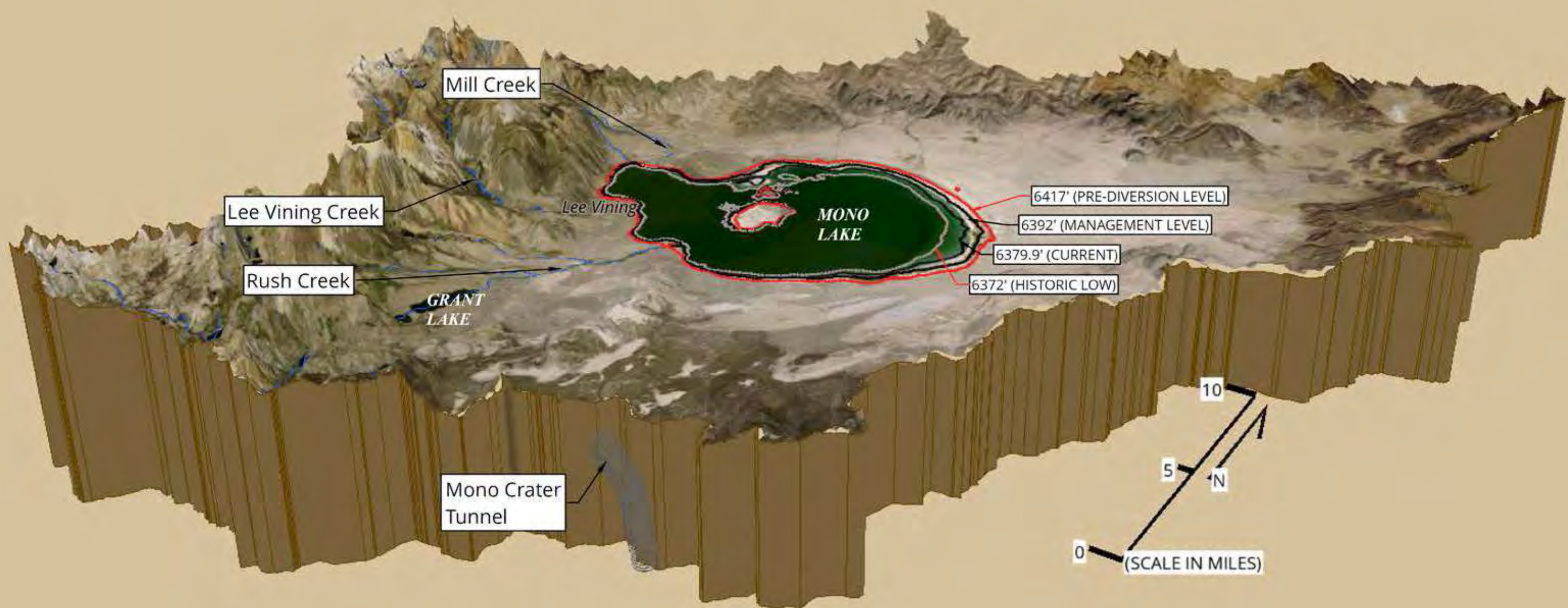
Photo by S. D Warner, May 2019

Two primary modeling approaches applied:

1. **Water balance information with measured hydroclimate data**
2. **Statistical analysis of hydroclimate and lake surface area data**

****Lake level models ARE NOT "Climate" models****

Mono Basin Water Setting



Contours shown are approximated from existing elevation sources (Raumann et al., 2002; National Elevation Dataset, 10M 7.5x7.5 Minute Quadrangles) and are not intended to be exact. Aerial imagery provided by the National Agriculture Imagery Program (NAIP), dated 2019 and 2020.

Source: Esri, USDA FSA

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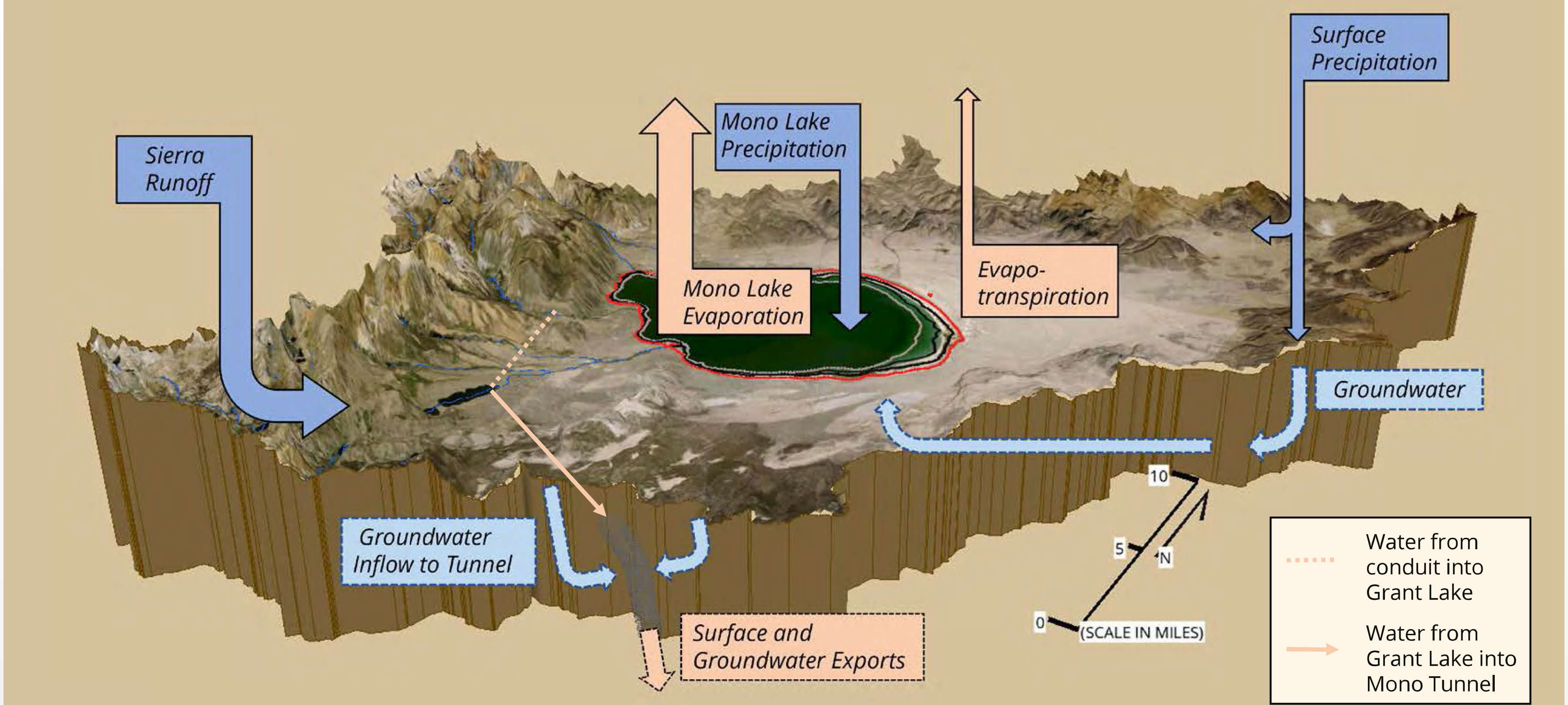
Mono Basin Water Balance



Contours shown are approximated from existing elevation sources (Raumann et al., 2002; National Elevation Dataset, 10M 7.5x7.5 Minute Quadrangles) and are not intended to be exact. Aerial imagery provided by the National Agriculture Imagery Program (NAIP), dated 2019 and 2020.

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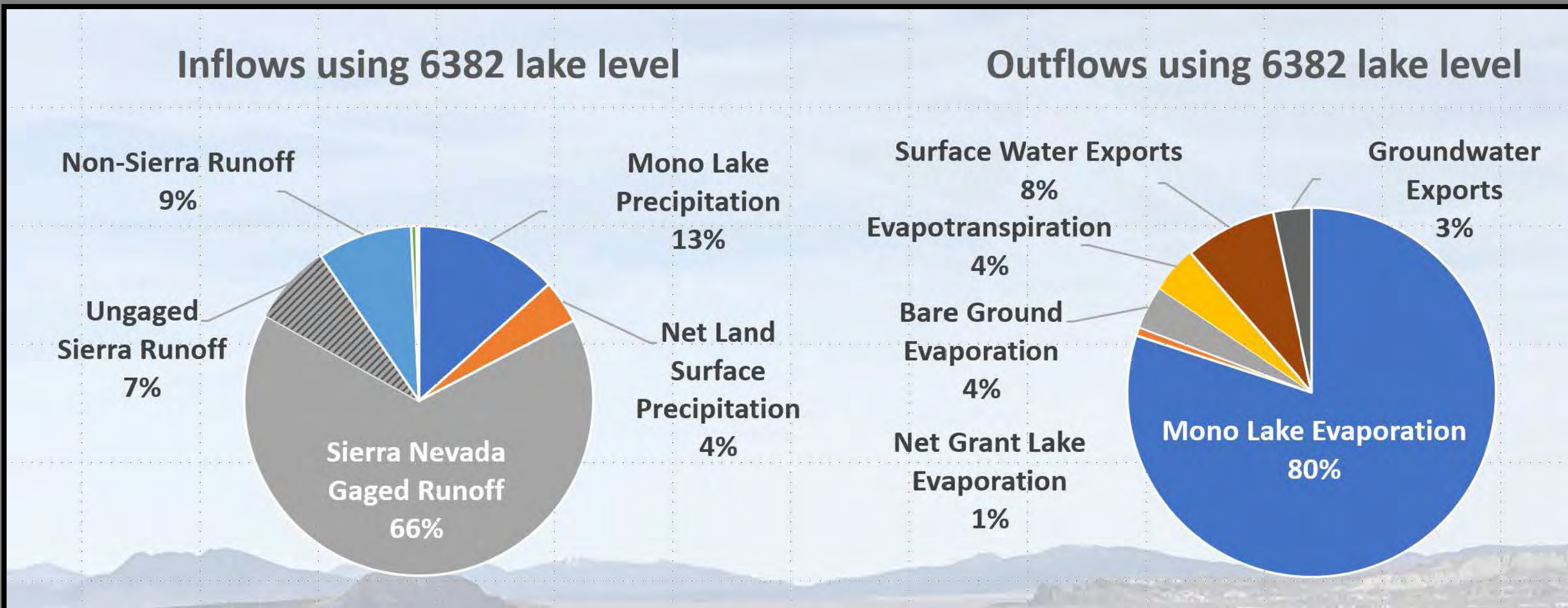

The Mono Basin Water Balance Components for Model Consideration

Information Provided by Mono Lake Committee

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List of Models

<u>Vorster Water Balance Model</u>

Annual lake level forecast model based on 18 components of the Mono Basin water balance.

<u>LADWP Forecast Model [within "e STREAM"]</u> (statistical/water balance)

Timestep: 12 monthly storage change regression equations from statistical analysis of 1980-2019 hydroclimate/lake surface area data

____

<u>LA Aqueduct Simulation Model - LAASM</u>

Developed by LADWP (1990), LA Aqueduct model with Mono Lake storage regression equations (projections referenced by GBUAPCD)

<u>LA Aqueduct Monthly Planning Model - LAAMP</u>

Developed by SWRCB for D1631 projections (1992), LA Aqueduct model with Mono Lake forecast module.

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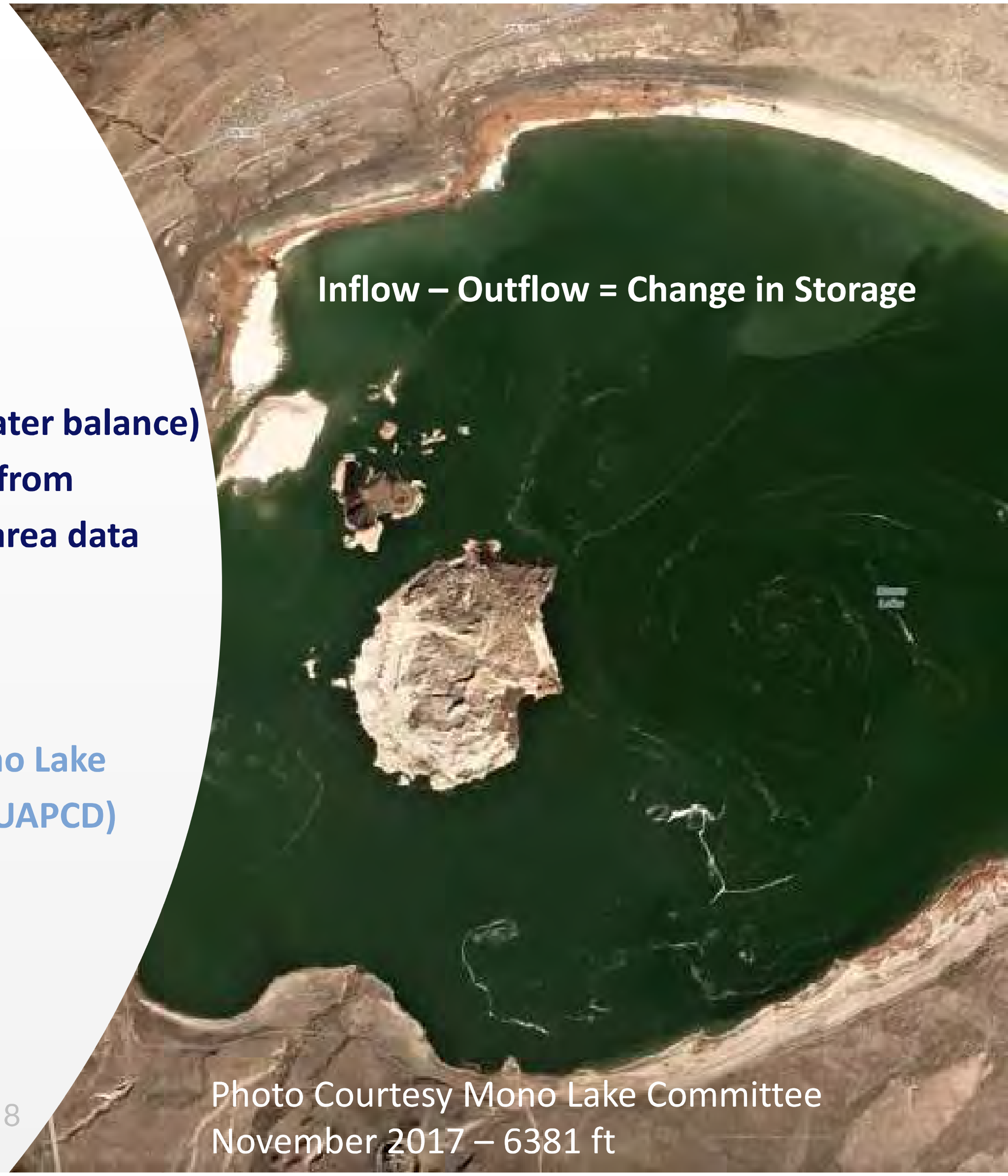

Comparison of Models Used

		Vorster water balance (1985) *(updated in 2019)* *Entire Mono Basin* *Annual Timesteps*	**LADWP Forecast Model** **("eSTREAM" Lake Level Module)** *Mono Lake* *Monthly Timesteps*
INFLOW	Gaged Sierra runoff	✓	✓
	Includes Mill Creek	✓	-
	Lake surface precipitation	✓	✓[1]
	Non-Sierra runoff	✓	-
	Ungaged Sierra runoff	✓	-
OUTFLOW	Mono Lake Evaporation	✓	✓[2]
	Surface water exports	✓	✓
	Bare ground evaporation	✓	-
	Evapotranspiration	✓	-
	Groundwater export	✓	-
	Grant Lake evaporation	✓	-
	Storage change	Mono Lake, Grant Lake Reservoir, Groundwater	Mono Lake

[1] - *Uses Cain Ranch precipitation as proxy*

[2] - *Uses lake surface area as proxy*

Information Provided by Mono Lake Committee

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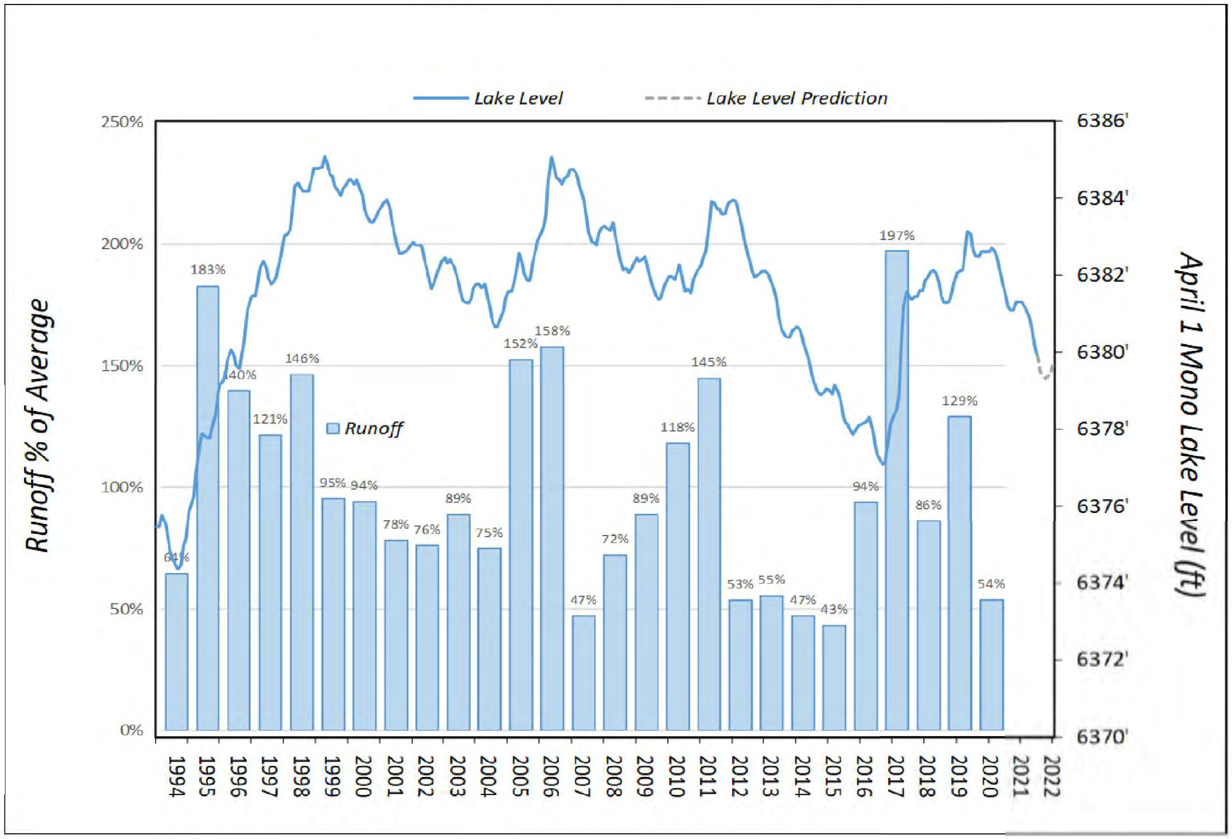
Observed Mono Lake Levels and Sierra Surface Runoff



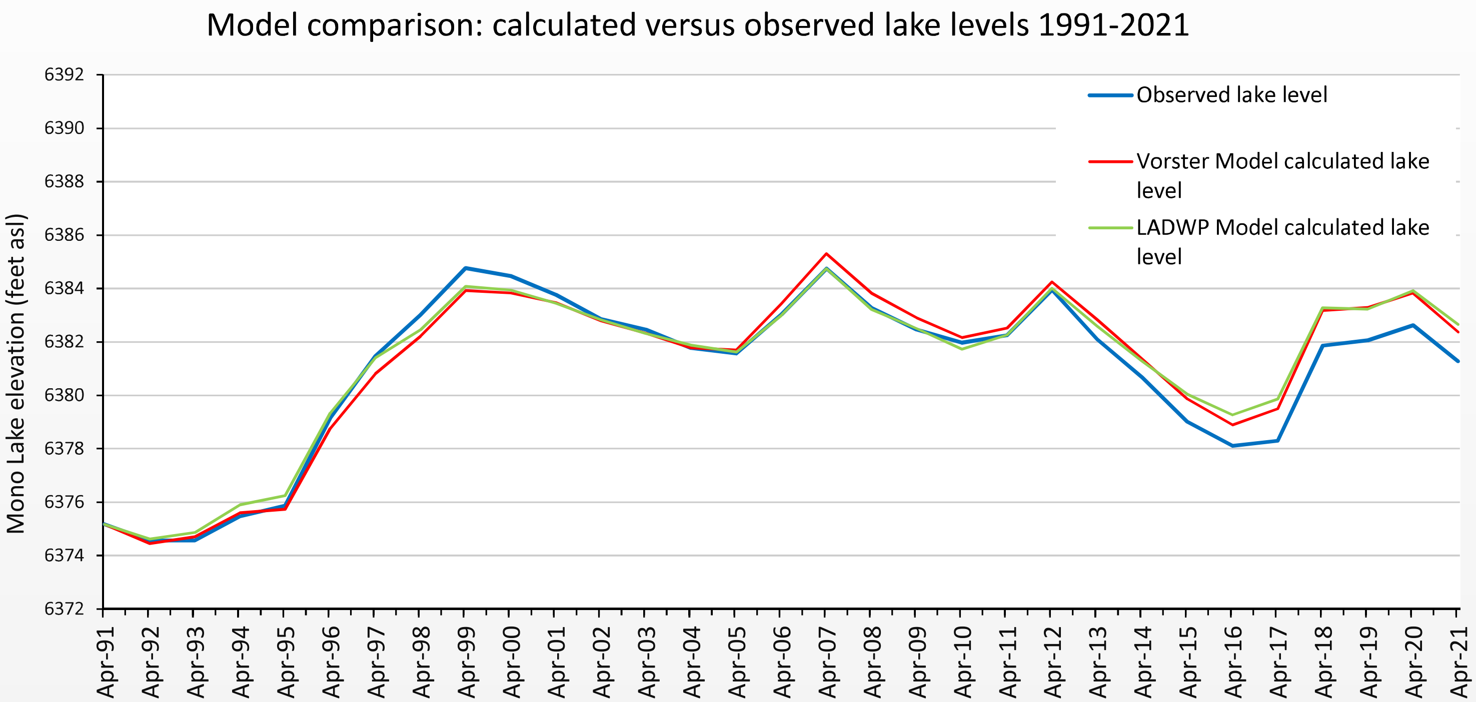
Hydroclimate conditions, (i.e., annual runoff), are highly variable.

Average runoff since 1994* is only slightly less than the long-term average.

*Decision 1631 issued September 28, 1994

Information Provided by Mono Lake Committee

Model Comparison and Validation: Test against Historical Lake Levels



The Vorster and LADWP models were used to calculate annual lake levels using observed hydroclimate data and LADWP stream diversion rules.

The model results adequately replicate observed lake level fluctuations.

Model Results Provided by Mono Lake Committee

B B J G R O U P

w w w . b b j g r o u p . c o m

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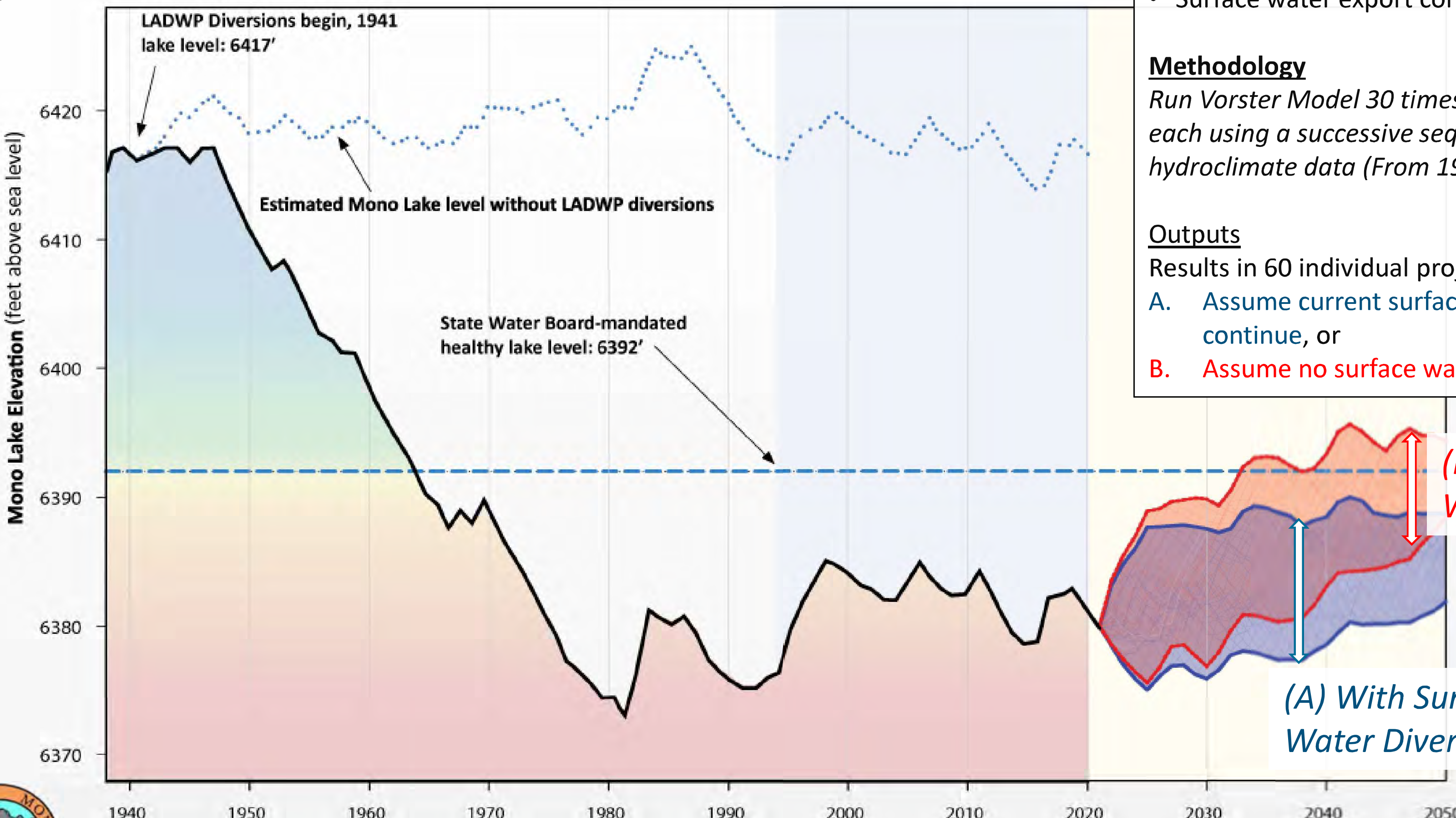
Projections using Historic Hydroclimate and Lake Level Data

Inputs
- 1991-2020 observed hydroclimate data (30 years)
- Starting annual lake levels
- Surface water export condition (2 conditions)

Methodology
Run Vorster Model 30 times per export condition, each using a successive sequence of historic hydroclimate data (From 1991-2020).

Outputs
Results in 60 individual projections, 30 each that:
A. Assume current surface water diversions continue, or
B. Assume no surface water diversions occur



(Graphic modified after Mono Lake Committee, 2021)

Concluding Statements

- The Vorster Model and the LADWP Model provide comparable results given the same hydroclimate data input between 1991 and 2020.
- The Vorster model and LADWP model replicate the observed lake level.
- The Vorster model calculations indicate that the management lake level cannot be achieved given the hydroclimate input from the past 30 years with continued licensed stream diversions.

Hydrology Model References

Vorster, P. (1985)*. A Water Balance Forecast Model for Mono Lake, California, MS Thesis. California State University, Hayward
http://monobasinresearch.org/onlinereports/waterbalance.php

Watercourse Engineering. (2020). Mono Lake Elevation Studies Technical Memorandum, *in*, LADWP, (2021) Final CEQA Initial Study and Mitigated Negative Declaration, Mono Basin Water Rights Licenses Project, Appendix E.
https://ceqanet.opr.ca.gov/2020110004/2

**The Vorster model was updated in 2019*

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MONO LAKE COMMITTEE

BBJ GROUP

Air Quality Modeling for the Mono Basin

Mono Air and Water Workshop

Presentation to the:
Governing Board of the
Great Basin Unified
Air Pollution Control District

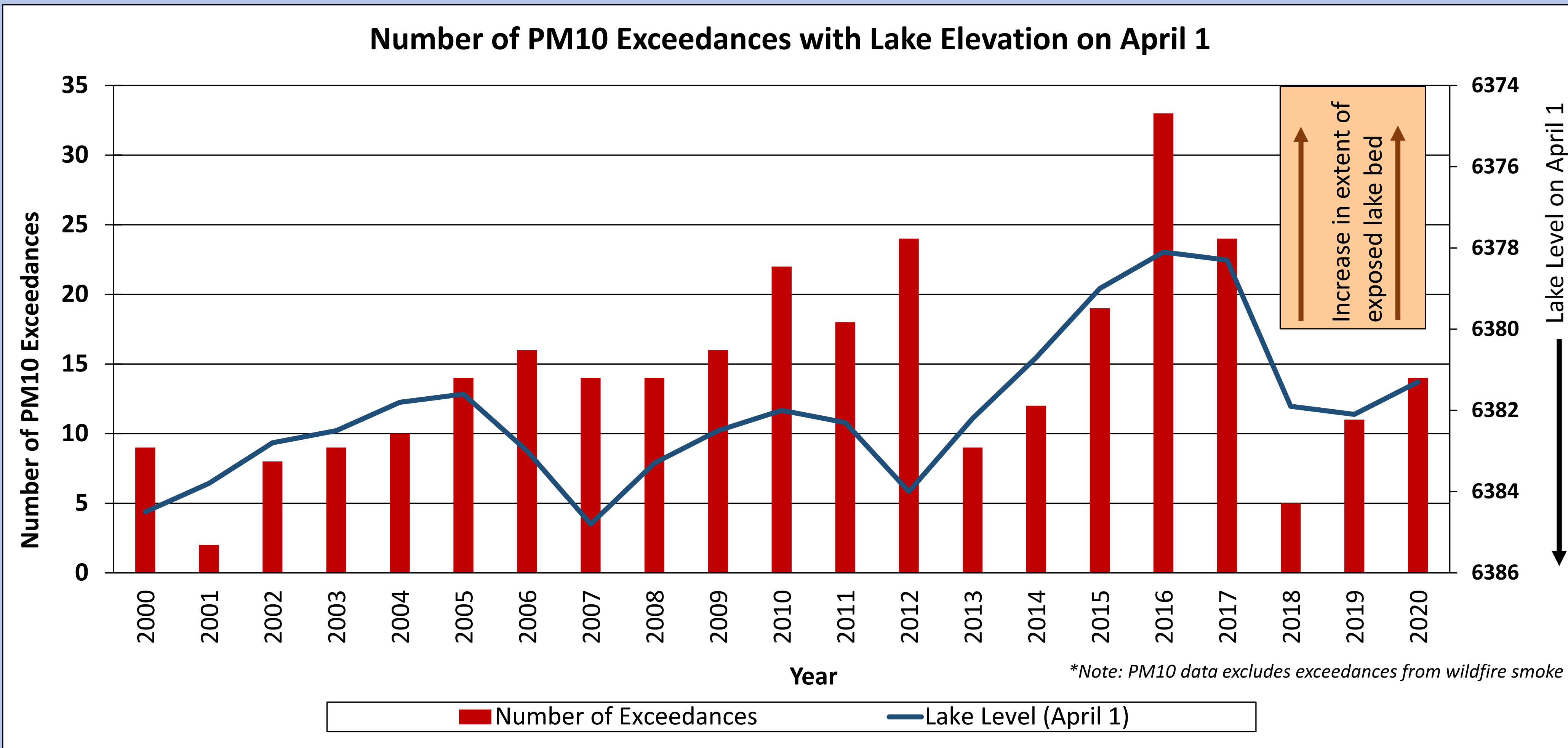
By: Grace A. McCarley Holder, Ph.D.

November 4, 2021

(Photo: February 2020)


OVERVIEW
• Previous Air Quality Modeling Work
• 2021 Mono Basin Air Quality Model
• Source Areas
• Emission Rates
• Next Steps
• Conclusions
2

Number of PM10 Exceedances with Lake Elevation

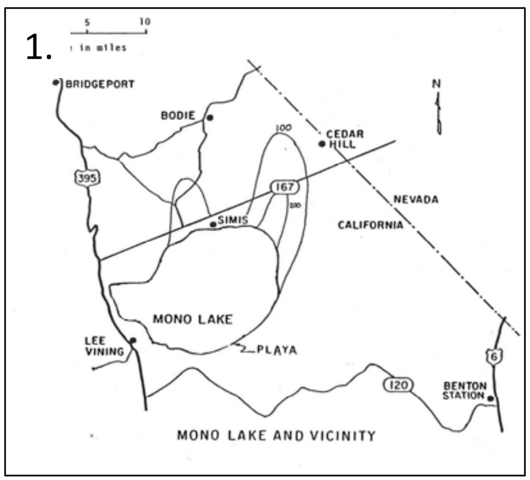


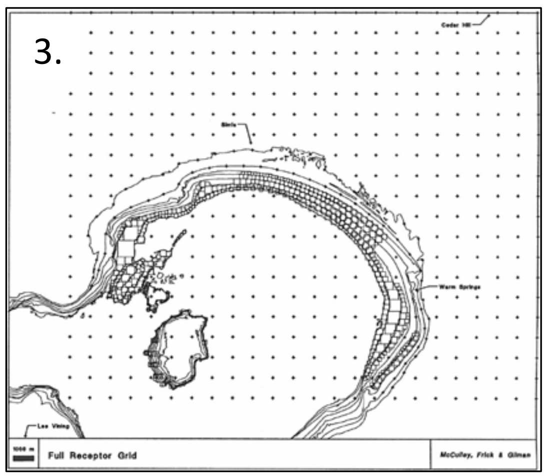
Previous Air Quality Modeling Work

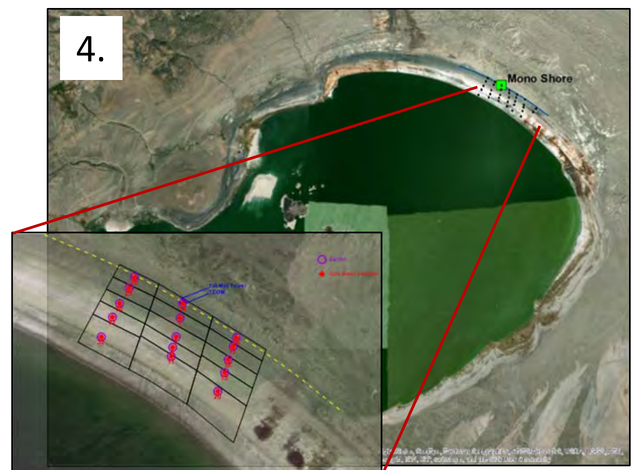
Four Previous Air Quality Modeling Studies from the 1980s to 2020

Summary of Previous Air Quality Models at Mono Lake

1. **1980s UC Davis Modeling.** [Contoured Total Suspended Particulates (TSP) concentrations along multiple linear transects through lake bed source areas]
2. **1991 Initial Modeling Evaluation Study.** [Evaluation of 2 dispersion models of lake bed area sources]
3. **1994 Air Quality Modeling Study.** [Demonstration model for 1995 Mono Basin Planning Area State Implementation Plan]
4. **2014-2020 Annual Model.** [small scale model focused on Mono Shore network]



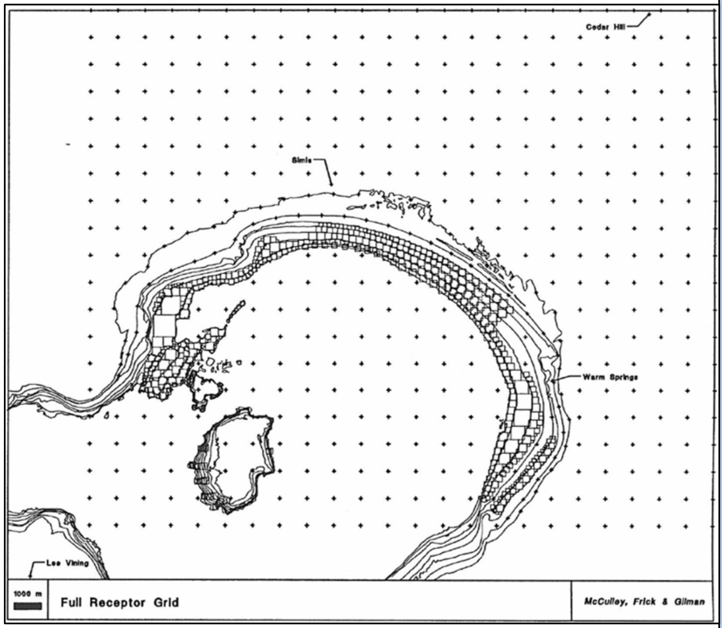




GBUAPCD Model for 1995 SIP (1994)

- **Conducted for GBUAPCD for the 1995 Mono Basin Planning Area State Implementation Plan**
- **Results were used in the 1994 State Water Resource Control Board Hearing for Mono Lake**
- **Established that the PM10 Federal Standard could be met if Mono Lake level reached an elevation of at least 6,391 feet above MSL**

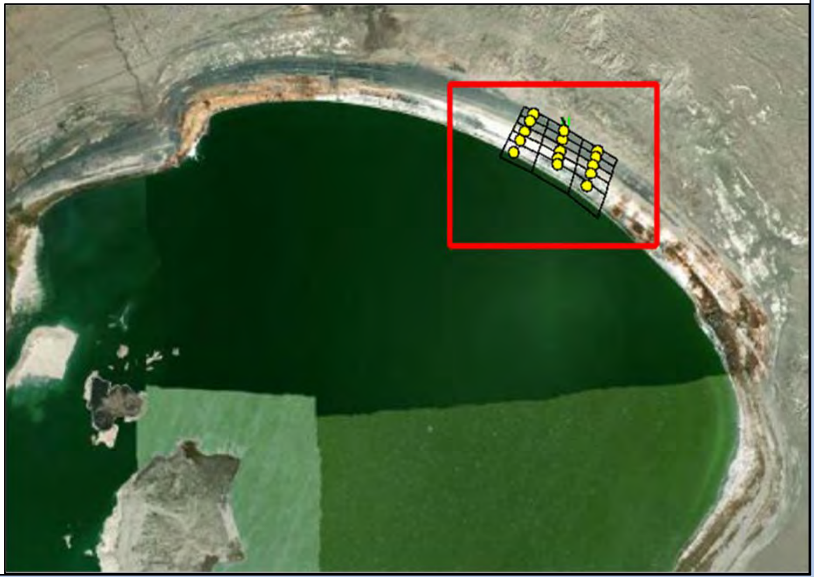
- Used ISCST dispersion model for EPA regulatory preference
- Emission rates from refined wind tunnel testing applied to all source areas
- Dust season April – December
- Meteorological data from Simis station
- PM10 data from Simis, Warm Springs and Cedar Hill



Source areas and receptors in 1994 model

Annual Modeling of North Shore Area

- **Conducted by Environ/Ramboll for GBUAPCD starting in 2014 using AERMOD system.**
- **Model focuses on sand flux monitoring network on north shore of Mono Lake.**
- **Model is similar to the Dust ID methodology developed for Owens Lake where PM10 flux is related to sand motion within the source. [EPA Approved Method OTM-30 (2012)]**
- **Model uses gridded source areas around the sand motion monitoring sites.**



- PM10 emissions in the model = K-factor x Sand Flux.
- K-factors only developed for winds >5 m/s,
  PM10 > 150 µg/m3, and winds "from the lake" direction.
- Seasonal K-factors used in model.

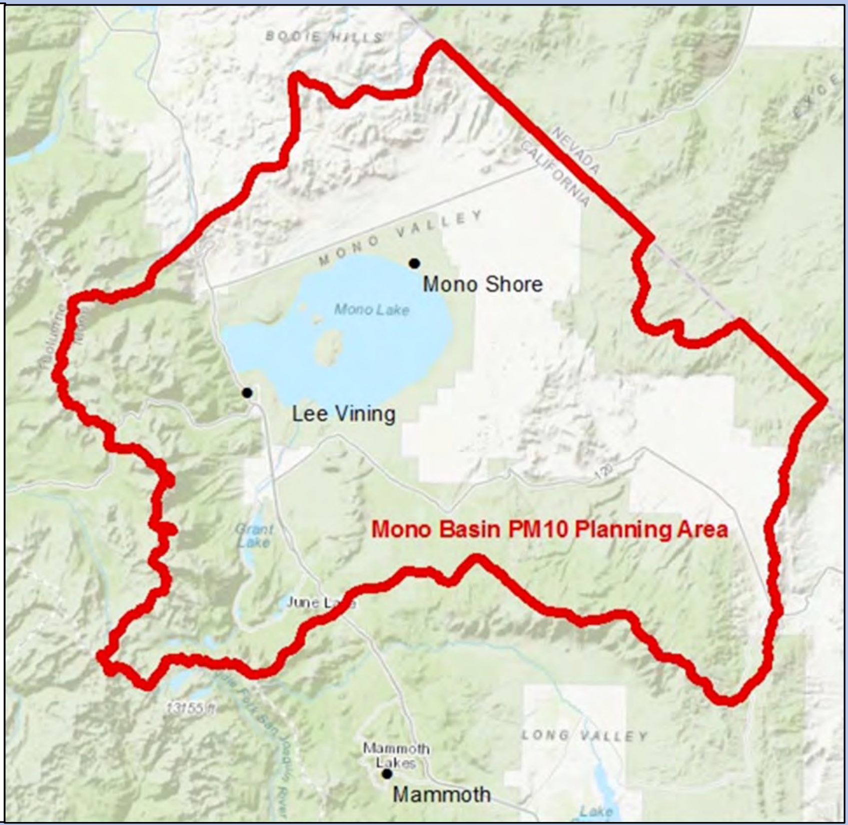
2021 Mono Basin Air Quality Model

First broad scale model since 1994
Incorporates data collected since 1994
Includes sources on and off the exposed lake bed

2021 Mono Basin Air Quality Model

GOAL

- Create an updated PM10 model for the Mono Basin PM10 Planning Area
- Utilizing improved data and updated modeling:
  - Refined source areas and emission rates
  - Incorporate sand flux monitoring data
  - Improved modeling methodology
- Updated air quality model will provide updated and improved information for all parties including:
  - Evaluation of the 6392-foot Management Lake Level
  - Re-Evaluation of lake level necessary for PM10 attainment
  - Ability to model air quality impacts associated with different lake levels



2021 Model Source Areas

2021 Modeling Source Areas

Lakebed Sources

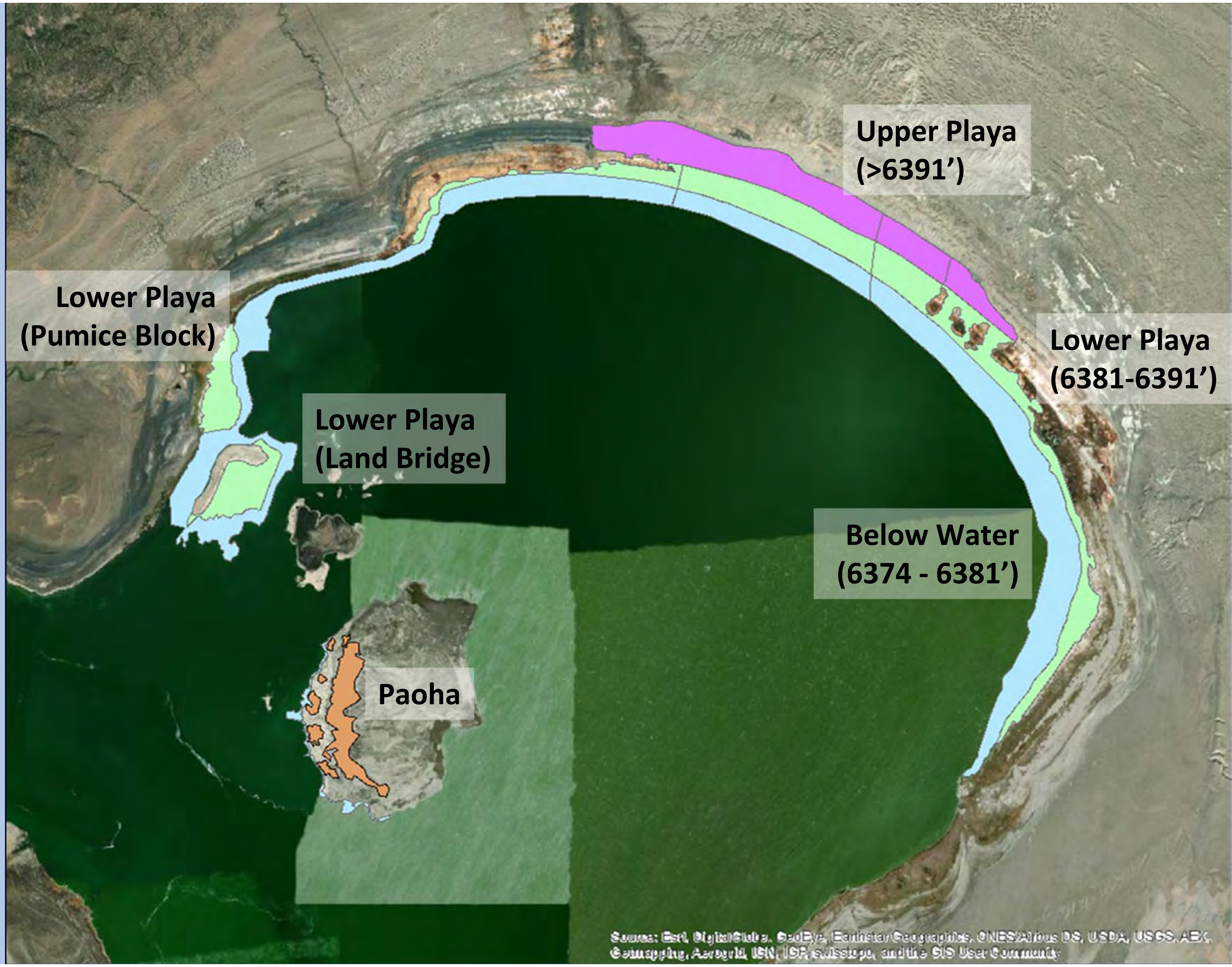
Exposed = **6.73 sq mi**
(purple, green, brown)
(>6381’ elevation)

Submerged = **5.94 sq mi** (blue)
(6374-6381’ elevation)

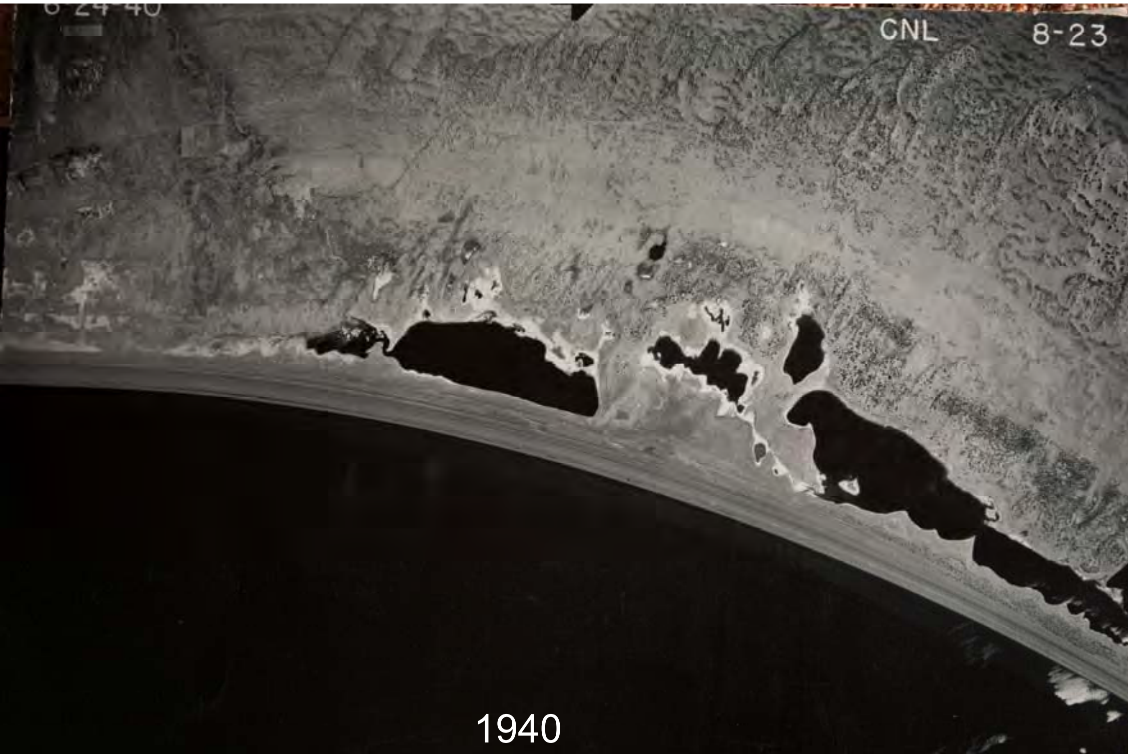
TOTAL = 12.67 sq mi

Source areas boundaries are based on field observations, vegetation cover analysis, elevation, and Lidar data.

Model also includes wildfire burn scars and stationary sources



North Shore of Mono Lake



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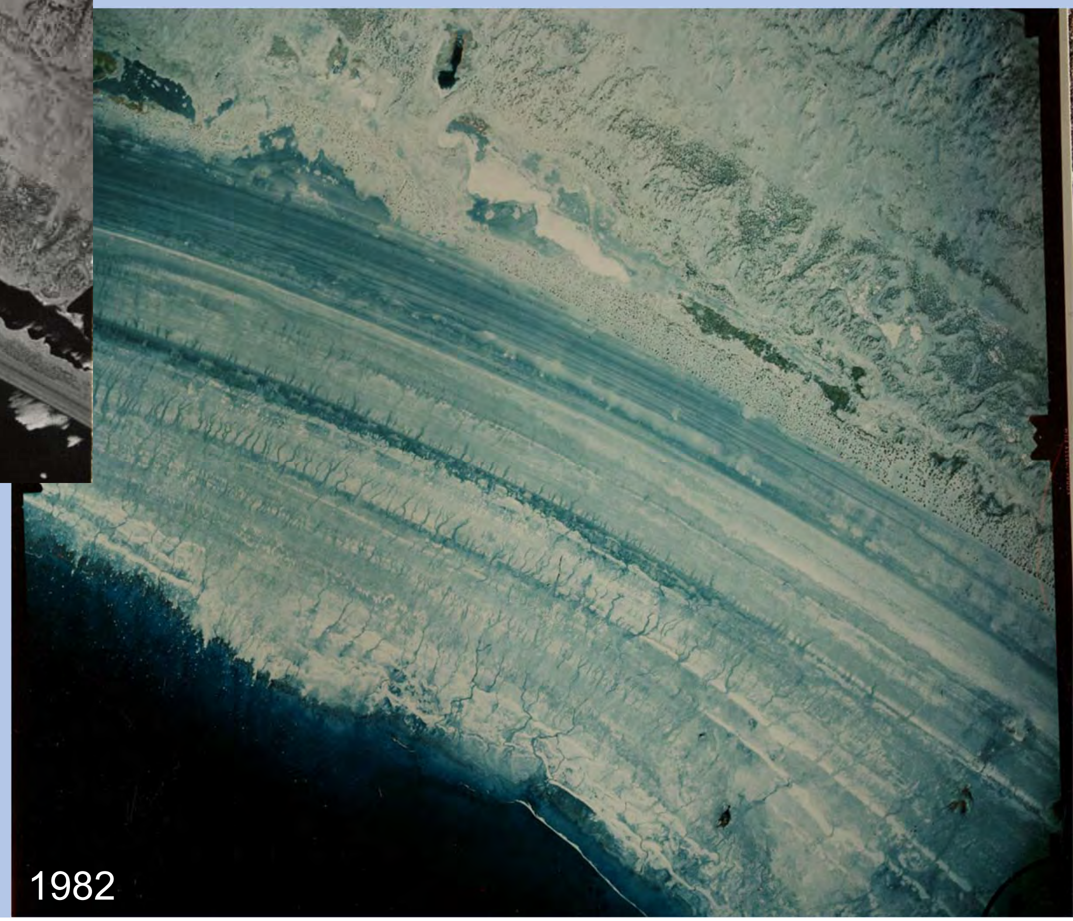

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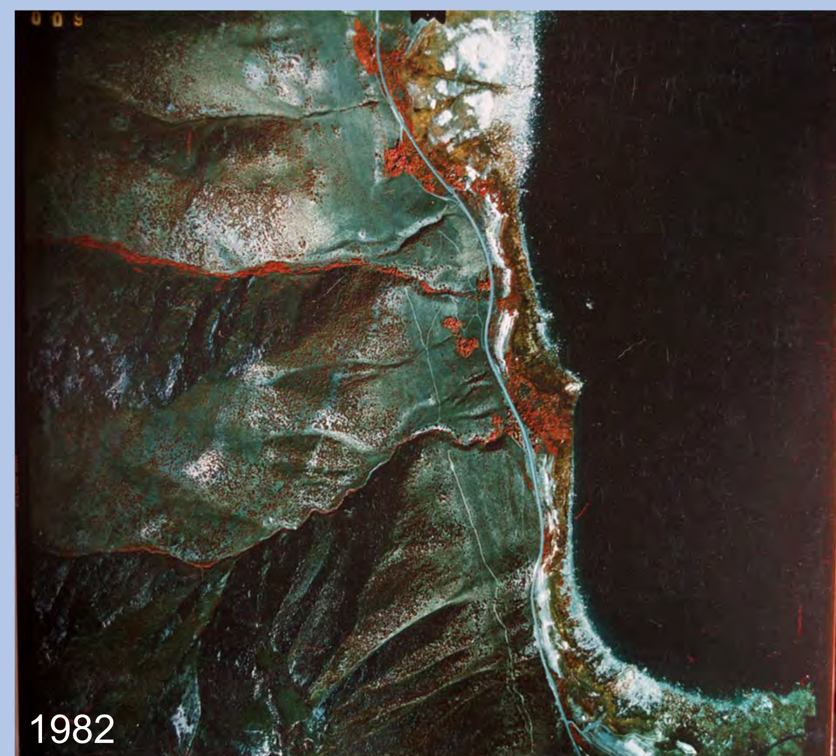
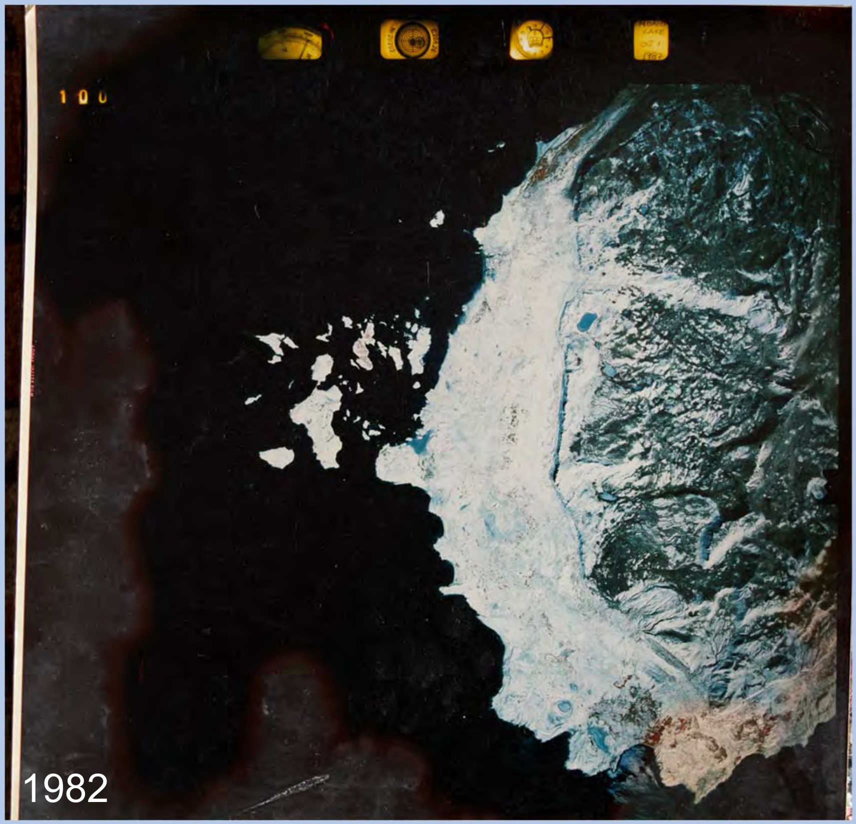
Photos courtesy of Dr. Scott Stine

West Shore of Mono Lake



Photos courtesy of Dr. Scott Stine

Paoha Island



Photos courtesy of Dr. Scott Stine

Southeastern Shore of Mono Lake

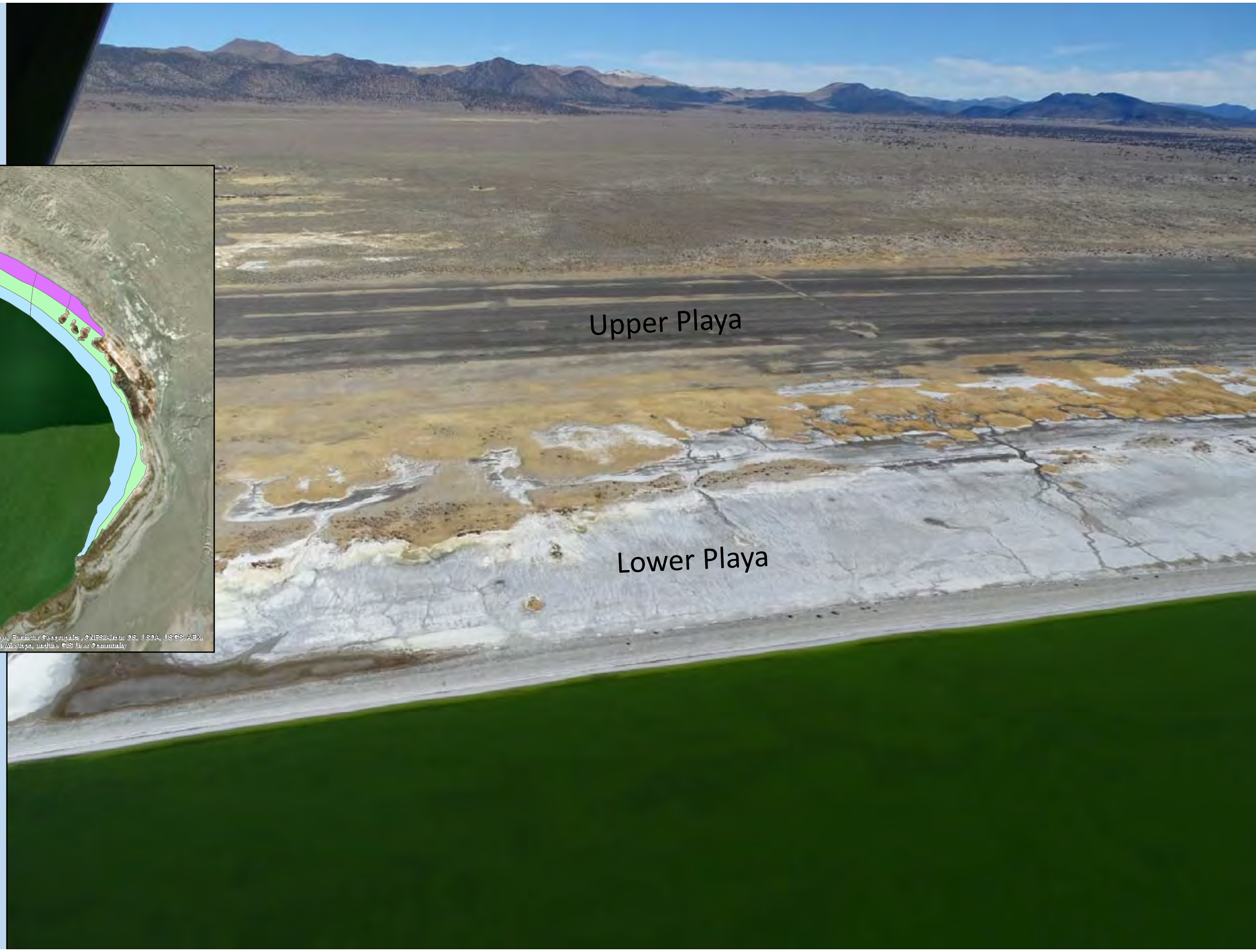
Photos courtesy of Dr. Scott Stine

Pumice Block Area

(Photo: August 2019)

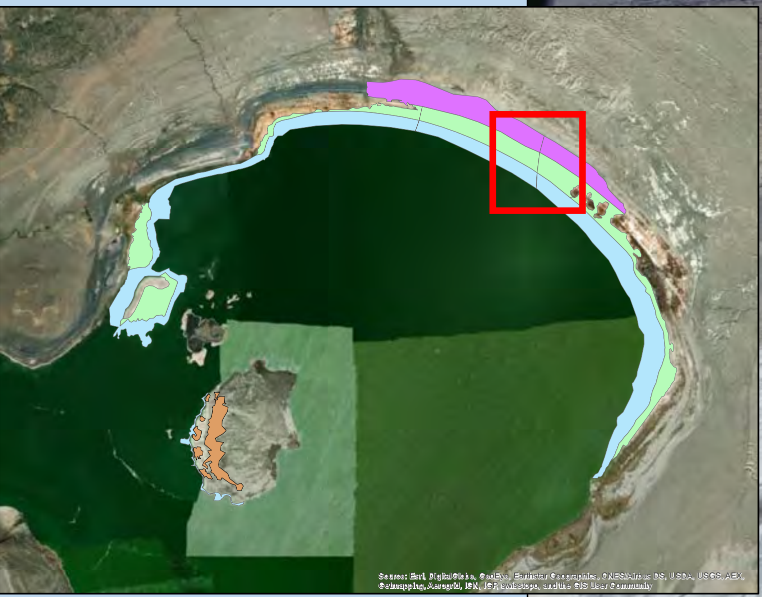
(Photo: February 2020)

10-Mile Area



(Photo: February 2020)

North Beach Area



Note: North Beach area is the area of highest PM10 emissions on the playa

(Photo: February 2020)

Warm Springs Area

(Photo: February 2020)

Paoha Island Area

(Photo: February 2020)

(Photo: August 2020)

2021 Mono Basin Model: Emission Rates for Lake Bed Sources

Development of Emission Rates for Lake Bed Sources

Previous Modeling Work Methodology – applied <u>one</u> emission rate for all sources.

2021 Basin-Wide Model

- Will utilize different seasonal emission rates for different source areas
- Emission rates have been developed from multiple sources, including:
  - Analysis of sand flux data from monitoring network on north shore of lake bed.
  - Portable wind tunnel tests
  - Roughness element analysis

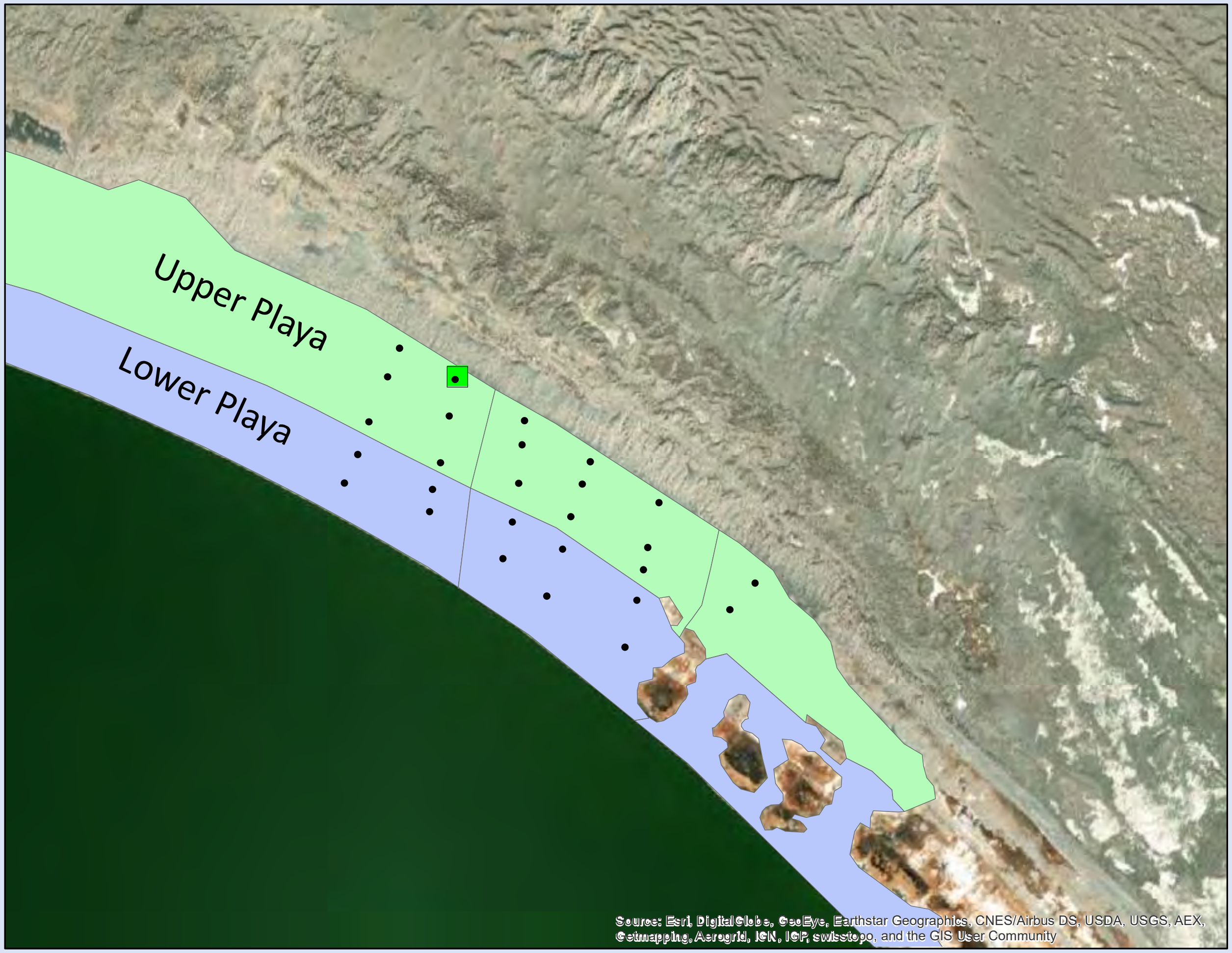
Analysis of Sand Flux Data for 2021 Basin-Wide Model

<u>Development of multiple emission rates based on area and season using data from 2009-2019:</u>

- ❑ 3 sources on the Upper Playa
- ❑ 2 sources on the Lower Playa

- Data were analyzed based on season since seasonal differences have been observed in previous work.

- ❑ Fall (Oct, Nov, Dec)
- ❑ Winter (Jan, Feb)
- ❑ Spring (Mar, Apr, May, Jun)
- ❑ Summer (Jul, Aug, Sep)



Next Steps

Next Steps - 2021 Modeling Work

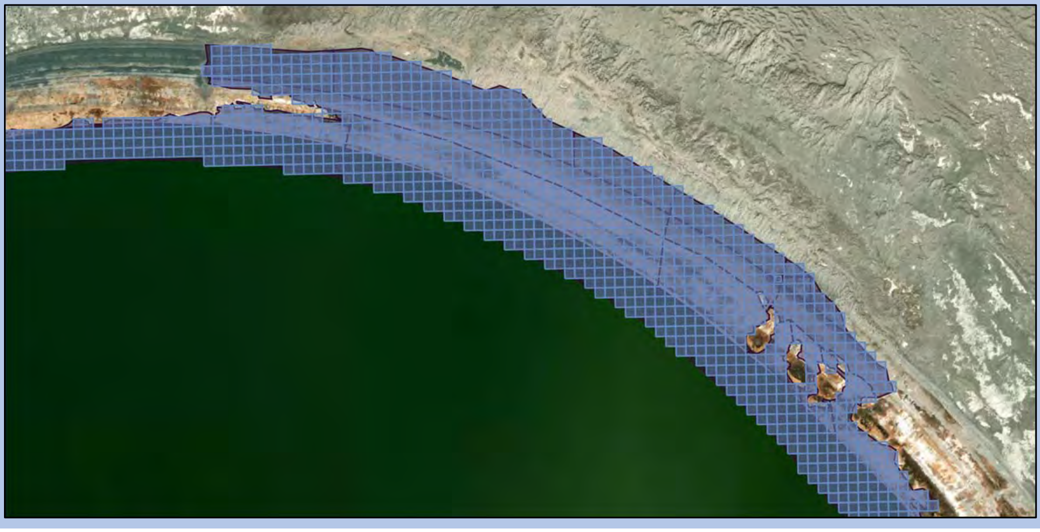
- Run model with previous meteorology and compare against observed PM10 impacts to ensure model adequately replicates air quality impacts. Refine model as needed.
- Utilize updated model for
  - Evaluation of the 6392 foot Management Level
  - Evaluation of lake level necessary for attainment for the PM10 Federal Standard
  - Ability to model air quality impacts associated with different lake levels based on hydrology modeling/export scenarios
- Modeling information will help inform all parties as we move forward in working to address the continued PM10 air quality issues in the Mono Basin

2021 Modeling
Next Steps – In Progress

- Initial screening for the model is in progress
- Source areas are broken into 2,228 100x100 m squares
  - Each area is assigned an emission factor
  - Sources can be included/excluded from modeling to simulate different lake levels

- 3D meteorology developed including:
  - Weather Research and Forecasting Model (WRF)
  - Incorporates data from Mono Shore and Lee Vining stations

- Model domain covers entire Mono Basin PM10 Planning Area



Conclusions

- Significant PM10 exceedances continue to occur from the exposed bed of Mono Lake.
- The number of exceedances per year increase with decreasing lake level.
- Previous air modeling predicted that PM10 attainment would be reached with a lake level of 6392 feet.
- 2021 basin-wide model is being developed to incorporate NEW data collected since 1994.
- The 2021 basin-wide model will evaluate the suitability of the target lake level in D-1631.
- Amended State Water Resources Control Board Licenses state that: "… analysis regarding target lake levels is appropriate for a separate proceeding from resolution of the stream restoration issues addressed by this Order, as anticipated in D1631. The State Water Board will work with stakeholders and interested parties to separately schedule appropriate proceedings to gather and consider pertinent information on this issue." *[SWRCB, October 1, 2021, page 11]*

Air Modeling References

Cahill, T.A. and T.E. Gill (1987). *Air Quality at Mono Lake*. Report to the Community and Organization Research Institute by the Air Quality Group at the Crocker Nuclear Laboratory, University of California at Davis, April 1987.

GBUAPCD (1991). *Mono Lake Air Quality Model Evaluation Study*. Final Report by TRC Environmental Consultants for Great Basin Unified Air Pollution Control District. November 11, 1991.

GBUAPCD (1994). *Mono Lake Air Quality Modeling Study*. Final Report by McCulley, Frick and Gillman Inc. to the Great Basin Unified Air Pollution Control District. October 4, 1994.

OTM – 30 (2012). *Method to Quantify Particulate Matter Emissions from Windblown Dust*: Revisions 2 – 6/20/2012. https://www3.epa.gov/ttn/emc/prelim/otm30.pdf


Questions?