Overview of Water Quality Issues on California Rangelands
Urban-Wildland-Agricultural Interface

80% of Reservoirs
Water Pollution

Human-induced alteration of the chemical, physical or biological integrity of water
Sources of Water Contaminants

Point source pollutants - originate from an identifiable source

Non-point source pollutants - originate from diffuse and hard-to-identify sources

Natural sources - originate from naturally occurring sources in the environment (sediment, nutrients)
Water quality standards are developed for each water body to meet a designated use (e.g. drinking water, recreation).

If water quality standards are not met, the water body is considered impaired.
Goal of Clean Water Act

- Restore and maintain the chemical, physical, and biological integrity of the Nation’s waters.
- All waters should be safe for swimming, fishing and as a source of drinking water.
Status of 303(d) List
(California Surface Waters - 2006)

- ~ 779 listed waters
- ~ 2237 impairments
- ~ 167 pollutant categories
- ~ 26,700 river/coastal miles
- ~ 255,000 lake/reservoir acres
Top Impairments - 2006

Number

- Pesticides
- Metals
- Pathogens
- Nutrients
- Organics
- Sediments
- Toxicity
- Salinity

http://www.swrcb.ca.gov/tmdl/303d_lists2006approvedd.thml
State-wide Survey
24 streams
2000 and 2001 water years
Nutrient Concentrations

n = 947
Pathogens

n = 947

Standard
E. Coli = 126
Cryptosporidium parvum
E. coli
Nutrients
Pathogens
Sediments

Photo Credit: H.D.A Lindquist, U.S. EPA
Dissolved Organic Carbon (DOC) + Chlorine → Disinfection Byproducts
Disinfection Byproducts form during Chlorination

- **Haloacetic acids**
  - Bromochloroacetic acid
  - Dichloroacetic acid
  - Dibromochloroacetic acid
  - Bromodichloroacetic acid
  - Dibromoacetic acid
  - Tribromoacetic acid

- **Haloacetonitriles**
  - Bromoacetonitrile
  - Dibromoacetonitrile

- **Haloketones**
  - Hexachloropropanone

- **Miscellaneous**
  - Sodium chlorate
  - 3-Chloro-4-(dichloromethyl)-5-hydroxy-2(5H)-furanone
  - Sodium bromate

- **Trihalomethanes**
  - Chloroform
  - Dichlorobromomethane
  - Dibromochloromethane
Instream DOC Dynamics

- Photodegradation
- Biodegradation
- Production - algae
Assimilative Capacity

Capacity of a water body to receive a pollutant, without harmful effects and damage to aquatic life and to humans who consume its water.
Seasonal DOC Dynamics in Streamwaters from California Rangelands
Seasonal Pattern in Streamwater Nitrate in California Oak Woodlands
Yuba River - Nitrate

~ 5 mg/L maximum in oak woodland stream
Nutrient Attenuation – Deer Creek

Nitrate Phosphate

\[ \text{NO}_3^- \text{N or PO}_4^-\text{P (ppm)} \]

<table>
<thead>
<tr>
<th>Mile 2</th>
<th>Mile 5</th>
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<tr>
<td>Nitrate</td>
<td>Phosphate</td>
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<td>15</td>
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Mile 2
Mile 5
Sediment Generation in Northern Coast Ranges

99% associated with historic land management or natural sources, 1% due to current management practices.
Mokelumne River Controlled-Release Flood

[Graph showing TSS (kg hr⁻¹) and Discharge (m³ s⁻¹) over time with data points at 0.7 km and 16 km.]
Water Quality Monitoring Considerations
Schubert Watershed; Annual N Load

![Graph showing the annual nitrogen load in Schubert Watershed from 1981 to 1998. The x-axis represents the water year, and the y-axis represents the mineral N load in kg/ha/yr.]
Seasonal Pattern in Streamwater Nitrate in California Oak Woodlands

\( \text{NO}_3 (\text{mg L}^{-1}) \)
Storm-Event Dynamics

Graphs showing the dynamics of NO₃ (mg N L⁻¹) and Flow (m³ s⁻¹) over time (Hours).
Irrigation Tailwater Runoff

Watershed 1 2006
6 hr sampling interval

Watershed 1 2007
Daily composite – 4 subsamples per day

n=557

n=138

May June July Aug Sept Oct

TN (mg L⁻¹)
Total Nitrogen (mg/L)

95% Confidence Interval - Total N

- $\mu + 50\%$
- $\mu + 20\%$
- $\mu = 8.14$

Number of Samples
Diel Cycle Dissolved Oxygen – San Joaquin River
Dissolved Oxygen Water Quality Standard

Dissolved Oxygen Saturation Concentration (mg/L)

Elevation (ft)
20+ Years of Research & Extension