Metropolitan Water District

Source Water Monitoring and Water Quality Trends at CRA Intake, Lake Havasu

Lake Mead Ecosystem Monitoring Workgroup
February 21, 2013

Presentation

- Metropolitan Background
- Metropolitan's Source Water Monitoring Program
- Water Quality Trends at Whitsett Intake

Southern California Water Sources

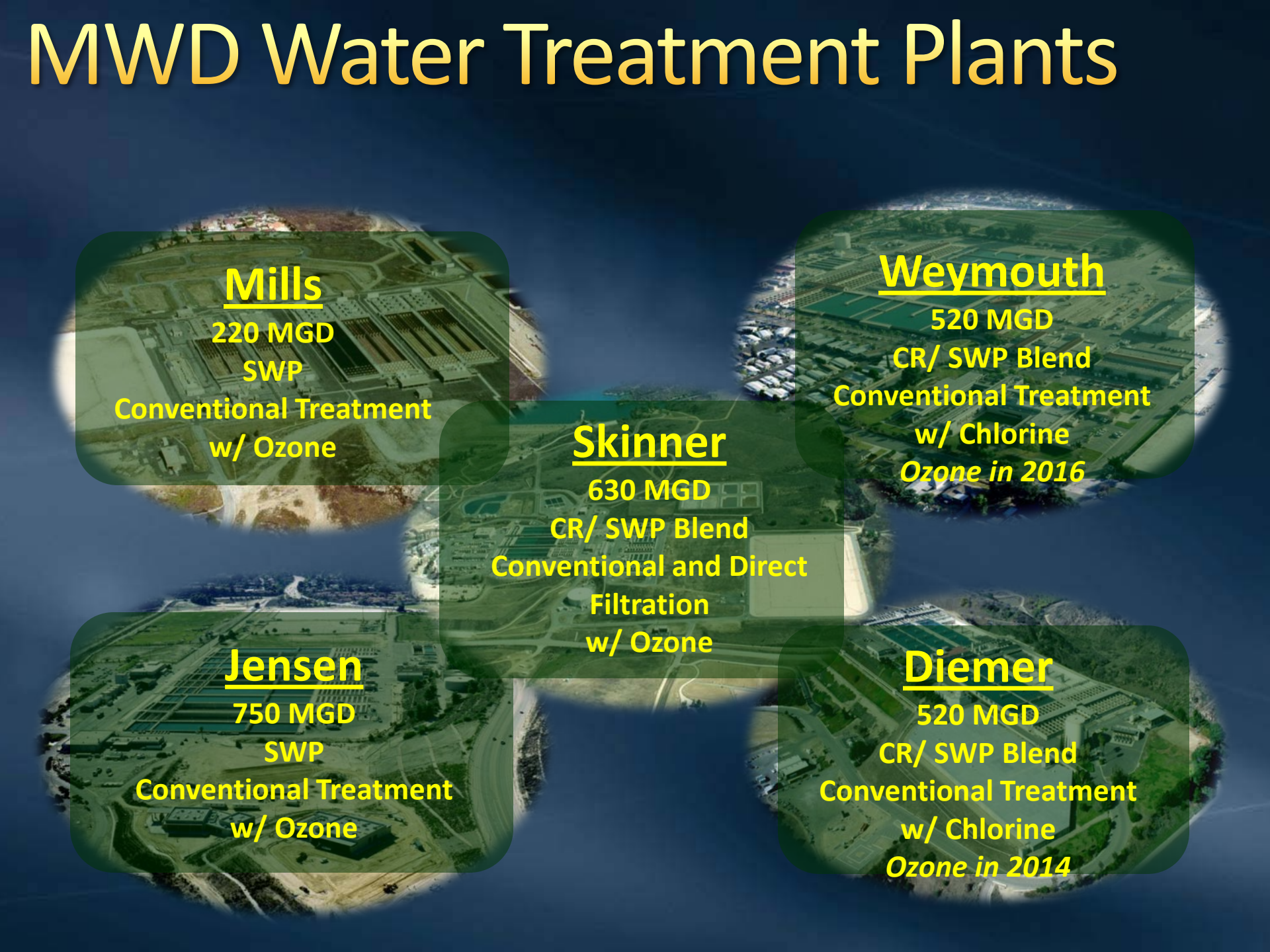
Metropolitan Overview

- Regional water wholesaler to 26 member agencies

- 5,200 square miles
- ~19 million residents
- Import ~2 MAF/year
- 5 treatment plants; combined capacity over 2 BGD
- $1 trillion regional economy

MWD System Delivery Map

MWD Water Treatment Plants



Mills
220 MGD
SWP
Conventional Treatment
w/ Ozone

Weymouth
520 MGD
CR/ SWP Blend
Conventional Treatment
w/ Chlorine
Ozone in 2016

Skinner
630 MGD
CR/ SWP Blend
Conventional and Direct
Filtration
w/ Ozone

Jensen
750 MGD
SWP
Conventional Treatment
w/ Ozone

Diemer
520 MGD
CR/ SWP Blend
Conventional Treatment
w/ Chlorine
Ozone in 2014

Presentation

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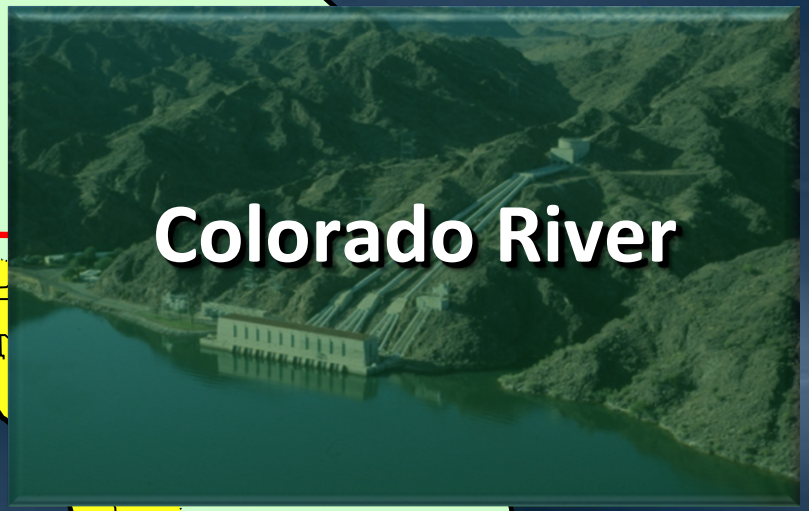
Multiple Barrier Approach

Source Water Protection

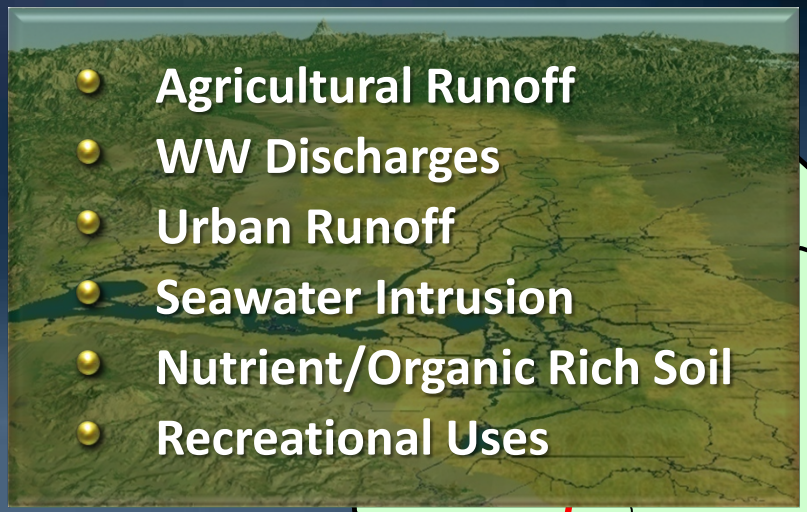
Treatment Effectiveness

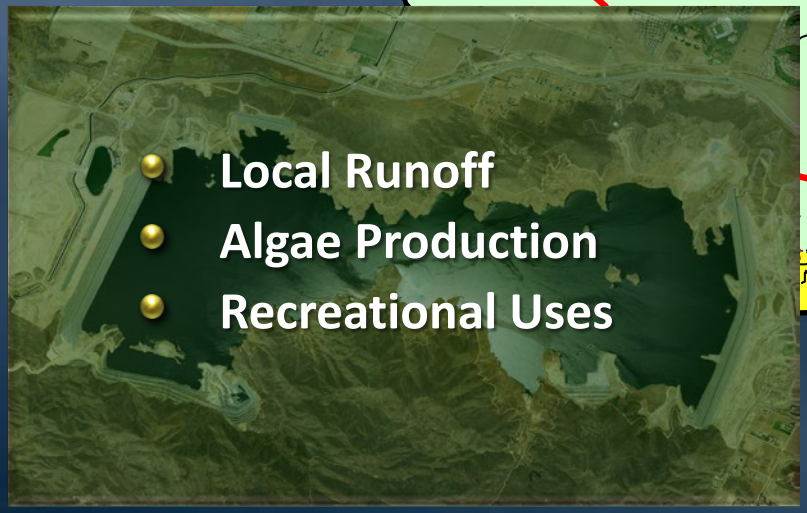
Distribution
Water Quality

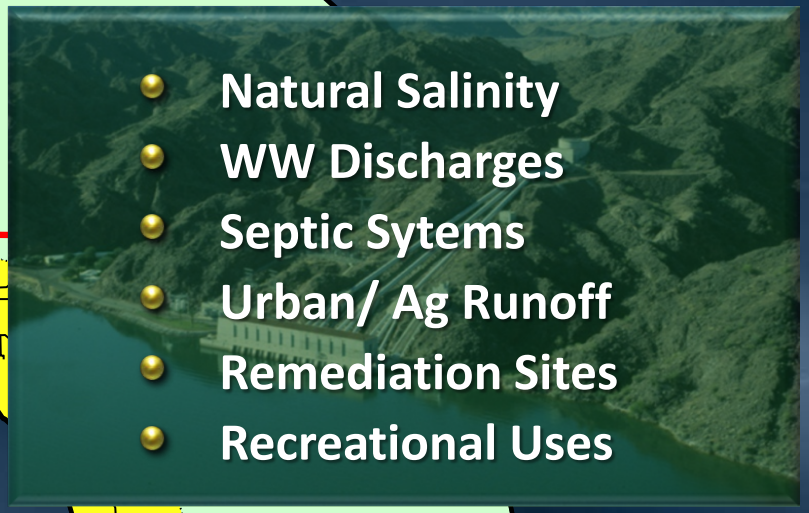
Metropolitan Source Waters



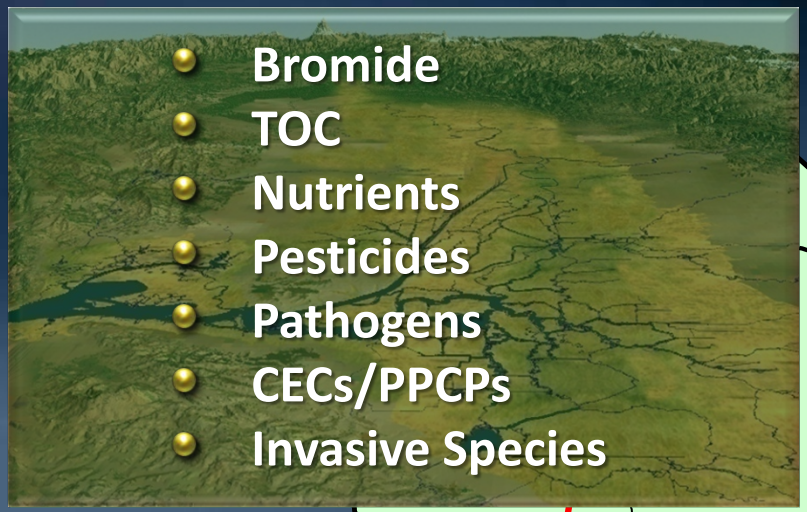
Potential Contaminant Sources

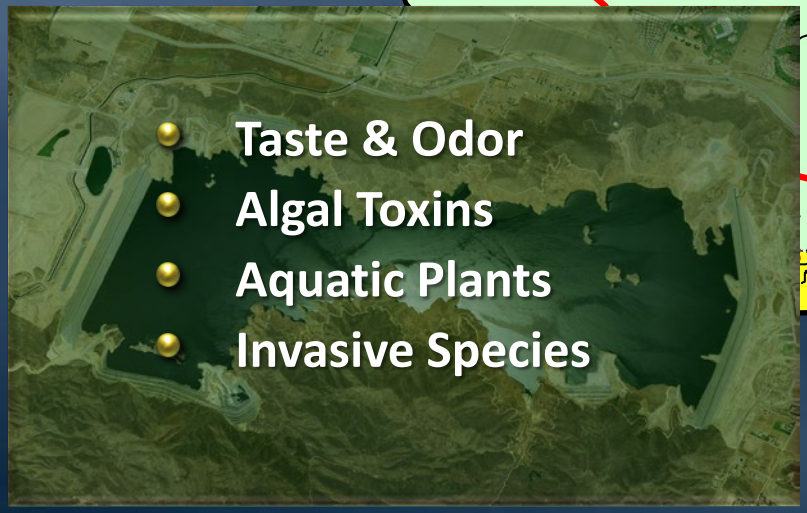


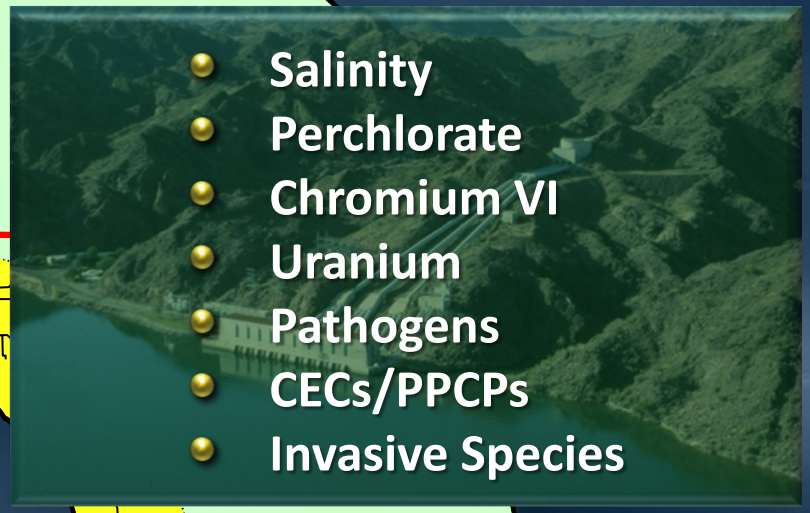




Constituents of Concern







Primary Regional Water Quality Issues

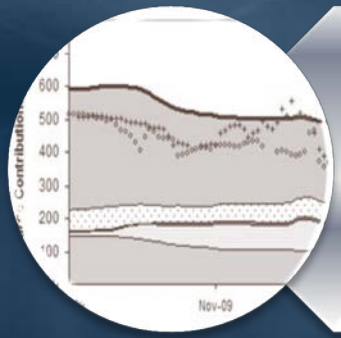
- Salinity
- Perchlorate
- Disinfection Byproduct Precursors
  - Total Organic Carbon
  - Bromide
- Nutrients
- Arsenic
- Uranium
- Chromium VI
- Constituents of Emerging Concern
  - N-nitrosodimethylamine (NDMA)
  - Pharmaceuticals and Personal Care Products

Source Water Protection Program

Watershed Management

Remediation and Protection Programs

Monitoring



Modeling and Forecasting

Resources and Planning

Regulatory and Legislative Actions

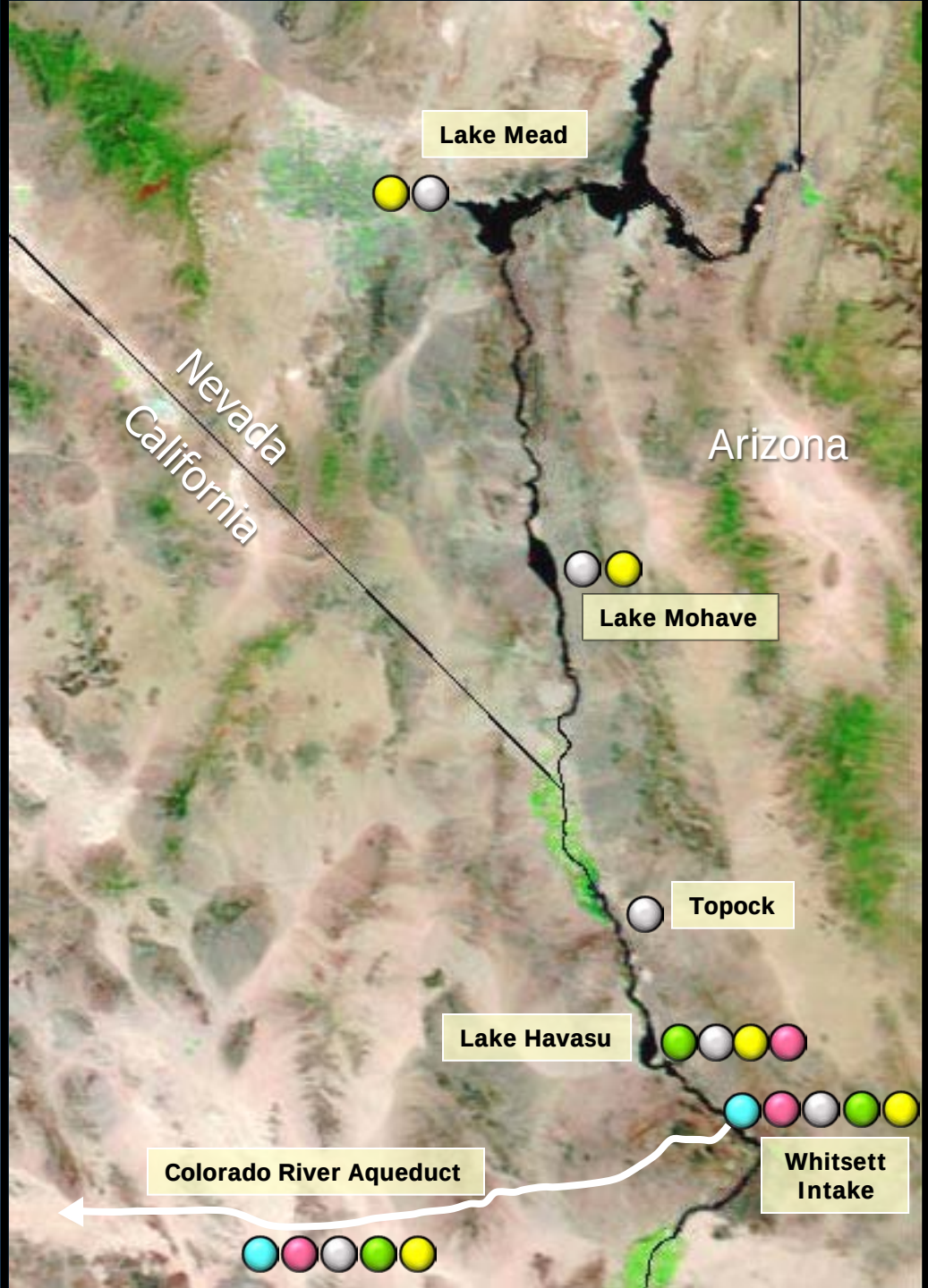
Monitoring Objectives

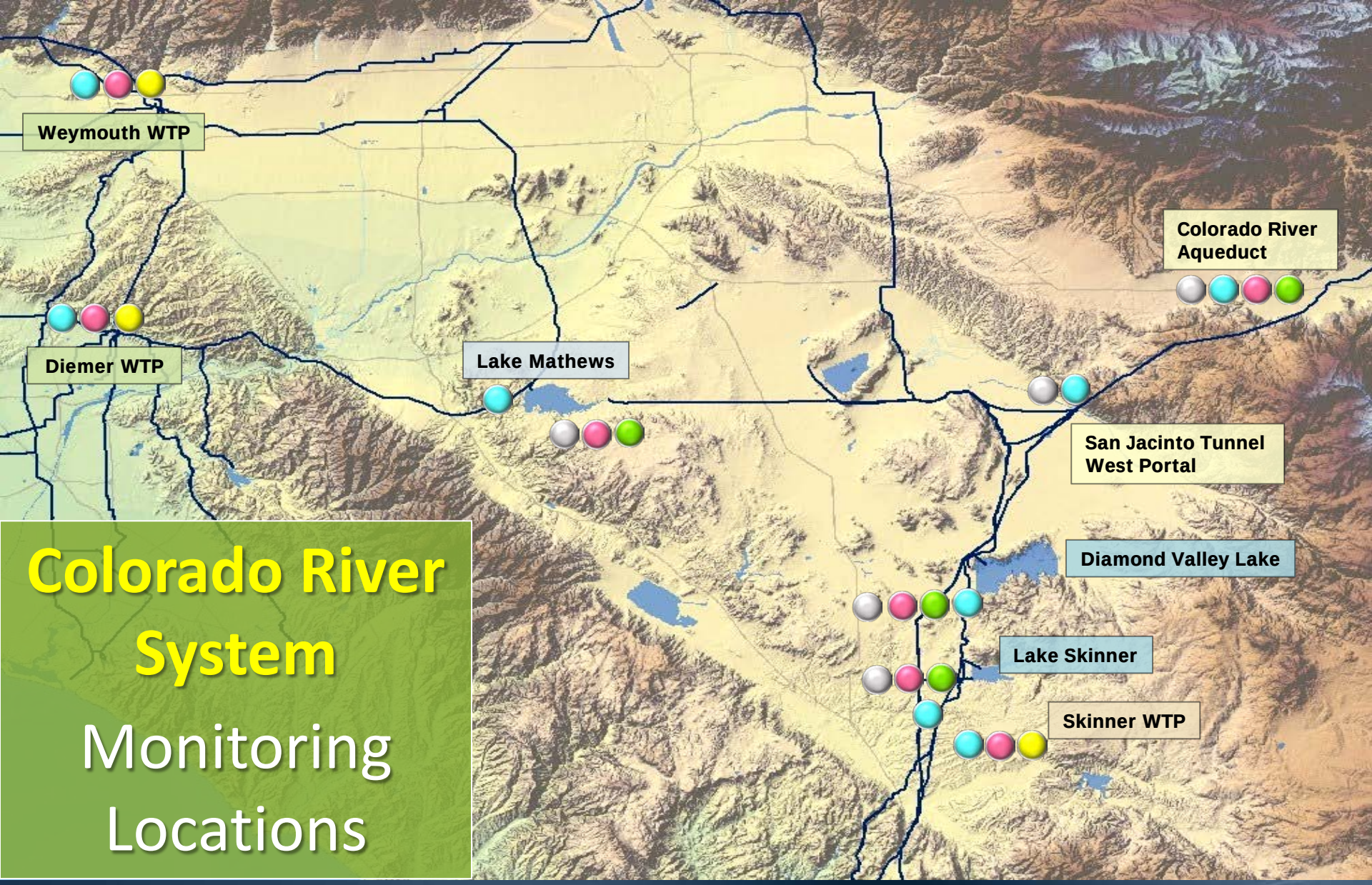
- Compliance with drinking water regulations
- Strategic monitoring to support operational decision-making
  - Assess temporal changes in water quality
    - DBP precursors, turbidity
  - Respond to water quality events
    - Perchlorate, chromium VI, uranium, etc.
    - Fires, spills, etc.
  - Provide early warning/ response to biological events
    - Taste and odor
    - Algal toxins
    - Filter clogging
  - Focused studies on emerging contaminants of concern and mussel management
    - Assess vulnerability

Colorado River System

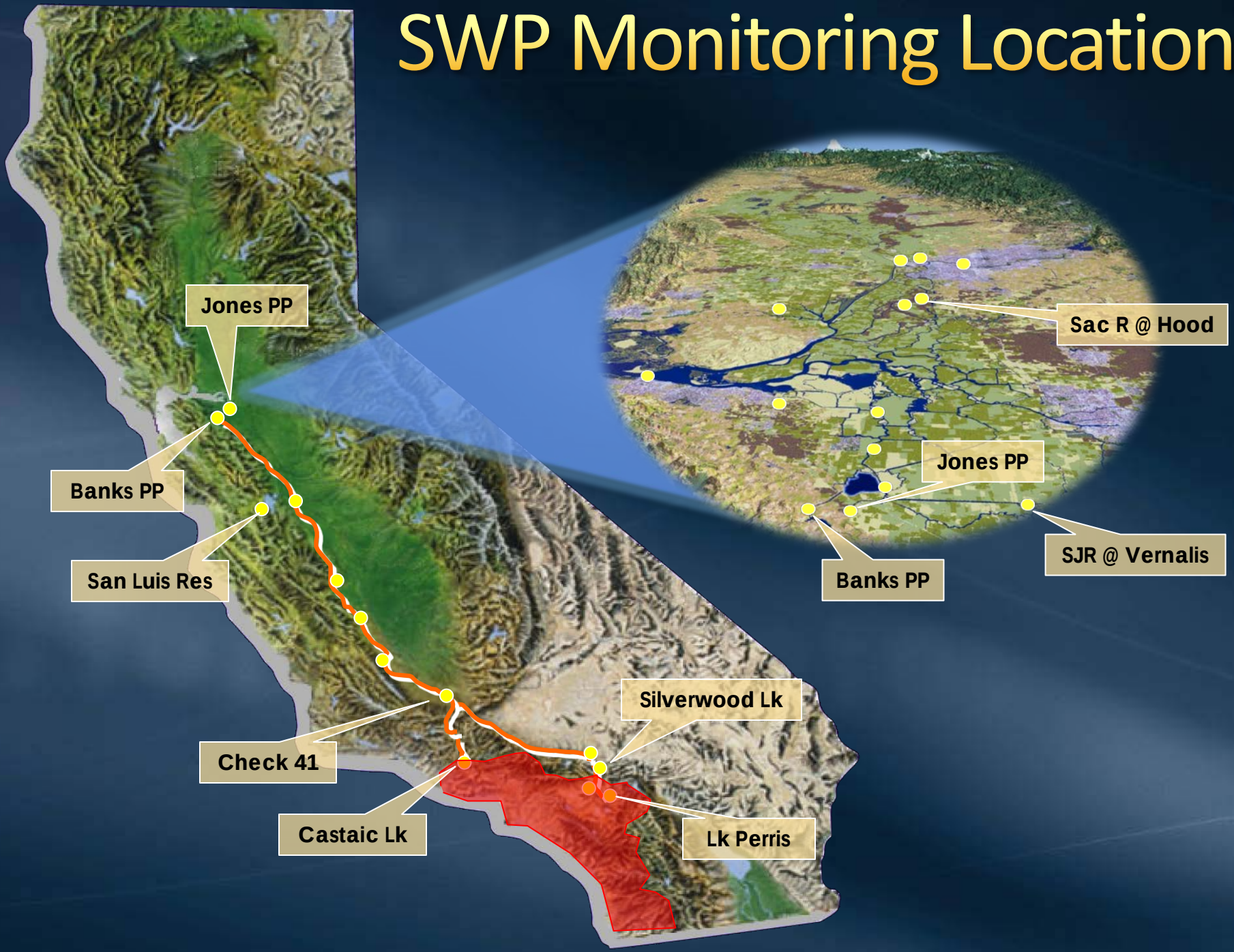
Monitoring Locations

- Compliance
- Strategic
  - Temporal
  - Events
  - Early Warning
  - Emerging




Weymouth WTP
Diemer WTP
Lake Mathews
Colorado River Aqueduct
San Jacinto Tunnel West Portal
Diamond Valley Lake
Lake Skinner
Skinner WTP
Colorado River System
Monitoring Locations
Strategic
Compliance
Temporal
Events
Early Warning
Emerging

SWP Monitoring Locations



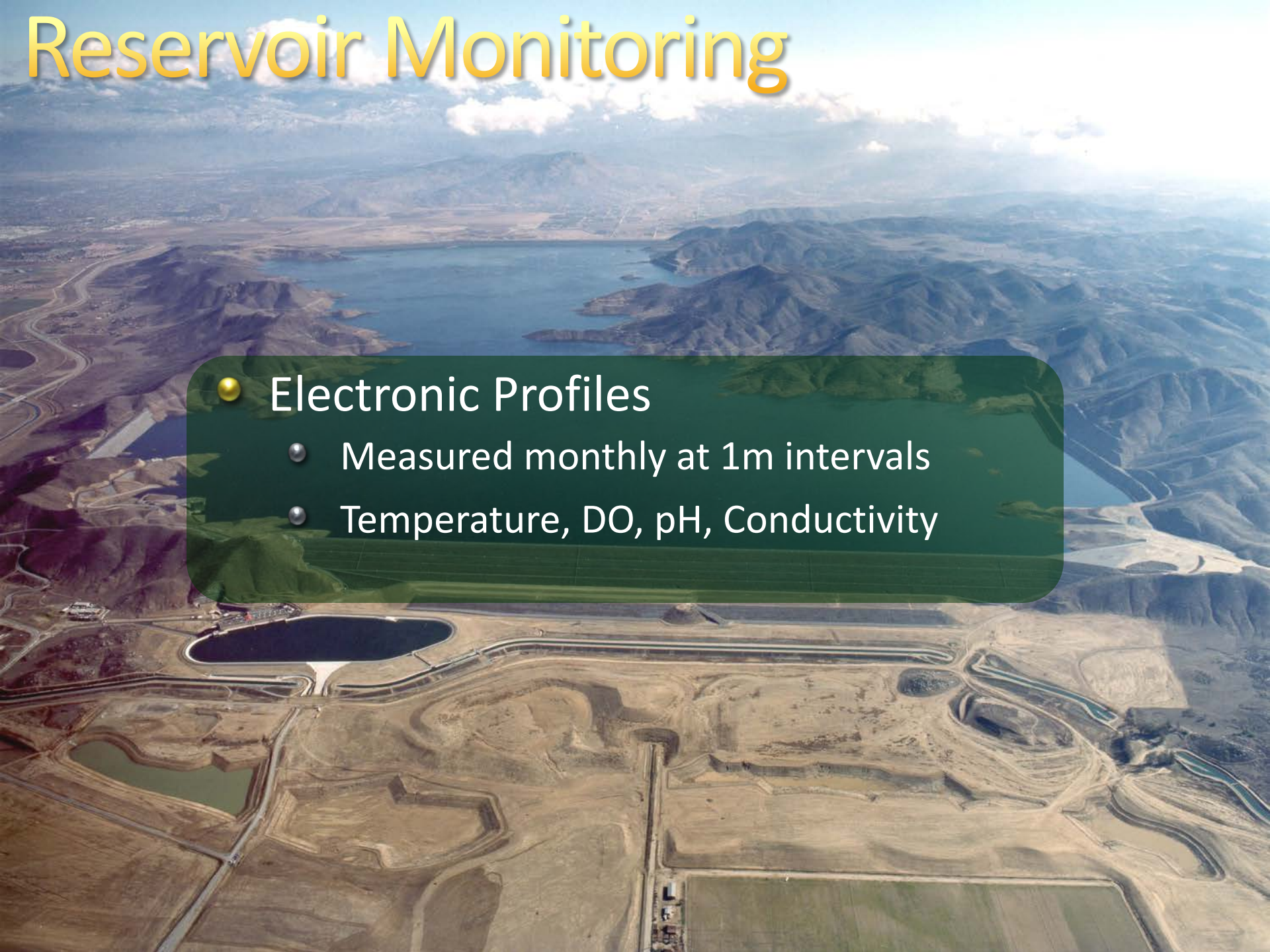
Chemical Compliance Monitoring

CHEMICAL COMPOUND GROUP	REQUIRED MONITORING	MWD MONITORING SCHEDULE
Asbestos	1x/cycle	1x/cycle
Cyanide	Annually	Annually
General Physical	Annually	**Monthly**
General Minerals	Annually	**Monthly**
Nitrite	1x/period	**Annually**
Nitrate	Annually	**Monthly**
Perchlorate	Annually	**Quarterly**
Radiological	4x/3 years	4x/3 years
Trace Elements	Annually	**Semi-annually**
Pesticides	2x/period	2x/period
VOCs	Annually	**Quarterly**
SVOCs	2x/period	2x/period
DBPs	Quarterly	**Weekly/Bi-weekly**
DBP precursors	Monthly	**Weekly**
UCMR 2	--	**Quarterly (Nitrosamines only)**

Microbiological Monitoring

Microbial Compound	MWD MONITORING FREQUENCY				
	Whitsett Intake	San Jacinto Tunnel - WP	Source Water Reservoirs	WTP Influent	WTP Effluent
E. coli	Monthly	--	Monthly	1 day/week	7 days/week
Cryptosporidium	--	--	--	Monthly	Monthly
Giardia	--	--	--	Monthly	Monthly

Reservoir Monitoring



- Electronic Profiles
  - Measured monthly at 1m intervals
  - Temperature, DO, pH, Conductivity

Reservoir Monitoring

- Chemical Profiles
  - Measured monthly at varying depth intervals
- Analytes include:
  - Chlorophyll
  - Fluorescense
  - Nutrients
  - MIB/ Geosmin
  - Microcystin Screening
  - TDS
  - pH
  - Conductivity
  - Turbidity
  - Alkalinity
  - TOC
  - VOCs (quarterly)
  - Trace Metals

Reservoir Monitoring

- Biological Profiles
  - Light profiles to measrue photosynthetically active radiation (PAR)
  - Phytoplankton at various depths
  - Zooplankton at 3 depth intervals
  - Quagga mussel/ veliger monitoring

Taste and Odor Monitoring

"Early Warning System"

- Proactive program for detection of algae and taste and odor compounds (MIB & Geosmin)
- Monthly (or more frequent) source water monitoring
  - Various source waters (lakes and conveyance system)
  - Depth profiles
  - Diver Required
- Taste and Odor Analysis
  - GC/MS analysis for quantitation of MIB and Geosmin
  - Flavor Profile Analysis to complement and validate aesthetic quality

William D. Taylor et al., *Early Warning and Management of Surface Water Taste-and-Odor Events, Publication No. 91102*, Denver, CO: American Water Works Association Research Foundation (AwwaRF), 2006.

Presentation

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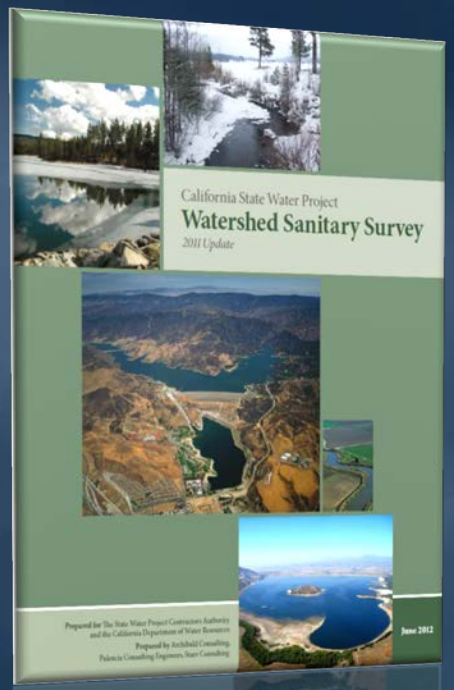
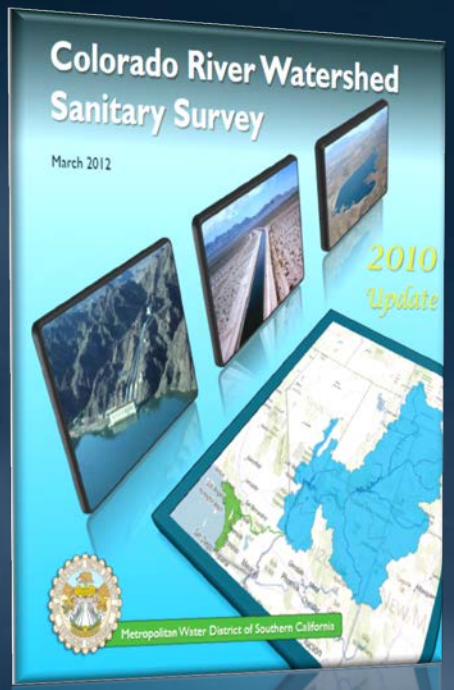
Watershed Sanitary Surveys

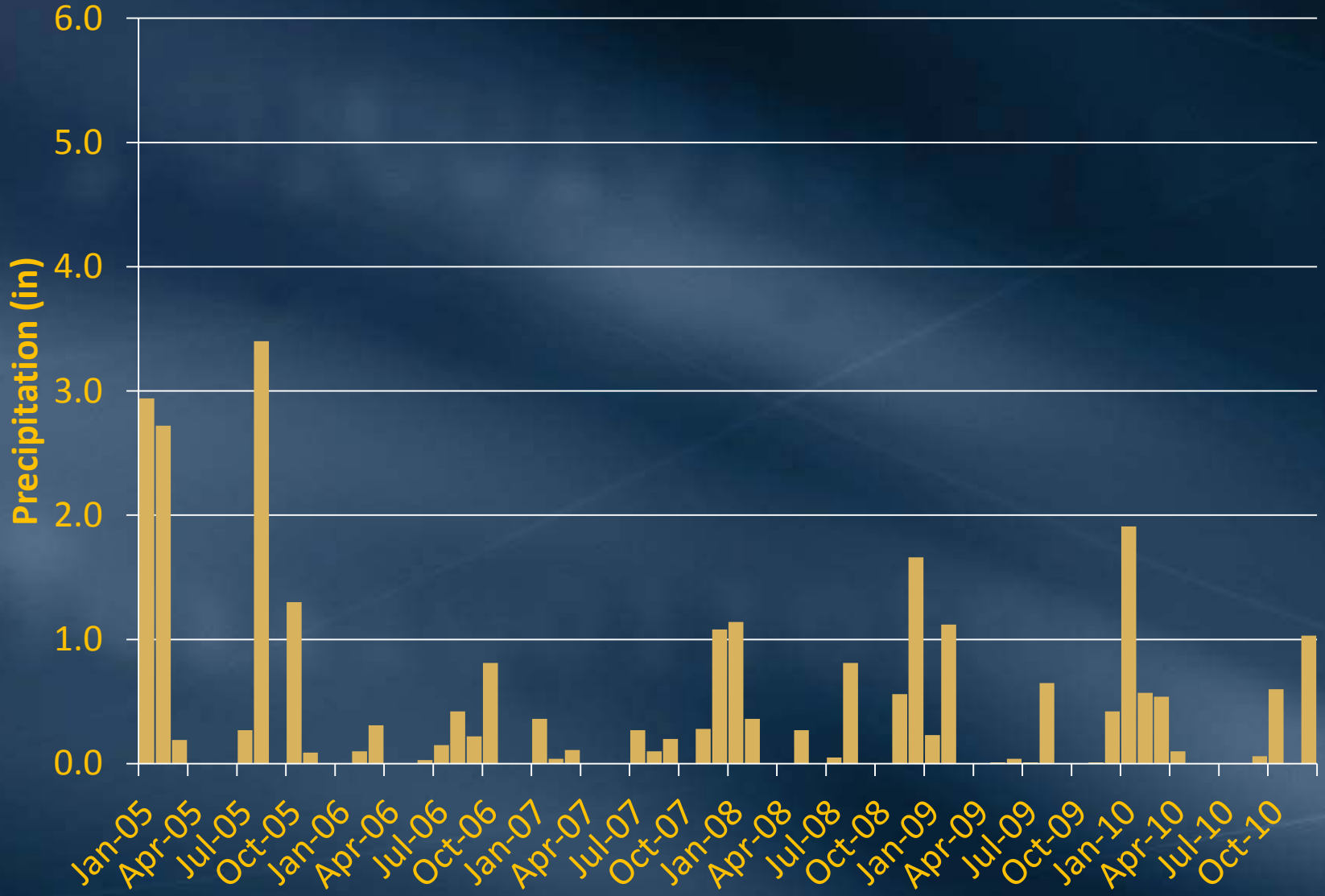
- California's Surface Water Treatment Rule requires every public water system to conduct a sanitary survey of its watershed(s) every 5 years



- Physical and hydrogeologic description
- Regulatory review
- Water quality data analysis
- Description of activities and contaminant sources
- Significant changes since last survey
- Watershed control and management practices
- Recommendations for corrective actions



Lake Havasu Precipitation



Lake Havasu Monitoring

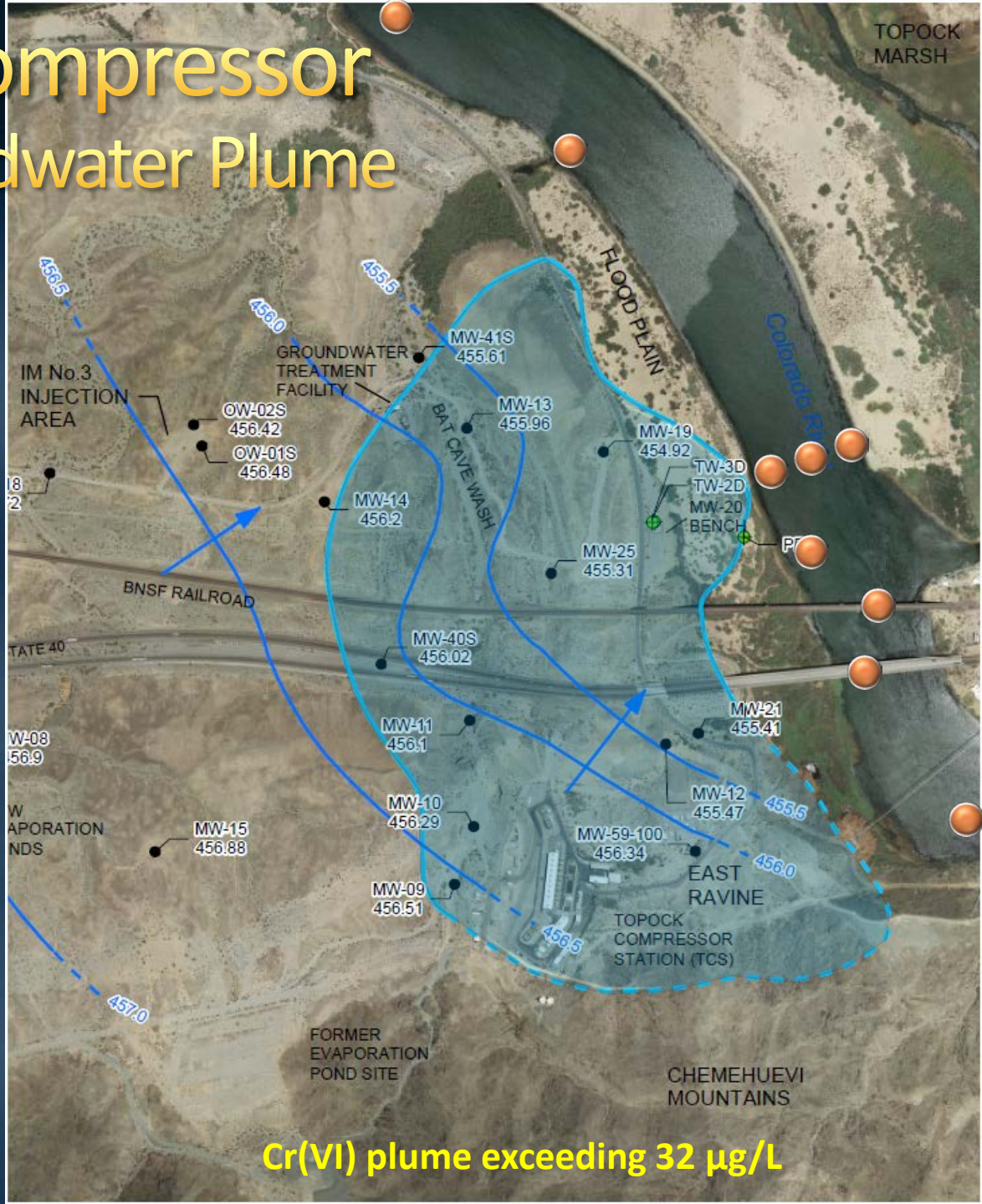
- Aluminum
- Boron
- Chromium VI
- Perchlorate
- TDS
- Sulfate
- Radionuclides
- Turbidity
- Nutrients
- NDMA
- TOC
- MTBE
- PPCP
- Coliforms
- Pathogens

Chromium VI

- Issue/Effects:
  - Naturally occurring; used as anti-corrosive agent
  - Toxic and known to cause lung cancer when inhaled
- Regulated through Total Cr MCL of 50 ppb
  - Mostly non-detect Cr VI levels in imported supplies
- PHG 0.02 ppb; draft MCL due July 2013
- Issue for member agencies

PG&E Topock Compressor
Chromium VI Groundwater Plume

- ~ 230 acres
- Interim Treatment
- Long-term in-situ treatment – 30 years
- Design Completed 2015
- Construction in 2016

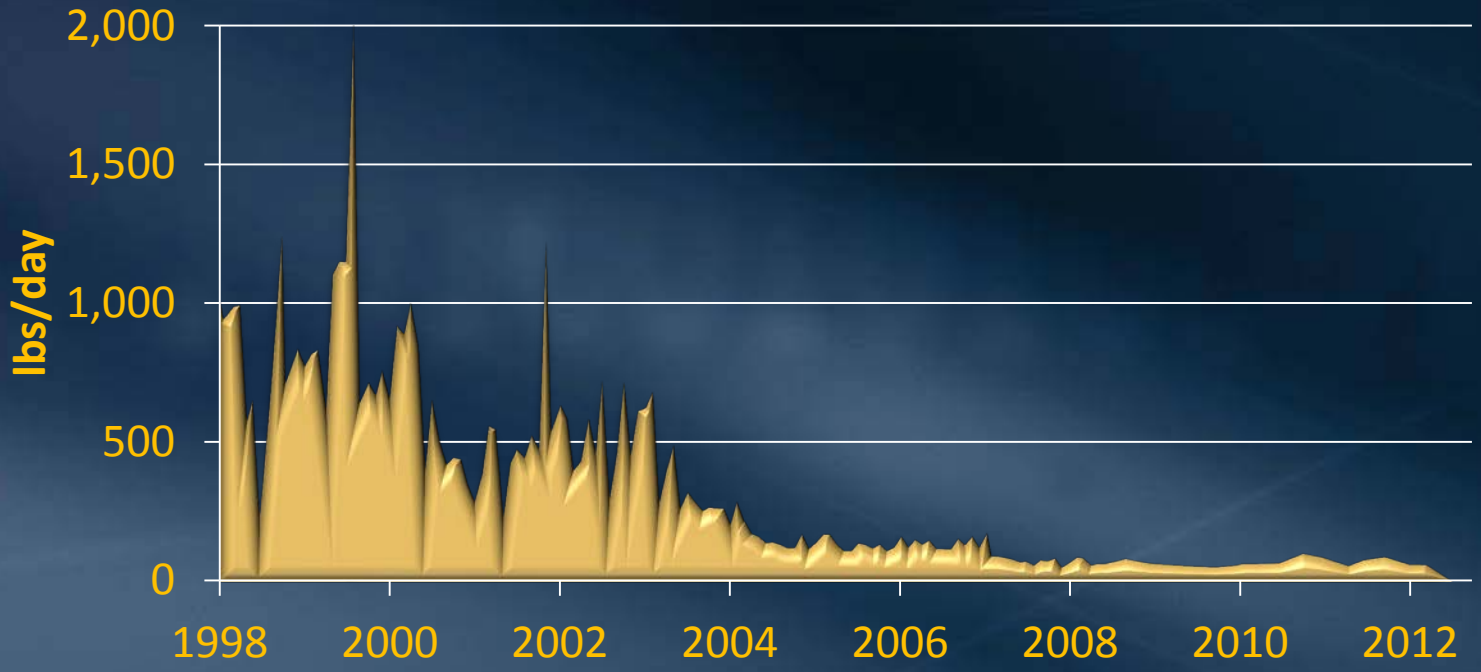


Perchlorate

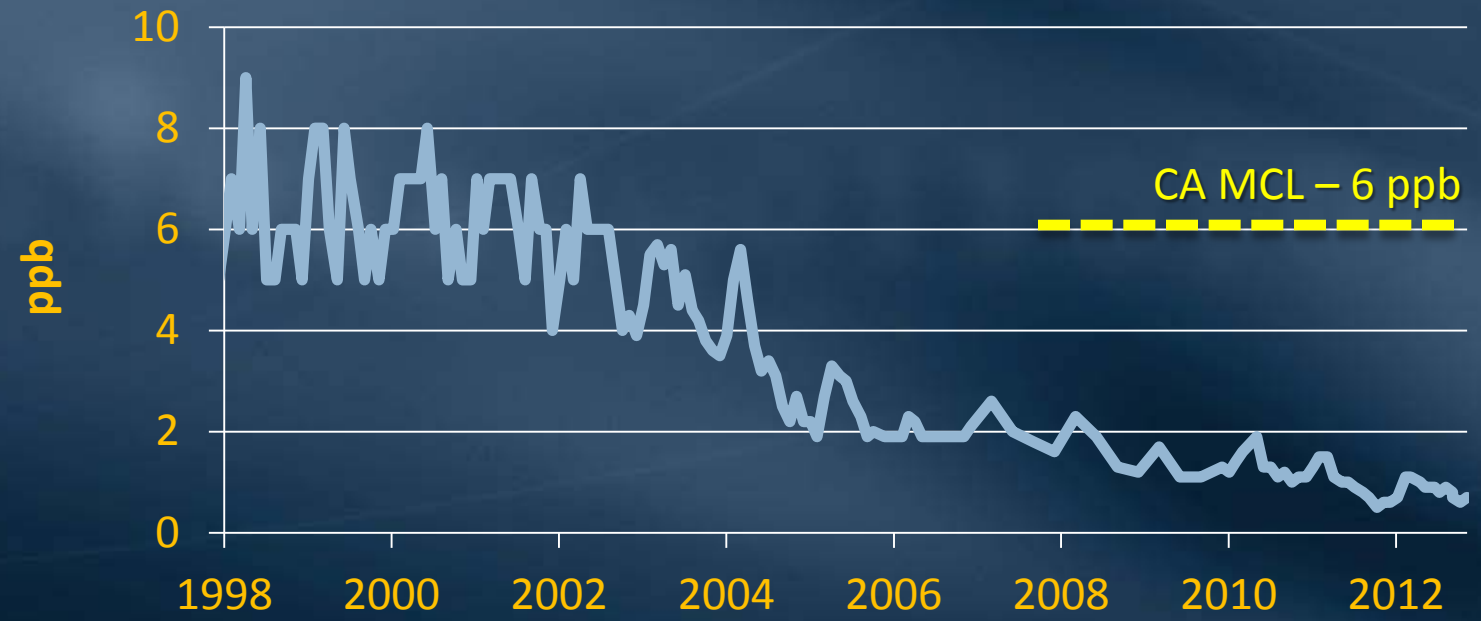
- Issue/Effects:
  - Thyroid interference affects normal growth/development
  - Conventional drinking water treatment not effective in removing perchlorate
- California MCL is 6 ppb (eff. Oct 2007); draft PHG 1 ppb

NERT & AMPAC Groundwater Treatment Systems

Continued Decline in Perchlorate Levels



Loading into Las Vegas Wash



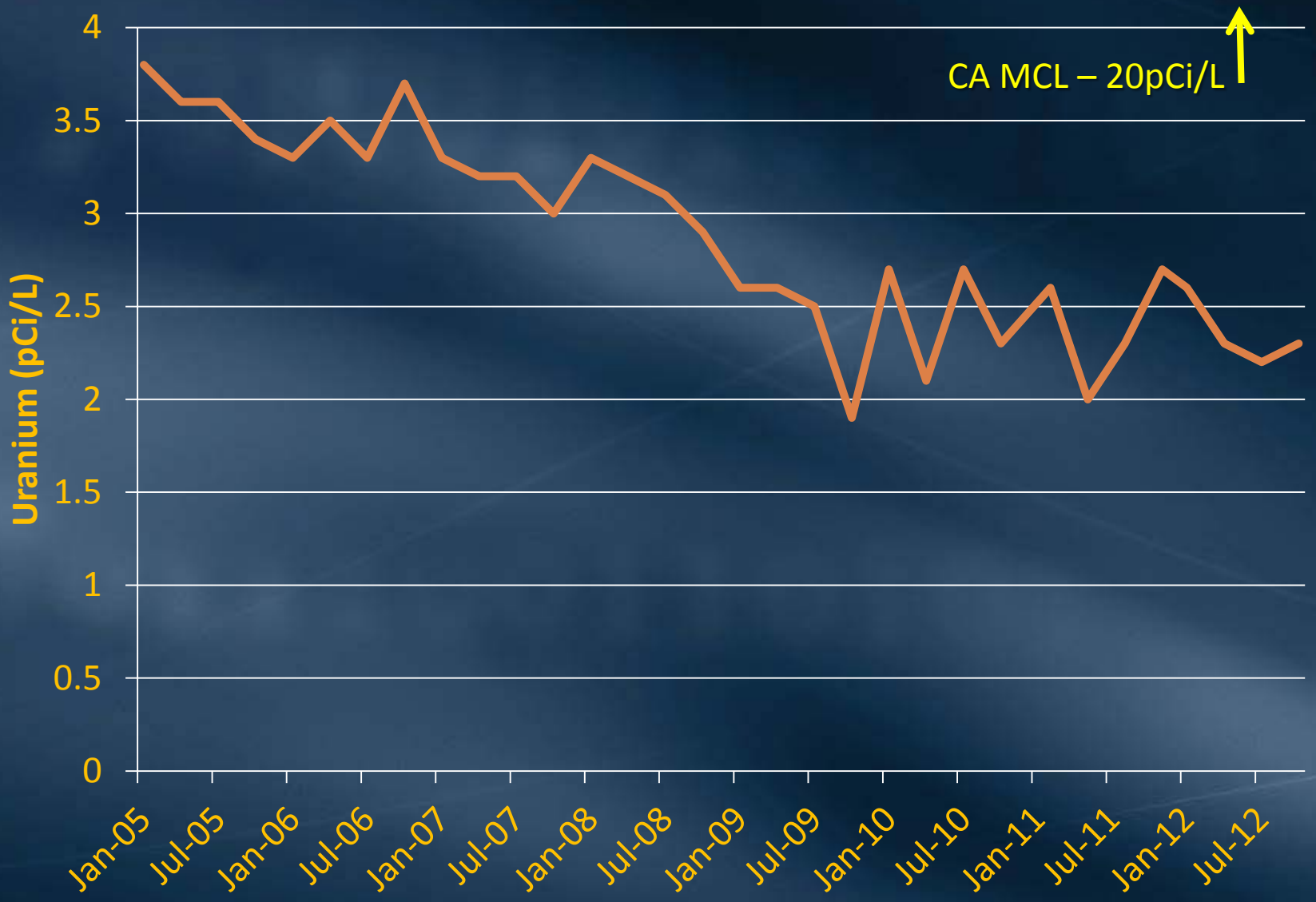
Levels at CRA intake at Lake Havasu

Uranium

- Issue/Effects:
  - Known kidney toxicant and considered human carcinogen
  - Consumer confidence concerns
- 16-mil ton pile of uranium mill tailings in Moab, UT
  - DOE began tailings removal and disposal in 2009
  - Full pile disposal est. 2025-2030

Uranium

Lake Havasu at Whitsett Intake, 2005-2012



Nutrients

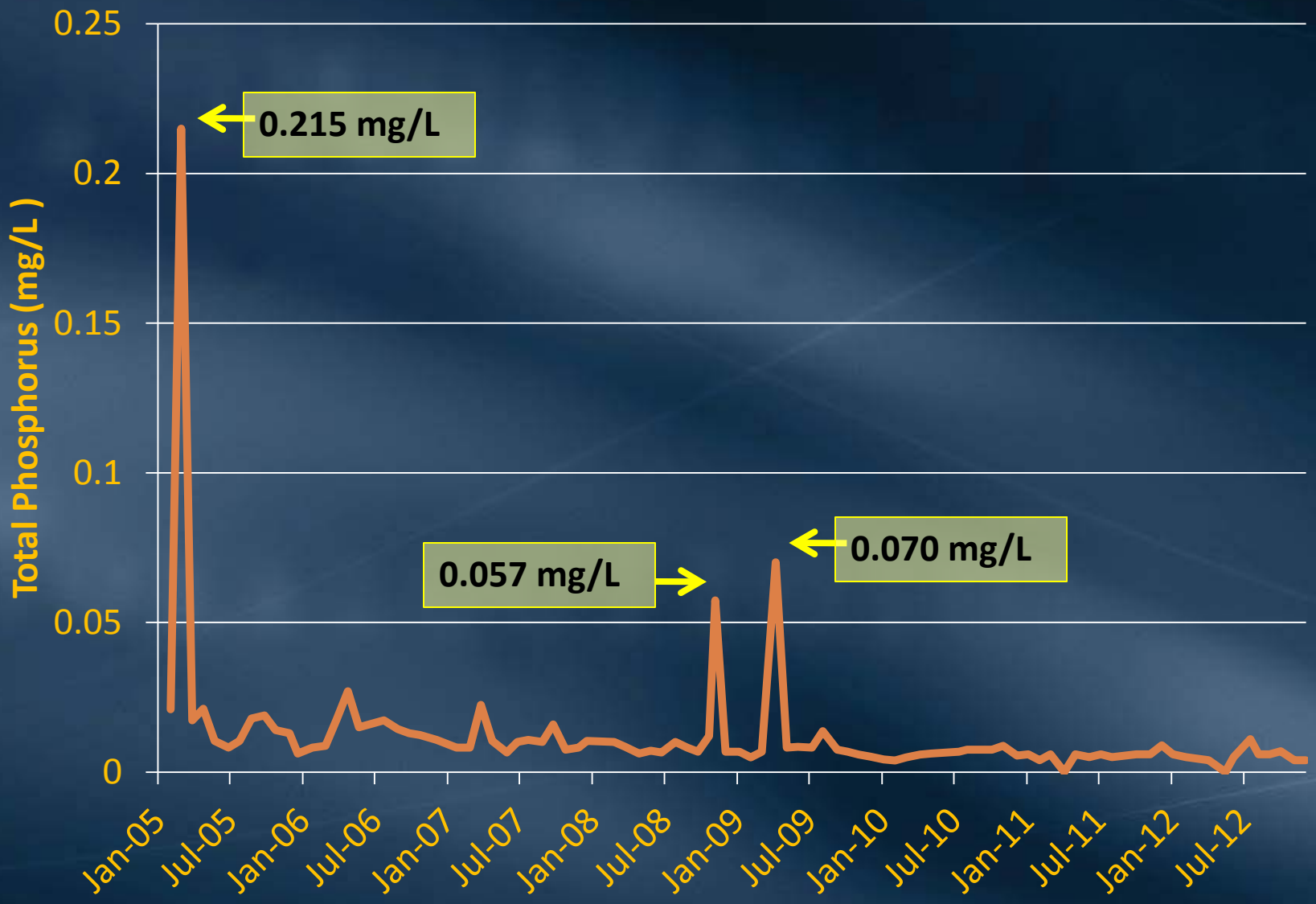
- Issue/Effects:
  - Stimulate algal growth; may produce T&O and toxins
  - Biomass can impact flow conveyance; shorten plant filter runs
  - Could provide food source for invasive species proliferation
- SWP nutrient levels significantly higher than Colorado River
- Source water protection is critical

Lake Mead

Lake Mathews

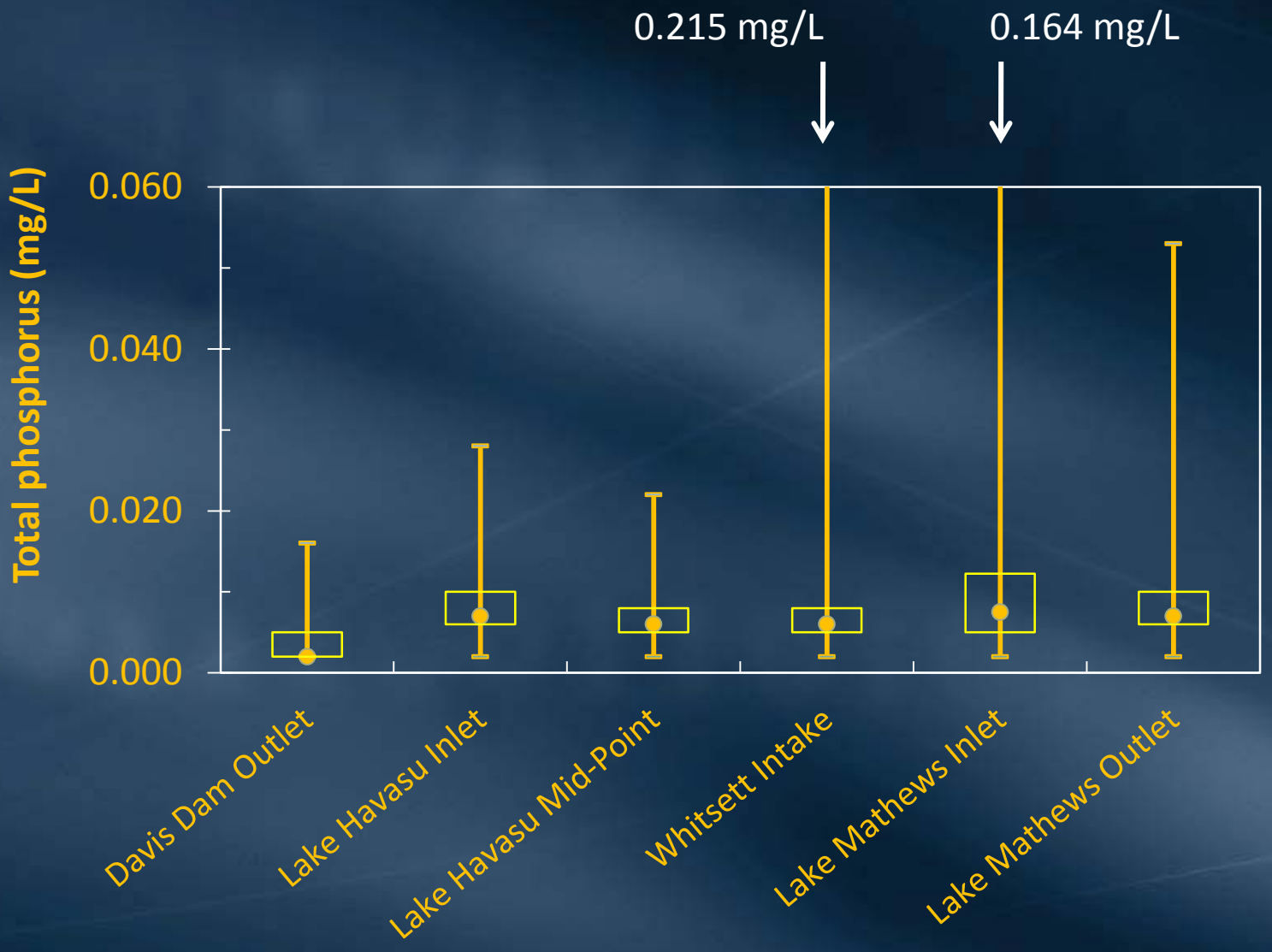
Total Phosphorus

Lake Havasu at Whitsett Intake, 2005-2012



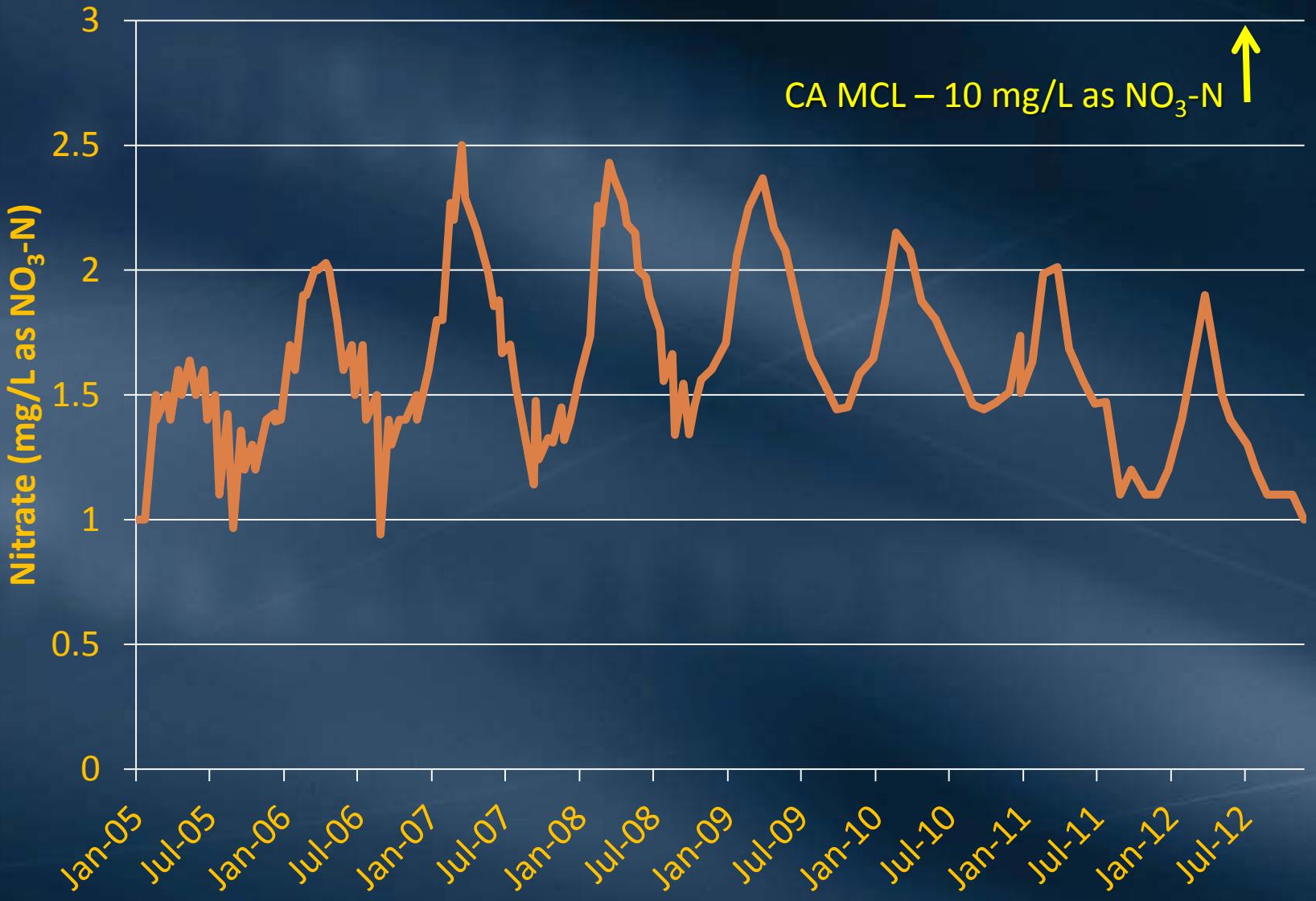
Total Phosphorus

between Davis Dam and Lake Mathews Outlet, 2005-2010



Nitrate

Lake Havasu at Whitsett Intake, 2005-2012



Disinfection Byproduct Precursors

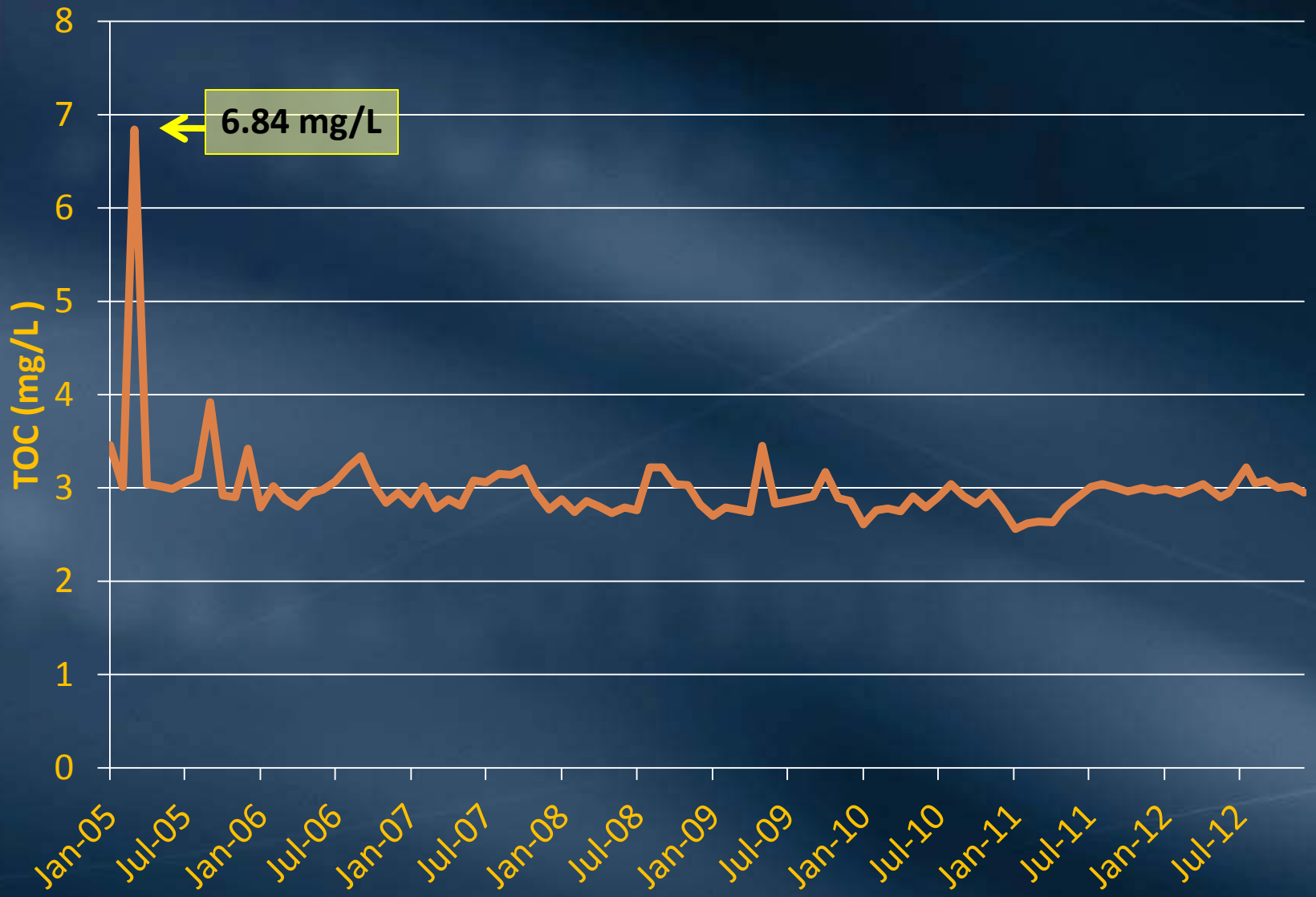
Total Organic Carbon and Bromide

- Issue/Effects:
  - React with disinfectants at treatment plants to form DBPs
  - Links to certain cancers; reproductive and developmental effects

- Regulated through Stage 1 and 2 D/DBP Rules
- Precursor levels in SWP are high due to seawater intrusion, ag drainage, and Delta soils
- Source water protection + effective treatment technologies ensure safe drinking water at reasonable cost

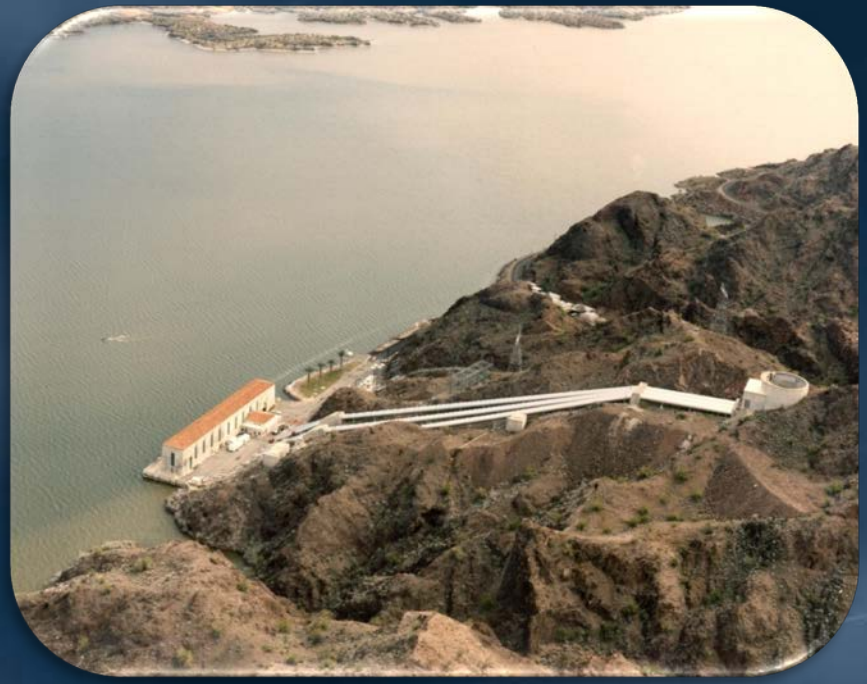
Total Organic Carbon

Lake Havasu at Whitsett Intake, 2005-2012



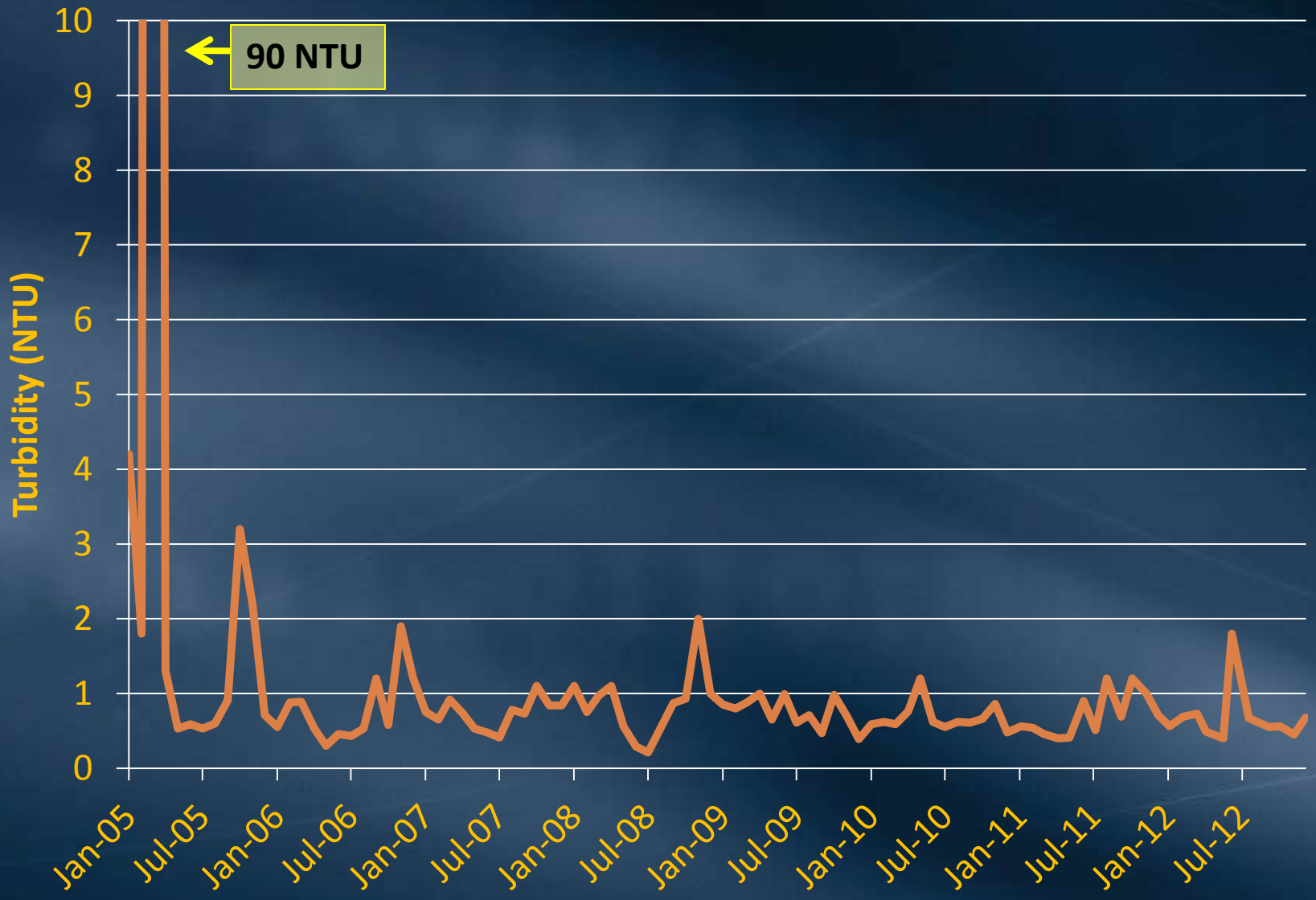
Turbidity

- Issue/Effects:
  - Masks the presence of microorganisms and interferes with their disinfection
  - Caused by erosion and sediment transport
- Regulated through CA SWTR and Federal IESWTR
- Monthly monitoring at Lake Havasu's Whitsett Intake



Turbidity

Lake Havasu at Whitsett Intake, 2005-2012



Microorganisms

- Issue/Effects:
  - Microbial contamination from humans, warm-blooded animals
  - Major health hazards
  - Removal through chemical disinfection at treatment plants
- Coliforms regulated through LT2ESWTR
- *Cryptosporidium* regulated through IESWTR and LT2ESWTR
- *Giardia* regulated through CA SWTR
- Monthly monitoring for coliforms at Whitsett Intake; pathogens monitored at downstream source waters

Coliforms

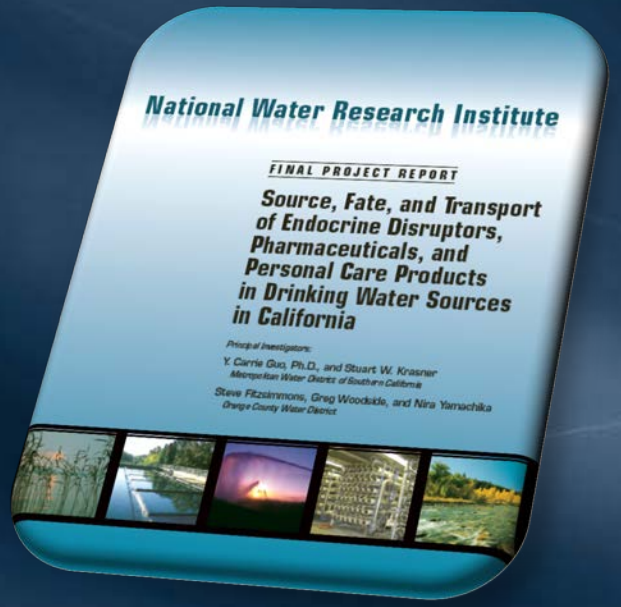
Lake Havasu at Whitsett Intake, 2005-2010, per 100 mL

	Total Coliforms	Fecal Coliform	*E.coli*
No. of Samples	72	59	72
Minimum	<1	<2	<1
10Th percentile	9	<2	<1
Median	120	<2	<1
Average	370	3	<1
90th Percentile	880	2	1
Maximum	7700	130	3

Pharmaceuticals and Personal Care Products (PPCPs)

- Issue/Effects:
  - Growing concern to water industry; media attention
  - Human health effects undetermined at low ppt levels
  - WW effluent is a primary source

- No regulatory limits at this time; no standardized analytical methods
- Metropolitan engaged in PPCP research studies

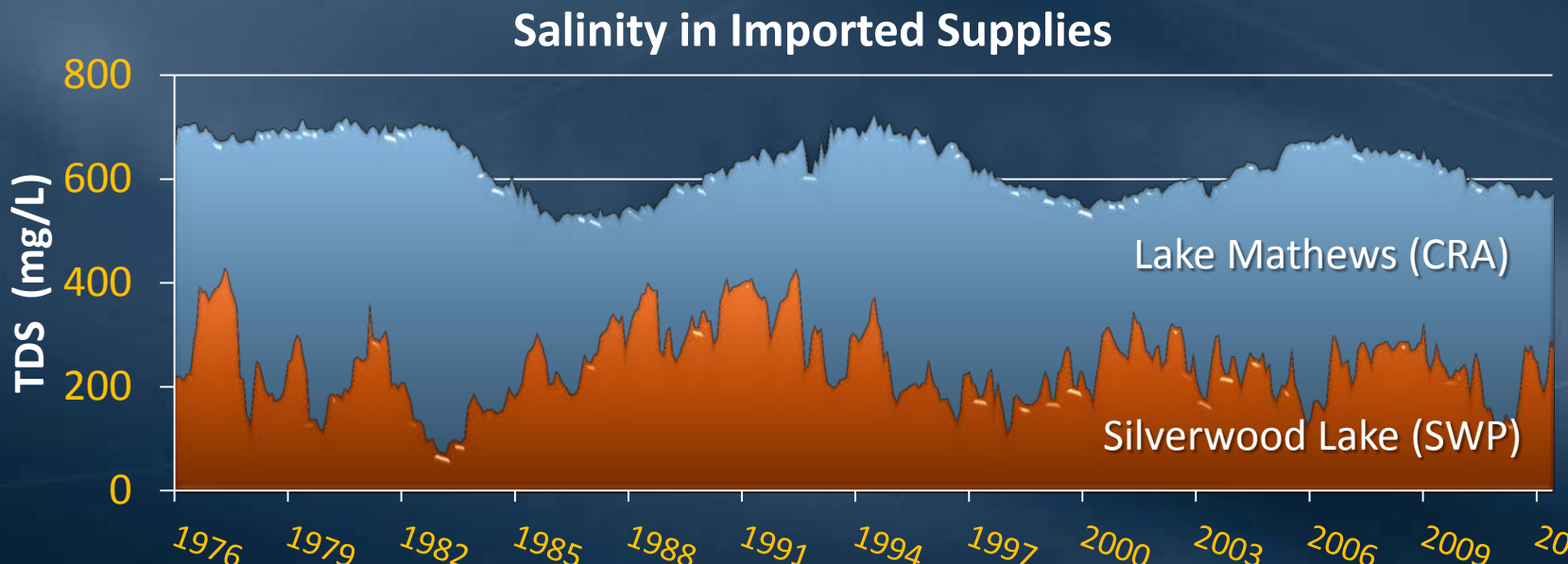


N-Nitrosodimethylamine (NDMA)

- Issue/Effects:
  - Byproduct of chloramine disinfection with organic nitrogen precursors
  - Family of potent carcinogens -- nitrosamines
  - WW effluent and ag runoff contribute precursors
- No MCL at this time; anticipated for future regulation
  - CDPH notification level (NL) at 0.01 ppb
- Metropolitan engaged in several NDMA studies
  - Understand sources, occurrence, and fate and transport
  - Develop treatment strategies to minimize formation

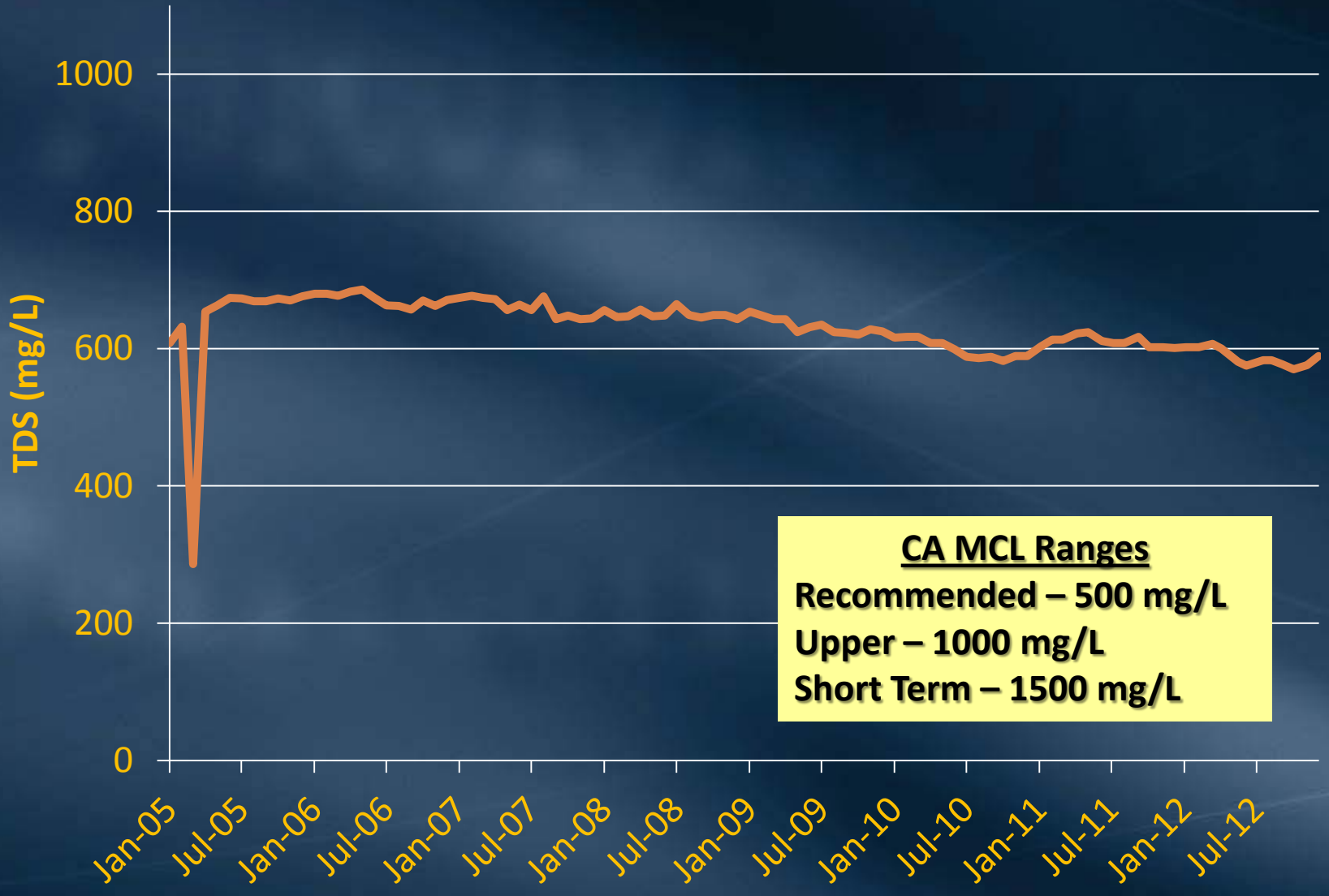
Salinity

- Issue/Effects:
  - Limits use of local gw basins for storage
  - Lowers usefulness; increases cost of recycled water
  - Impacts to household appliances and plumbing
  - Reduces crop yields
  - Can impart unpleasant taste in drinking water



Total Dissolved Solids

Lake Havasu at Whitsett Intake, 2005-2012




THE METROPOLITAN WATER DISTRICT OF
SOUTHERN CALIFORNIA
1928

Changes in Imported Water Deliveries