RECLAMATION

Managing Water in the West

Bureau of Reclamation Lake Mead Water Quality Monitoring

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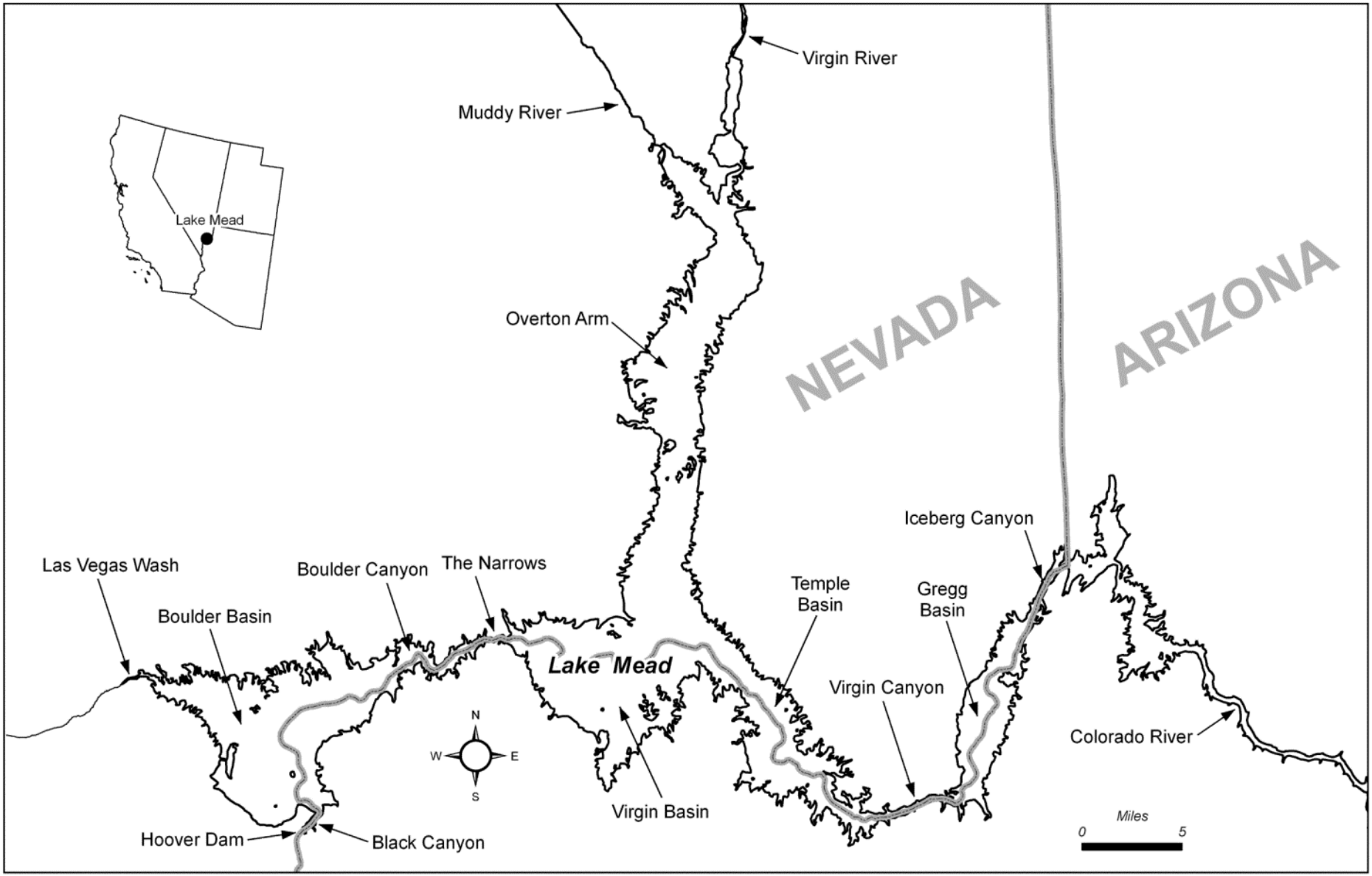
U.S. Department of the Interior
Bureau of Reclamation

Why is Lake Mead Important?

- One of the first multipurpose reservoirs constructed by the federal government
- Greatest capacity of any reservoir in the United States and second only to Lake Powell in surface area
- Used as a supply of municipal and industrial water and irrigation water by approximately 25,000,000 users
- It is unlikely that the southwest could have developed as it has without the water and power provided by Lake Mead

Colorado River System
WYOMING
Flaming Gorge Reservoir
COLORADO
Denver
Salt Lake City
NEVADA
UTAH
Green River
Colorado River
Lake Powell
San Juan River
Lee Ferry
Virgin River
Lake Mead
Las Vegas
Little Colorado River
NEW MEXICO
Albuquerque
CALIFORNIA
Lake Mohave
Lake Havasu
ARIZONA
Los Angeles
Colorado R. Aqueduct
CAP Canal
Phoenix
Salton Sea
AAC
Gila River
San Diego
Morales Dam
Tucson
Upper Basin
Lower Basin
Dam Locations
Basin Divide
City
N
SNWA 10/98



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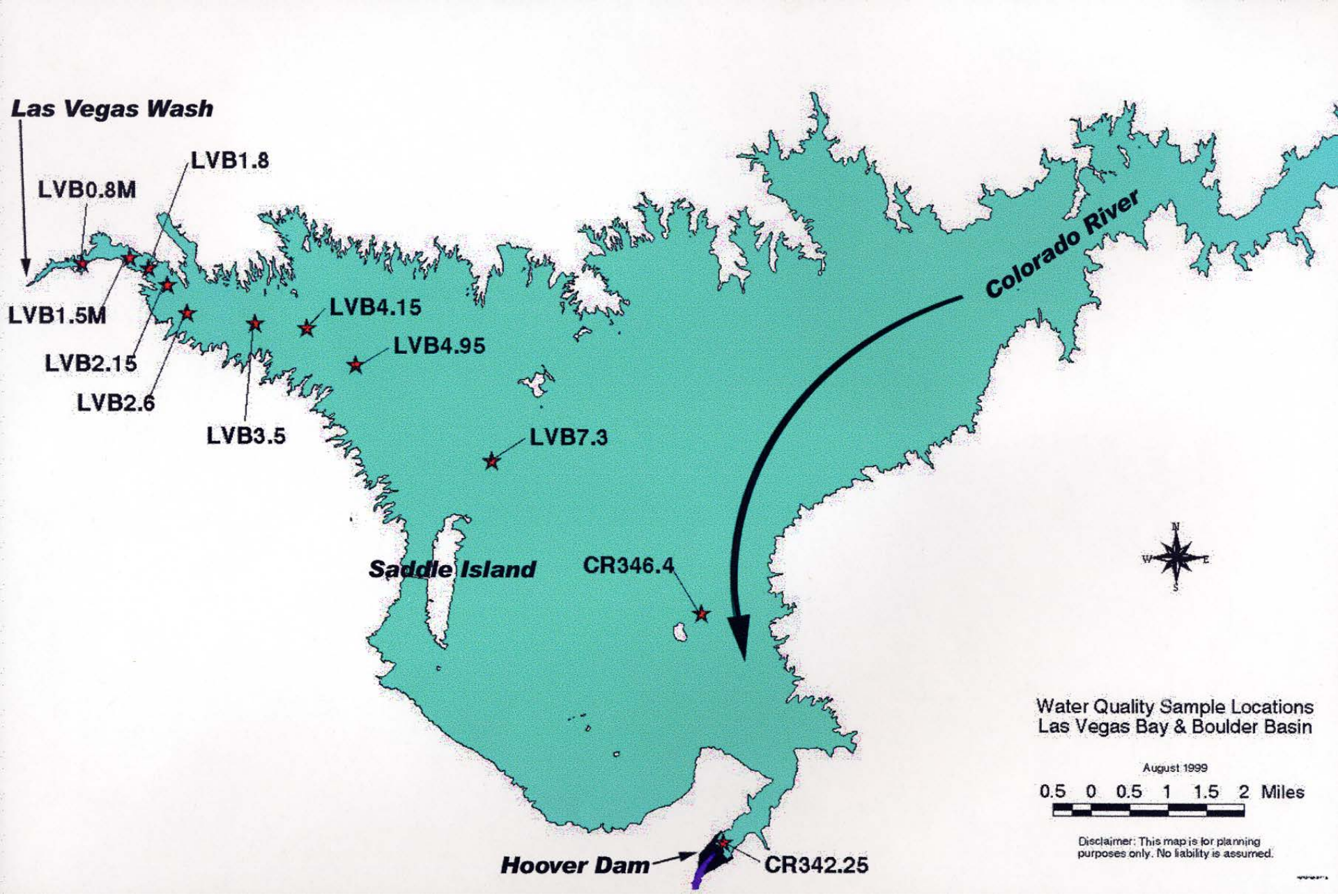
Reclamation Monitoring Program

- **Started in 1990**
  - **Samples collected at 14 sites in Boulder Basin on a transect from the Las Vegas Wash inlet to Hoover Dam in July and September**
  - **Profiles (temperature, dissolved oxygen, pH, and conductivity), Secchi depth, chlorophyll a, phytoplankton, and zooplankton analyzed at each site**

Program Evolution

- 1991 - Nutrients and monthly sampling added
- 1992 - Redundant sites dropped
- 1994-1997 Program largely unchanged
- 1998 - ClO_4 and bacteria added
- 1999 - Adopted standard site names
- 2000 - Moved to standardized methods for nutrients



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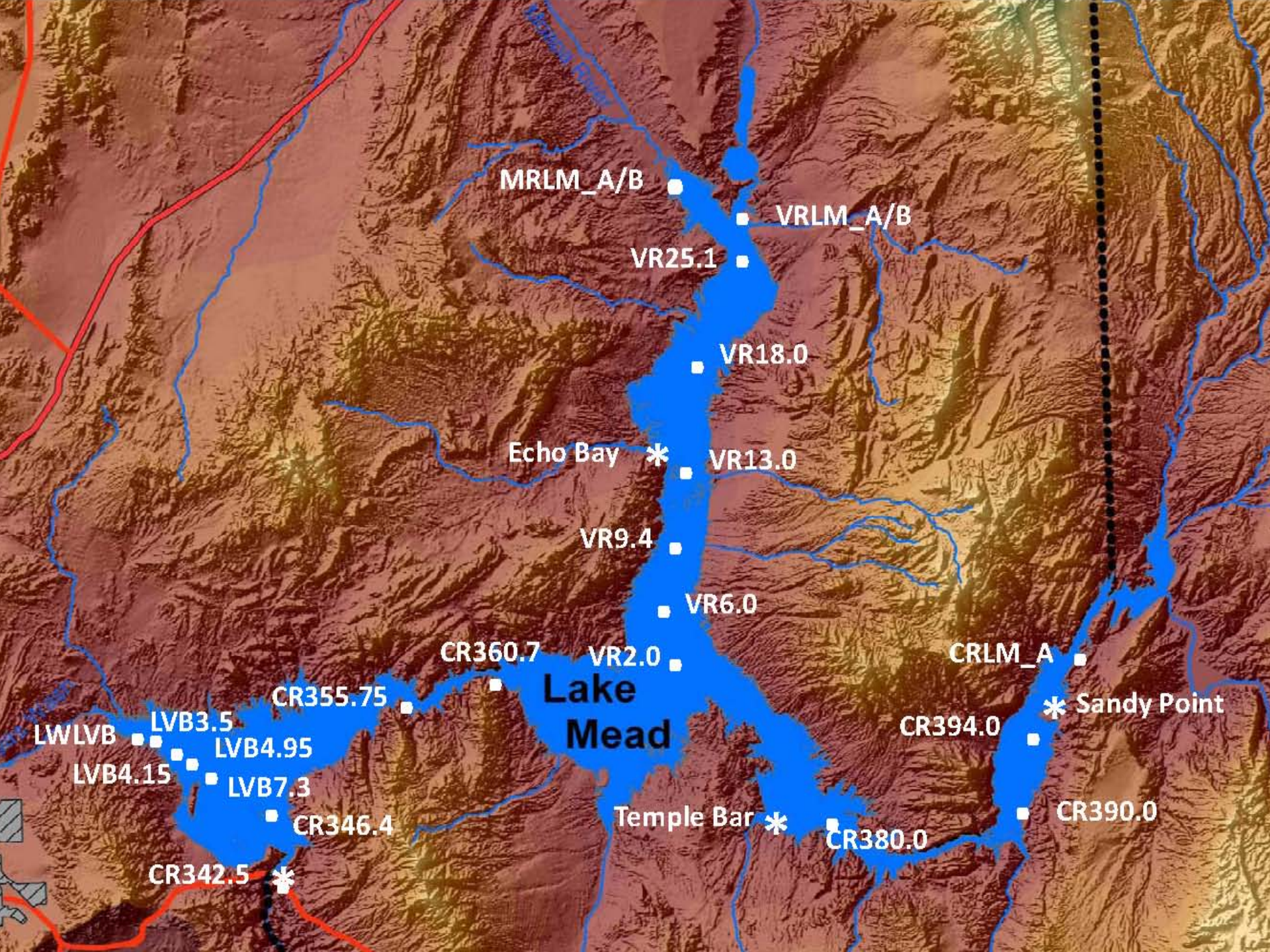
Upper Lake Mead Sampling

- **1999 – 5 sites from the Virgin River inlet to Overton Marina added to provide baseline data to examine the impacts of future development in the Virgin Basin**
- **2000 – The Muddy River inlet was added**
- **2001 – 6 sites from the mouth of the Grand Canyon to The Narrows added along the main stem of the Colorado River**


MRLM_A/B
VRLM_A/B
VR25.1
VR18.0
Echo Bay
VR13.0
VR9.4
VR6.0
CR360.7
VR2.0
Lake
Mead
CRLM_A
Sandy Point
CR355.75
LWLVB
LVB3.5
LVB4.95
LVB4.15
LVB7.3
CR346.4
CR342.5
CR394.0
Temple Bar
CR380.0
CR390.0

Recent Monitoring

- 2005 – Additional sites added in the Overton Arm and along the main stem of the Colorado River with funding from SNWA and SNPLMA
- 2007 – 4 sites (3 new) in Lake Mead and 4 sites in Lake Mohave added specifically for quagga mussel veligers
- 2007-2012 – Monitored 24 sites throughout the lake

2011 Lake Mead Sampling Stations
MRLM
VRLM
VR/MRLM
VR22.0
VR18.0
Echo Bay
VR13.0
VR9.4
VR6.0
VR2.0
CRLM_A
CR360.7
CR355.75
LWLVB
LVB3.5
LVB4.95
LVB4.15
LVB7.3
Sandy Point
CR394.0
CR346.4
Temple Bar
CR380.0
CR390.0
CR342.5

Lake Characteristics*

Surface Area	157,418 acres
Volume	28,763,140 acre-ft
Mean Depth	182 ft
Maximum Depth	532 ft
Watershed Area	167,000 mi^2
Mean Inflow	10,900,000 acre-ft/yr
Hydraulic Residence Time	2.6 years
Shoreline Length	550 miles

*At surface elevation = 1221.4' (top of spillway)

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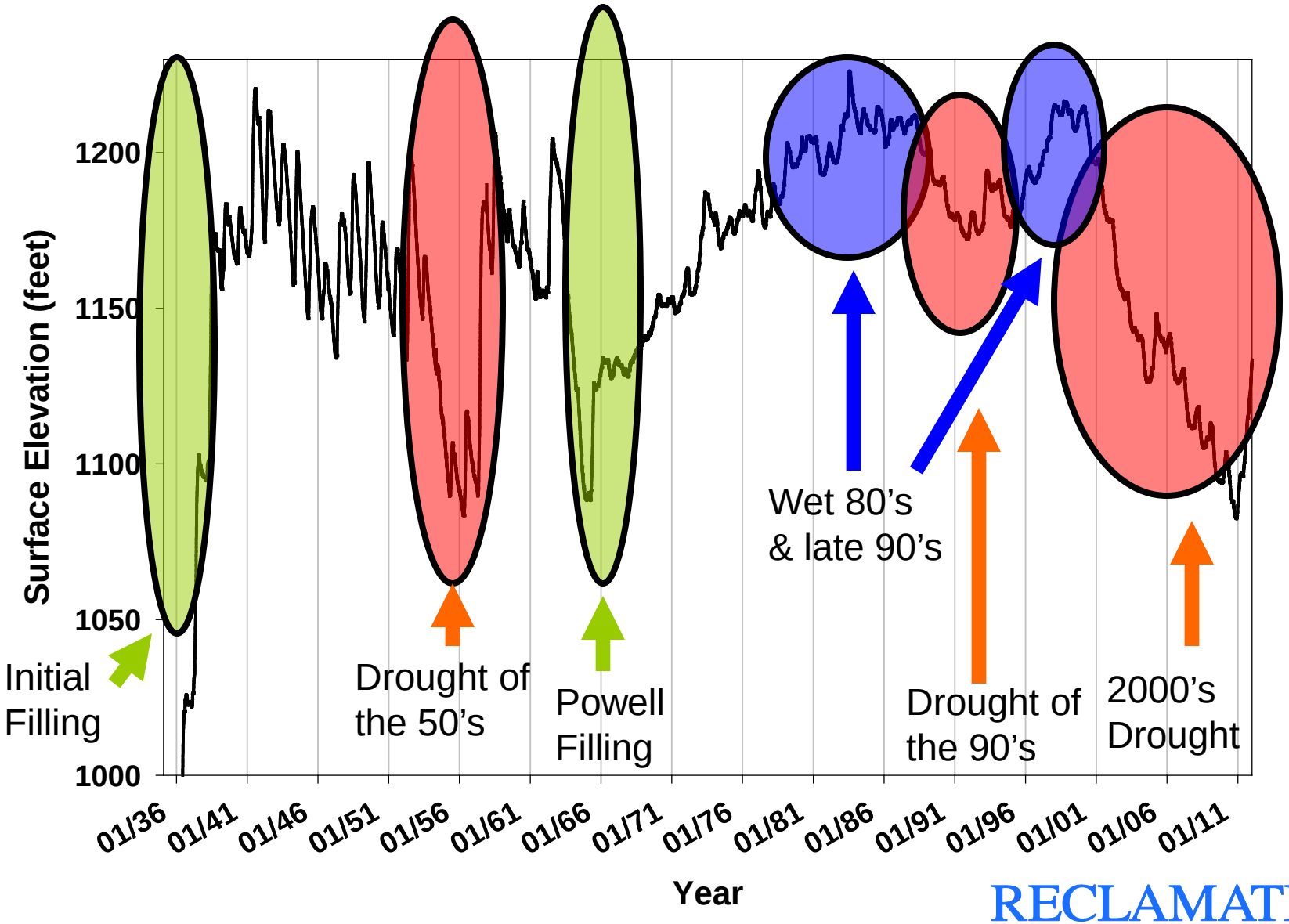
Lake Mead Surface Elevation



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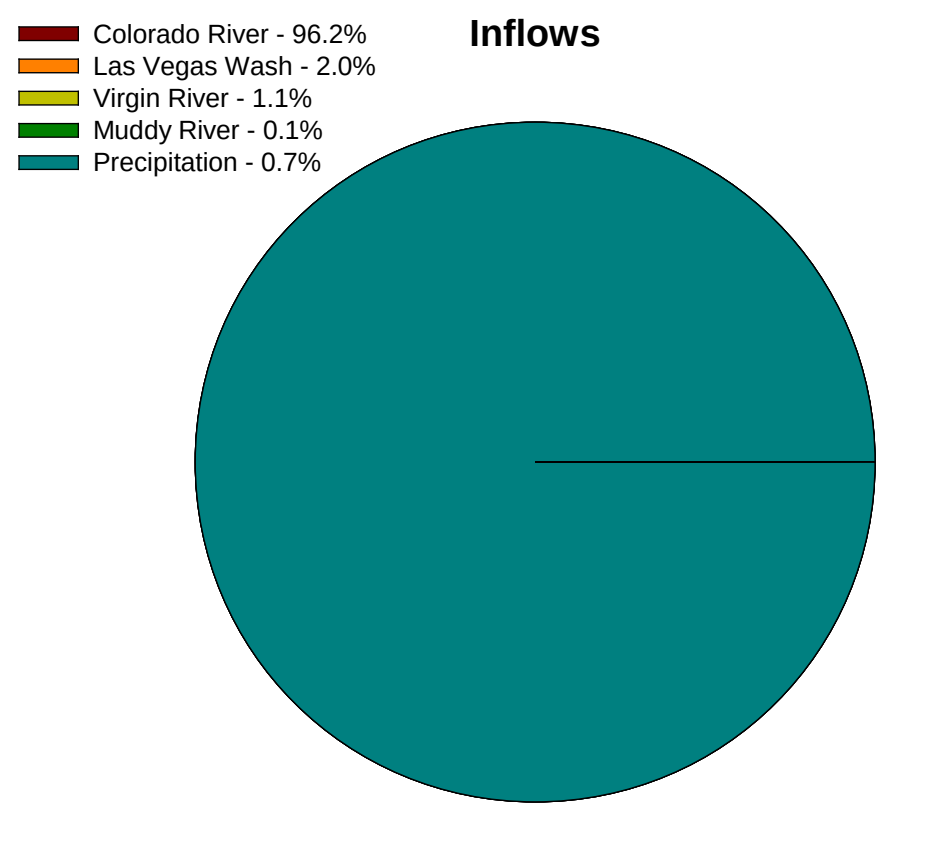
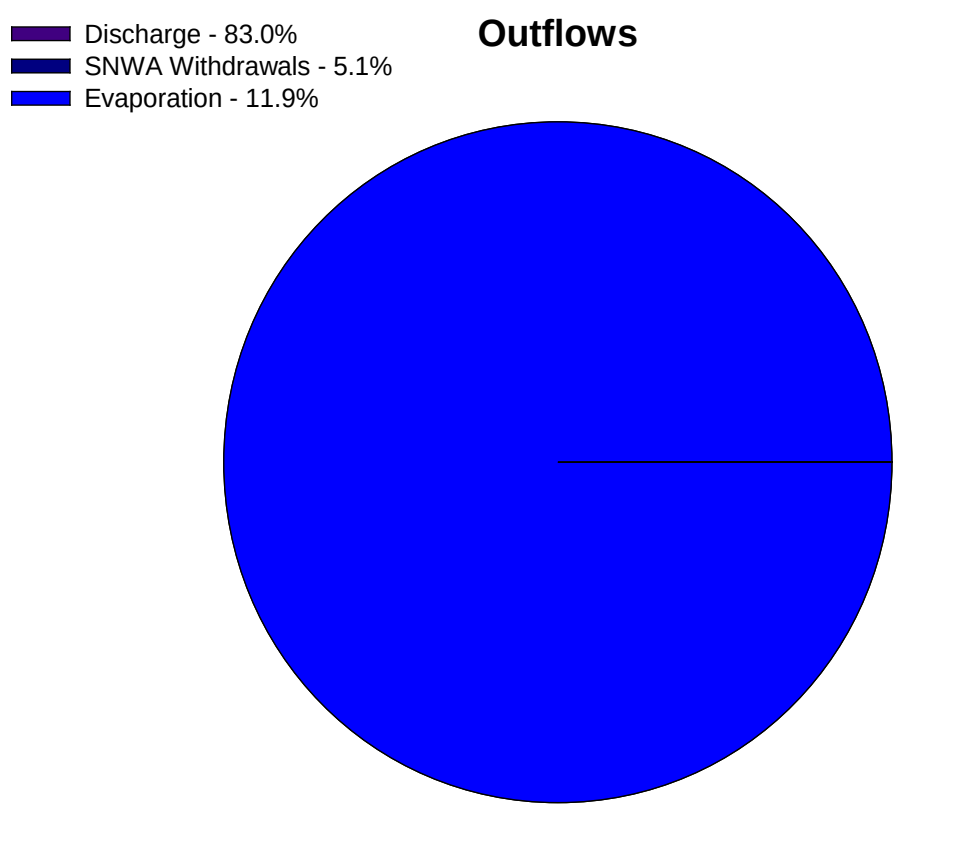
Lake Mead Water Budget





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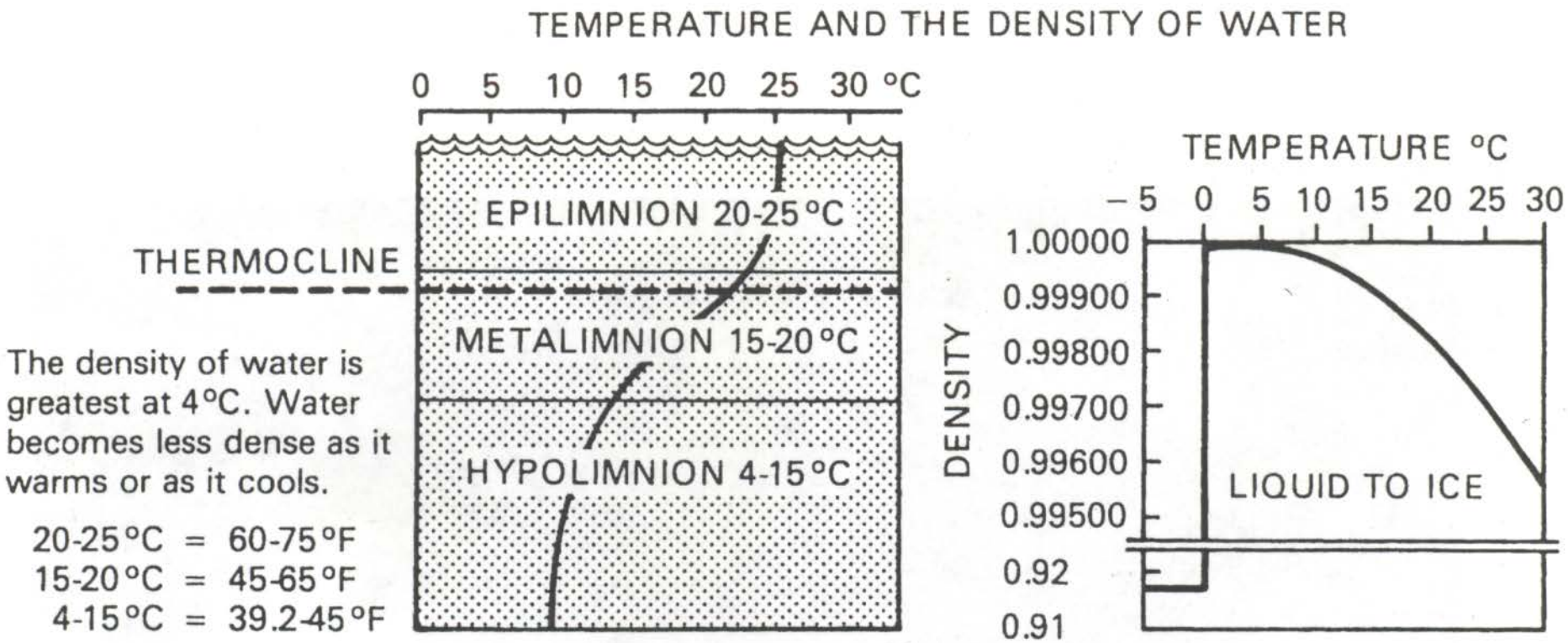
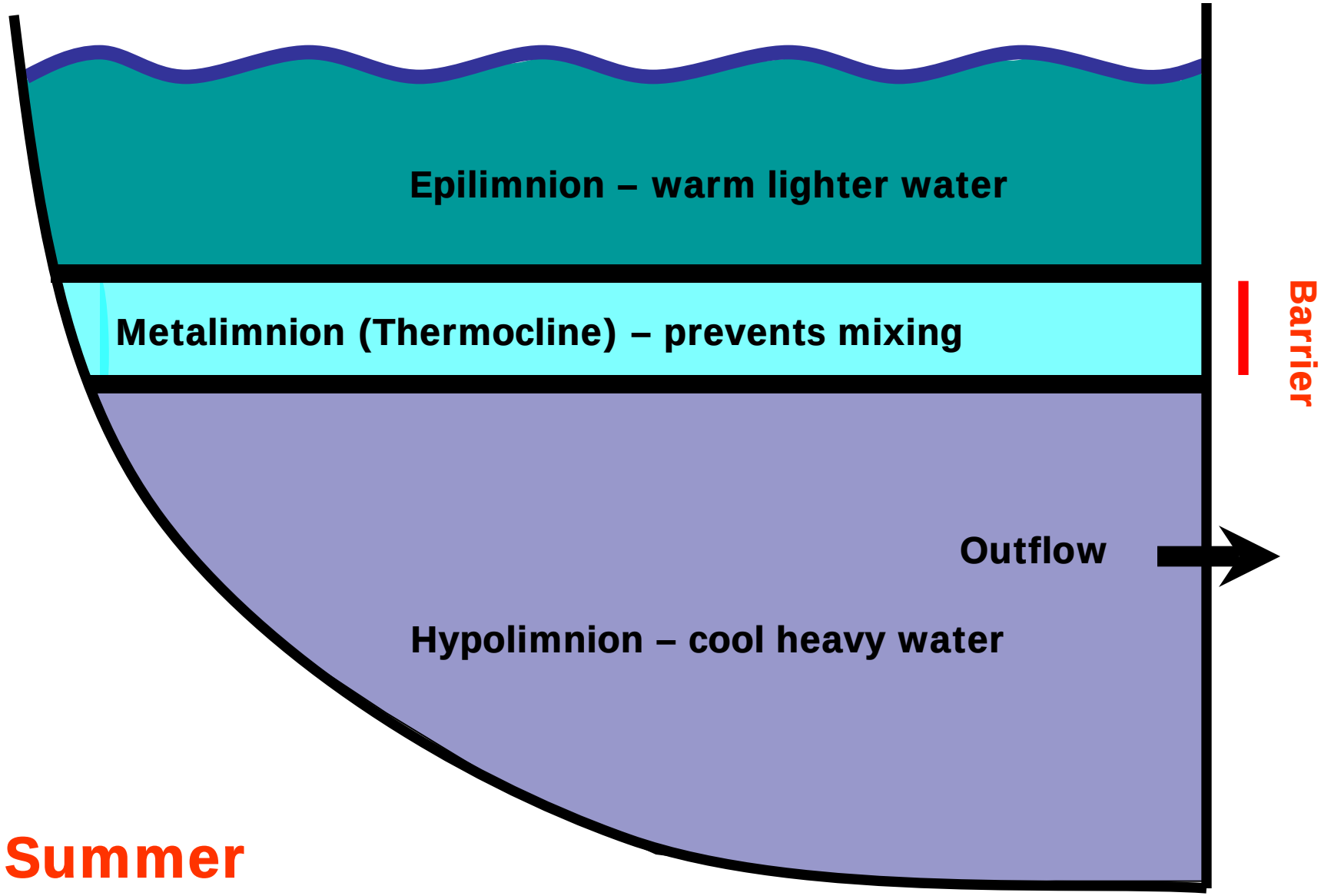
Temperature

- Basis of Stratification
- Affects chemical and biological processes
- Impacts lake ecology/fisheries
- Can have significant downstream effects
- Can affect other management issues (treatment processes)

Temperature and Water Density

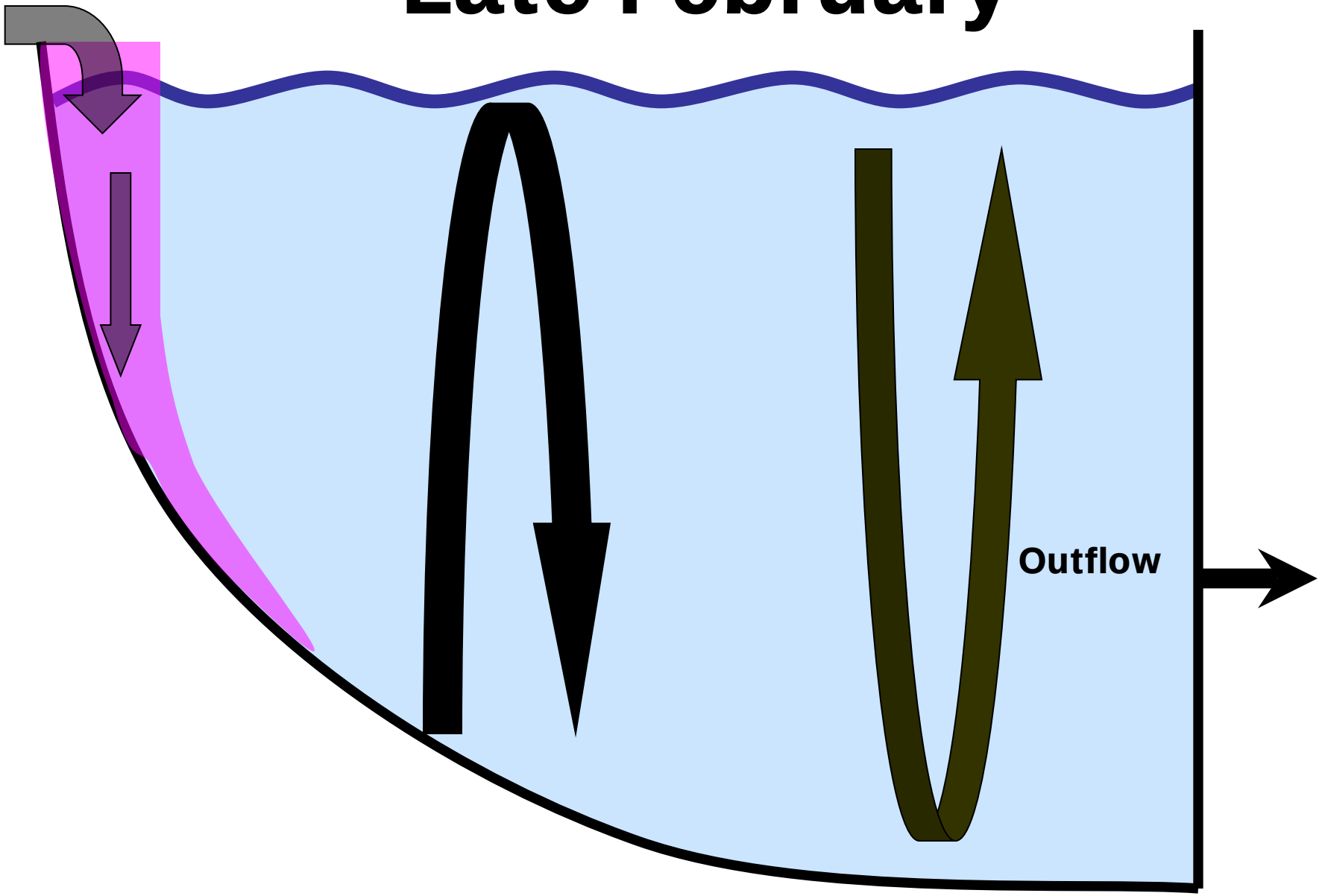


Stratification



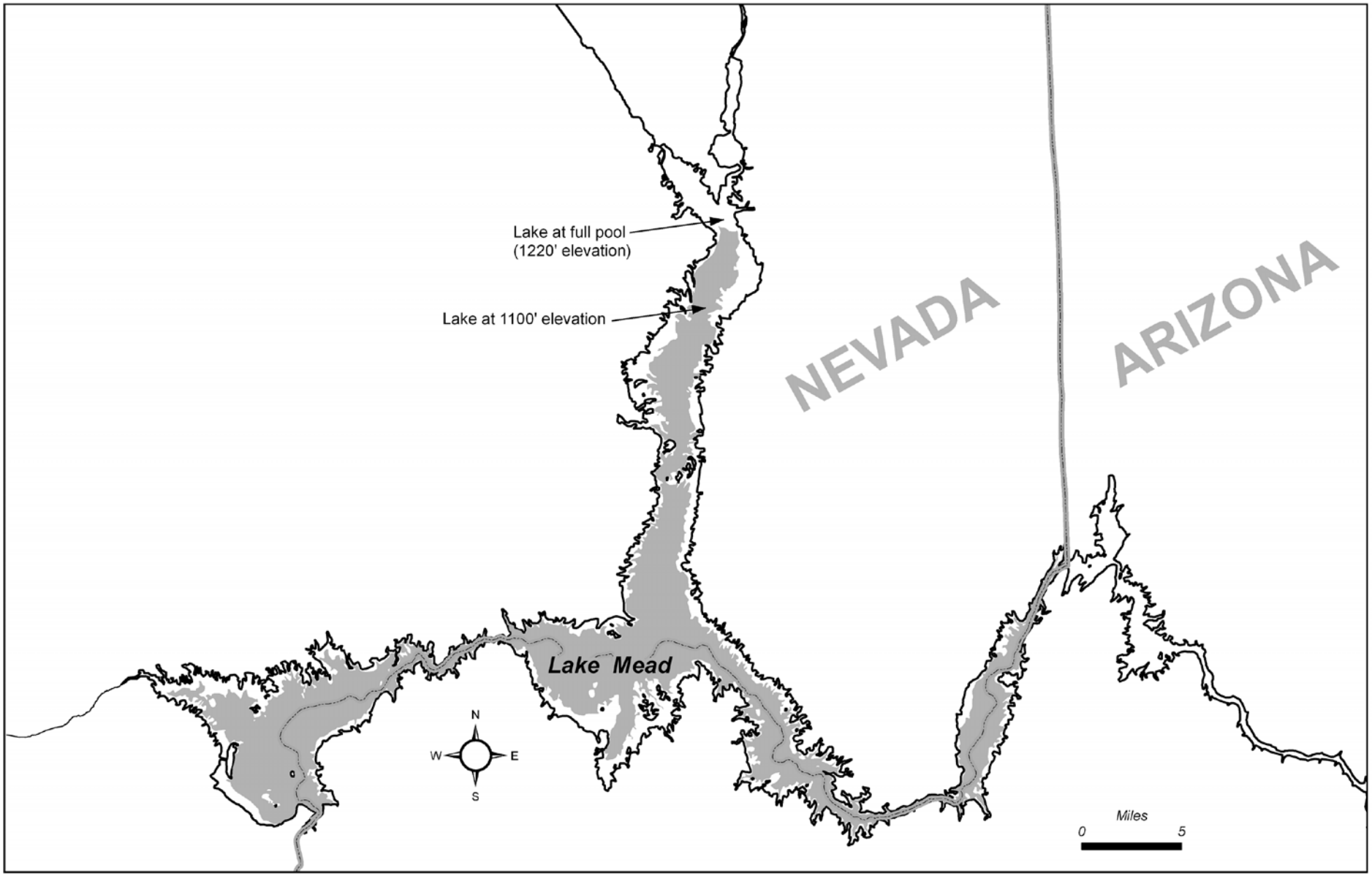
Summer

Late February



Inflow Characteristics

Variable	Colorado R.	Las Vegas Wash	Virgin R.	Muddy R.
Temperature (°C)	14.98	21.53	19.50	18.68
pH (standard units)	8.14	8.02	8.24	8.40
Specific Cond. (µS/cm)	876	2219	2955	2831
Ortho P (mg/L)	0.005	0.080	0.010	0.021
Total P (mg/L)	0.505	0.754	0.859	0.246
Total N (mg/L)	0.516	15.4	0.423	0.156



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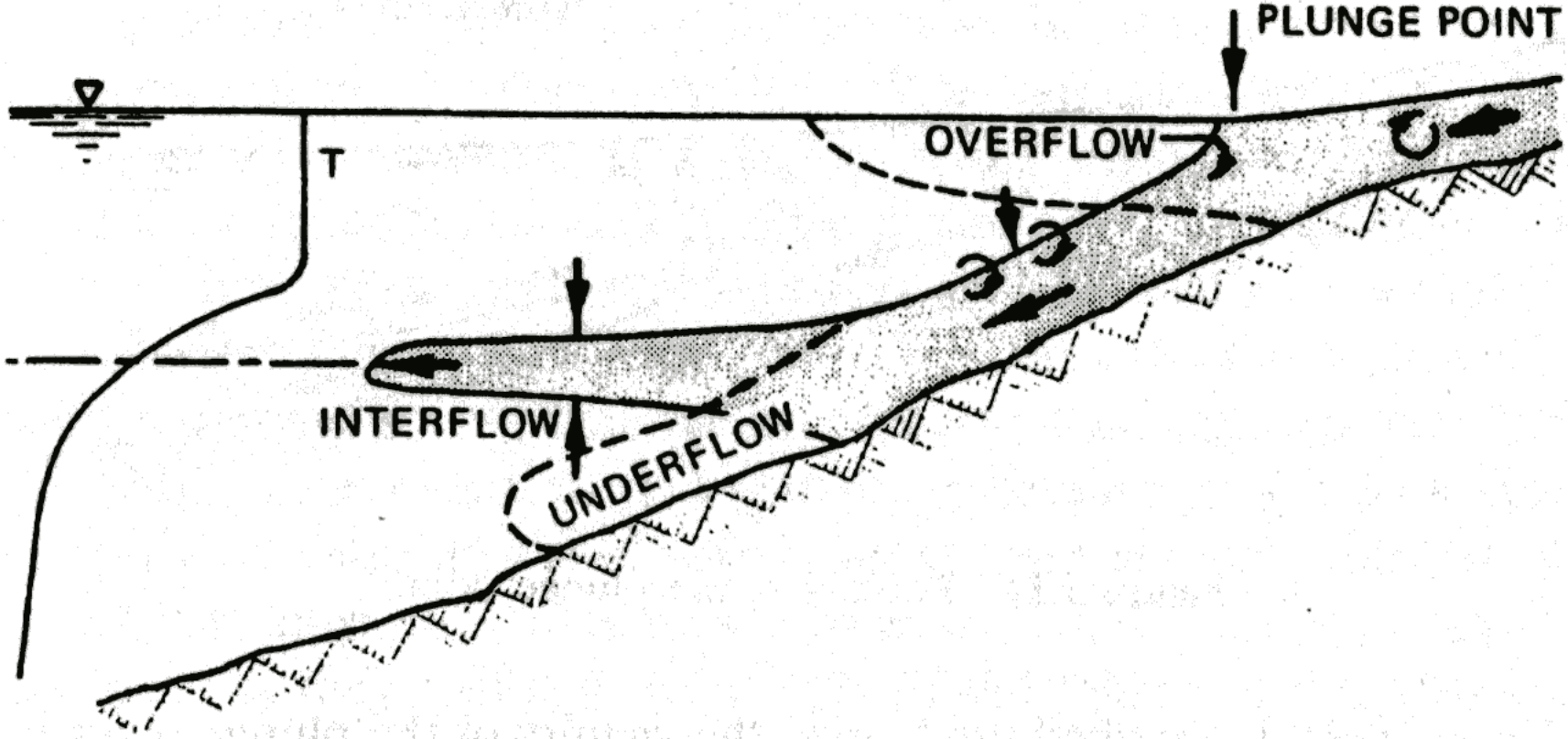
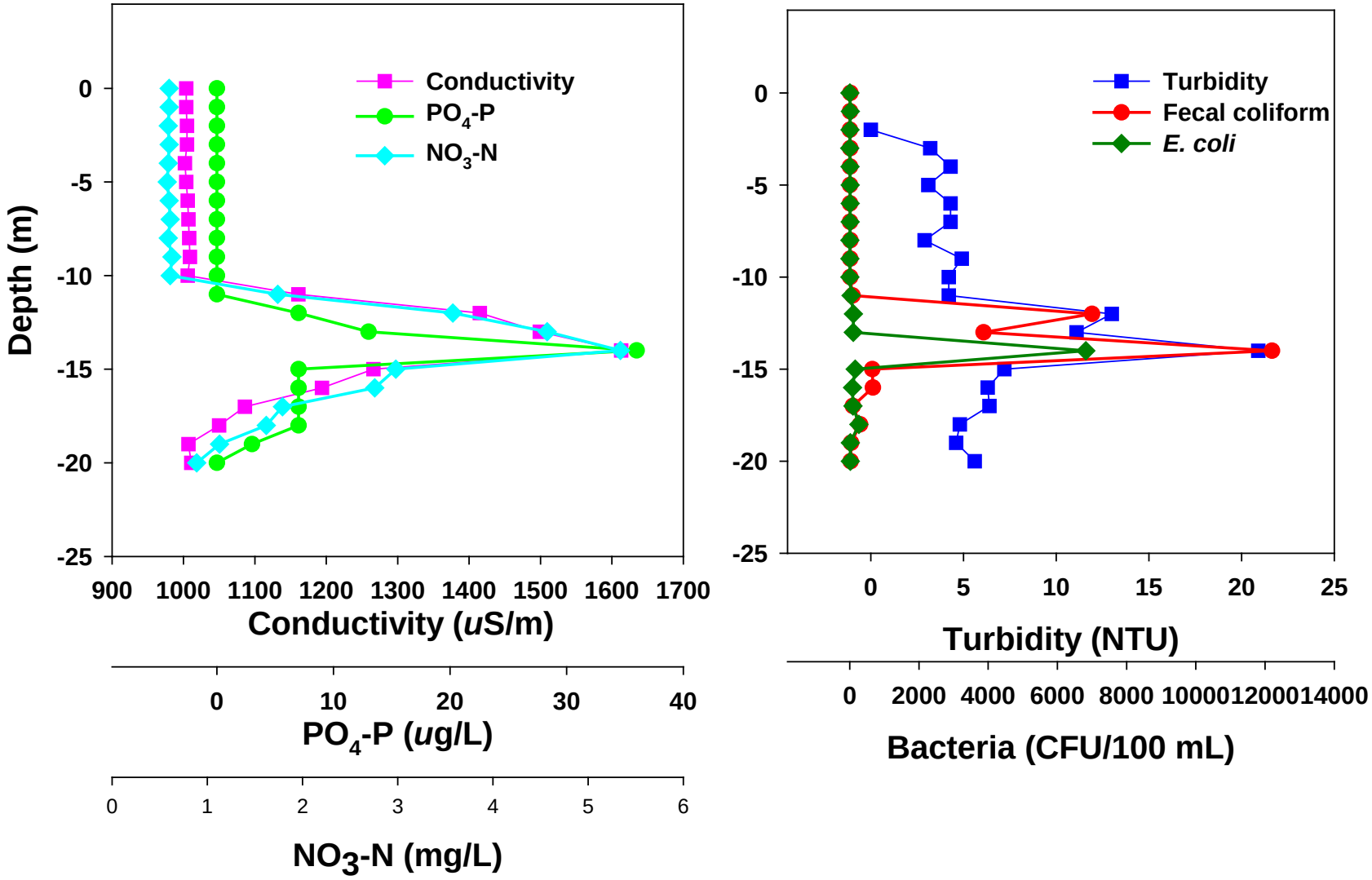
Interflow



Density inflows to impoundments.

LVB2.7 Profiles, 9 September 1998



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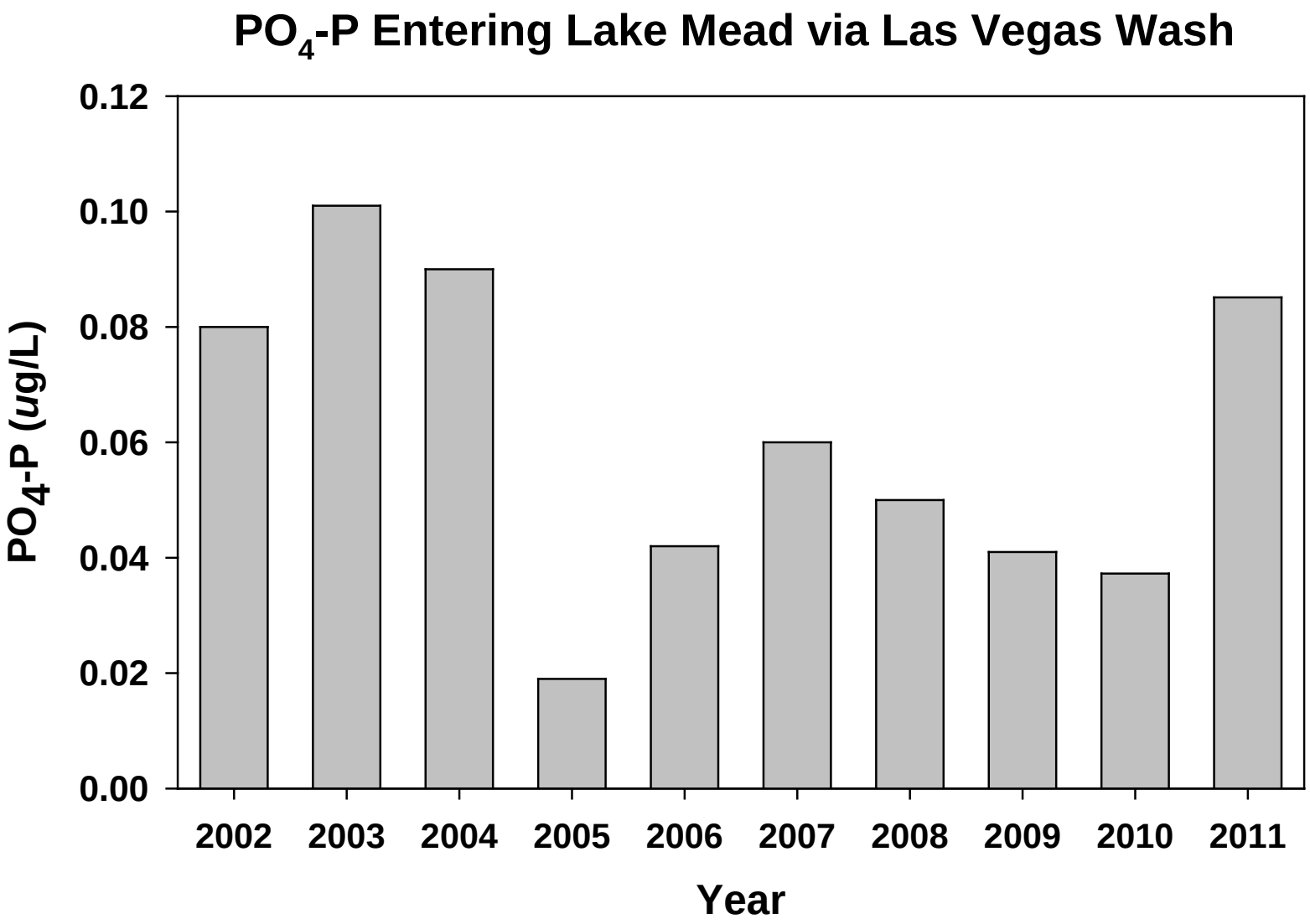
Nutrients

- The primary nutrients of concern to lake management are nitrogen (N) and phosphorus (P)
- These major nutrients are necessary for the growth of aquatic plants and animals
- P is the nutrient limiting algal growth in Lake Mead
- Significant reductions in P concentrations in wastewater treatment plant discharges to Lake Mead have been made since 2001



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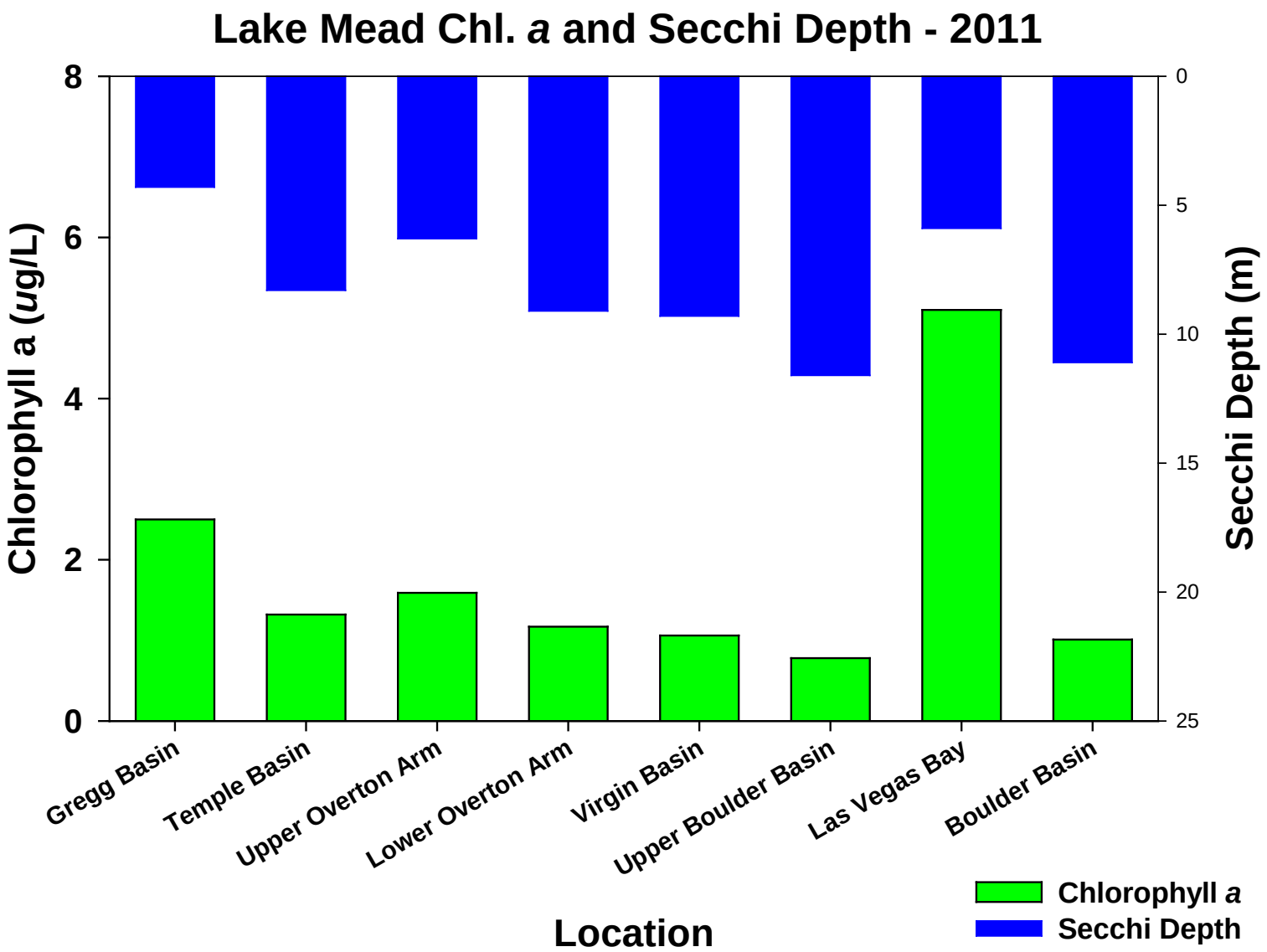

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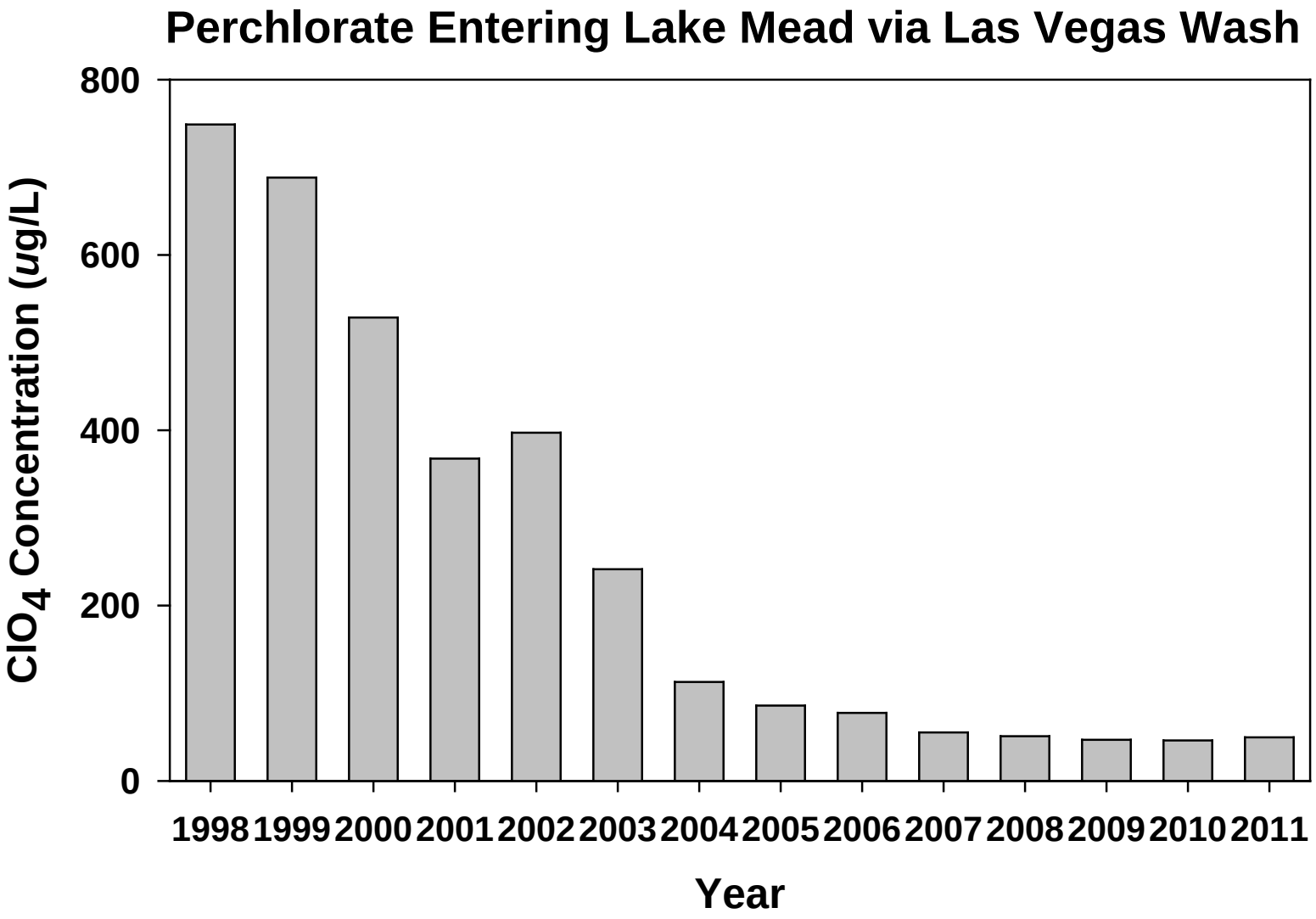
Perchlorate

- Ammonium perchlorate, a component of rocket fuel, was manufactured in Henderson, NV, from approximately 1945 through 1988
- Perchlorate entered the environment through disposal of wastes into unlined ponds and other leaks from the facilities
- Found in Southern California water supplies in July 1997, and the source was traced upstream to Lake Mead and Las Vegas Wash
- Remediation efforts have been very successful



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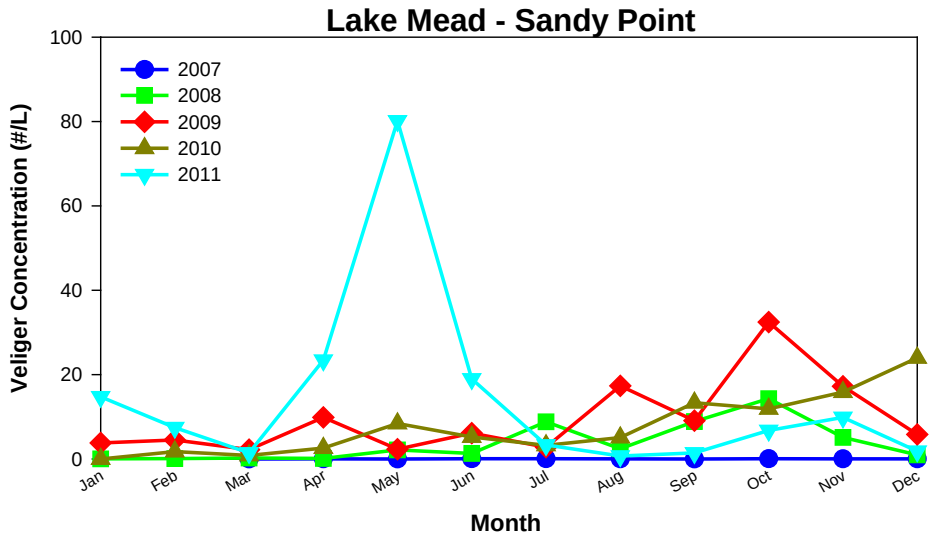
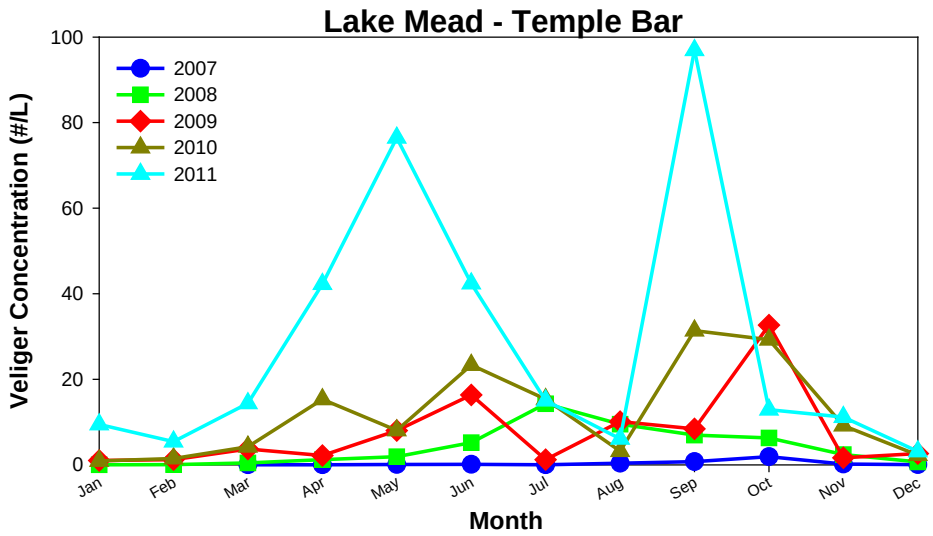
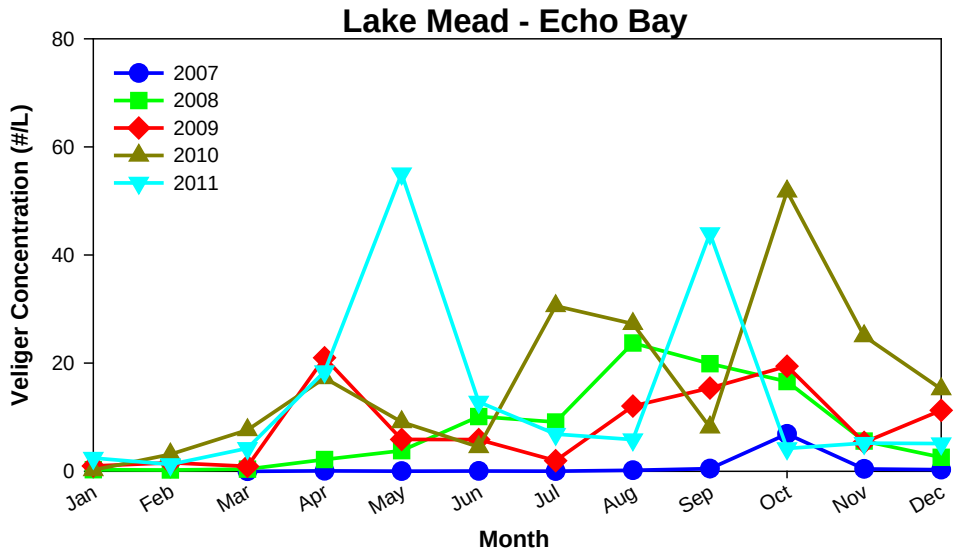
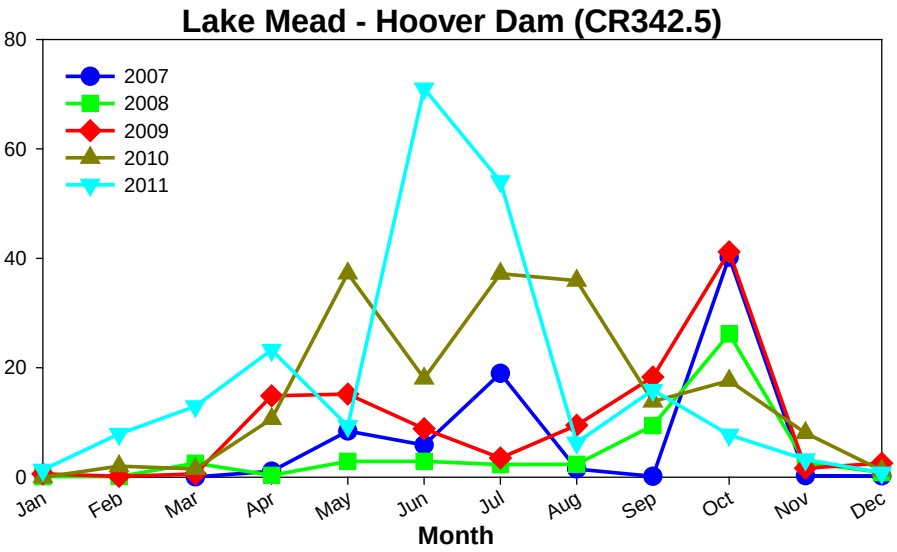
Biological Threat – Quagga Mussels

- Adult quagga mussels were found in Boulder Basin in January 2007
- Veligers (larval mussels) had spread to all sampling stations by May 2008
- Significant impacts on water quality, lake biology and infrastructure were expected
- To date, no significant impacts on water quality or lake biota have been published that can be directly attributed to quagga mussels









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Summary

- **Lake Mead is arguably the most important reservoir in the United States**
- **The ecology of Lake Mead is influenced by the temperature and content of the inflows, and by the position at which they enter the water column**
- **Phosphorus is the limiting nutrient, affecting algal growth (chlorophyll *a*), Secchi depth, and, potentially, the spread of quagga mussels**