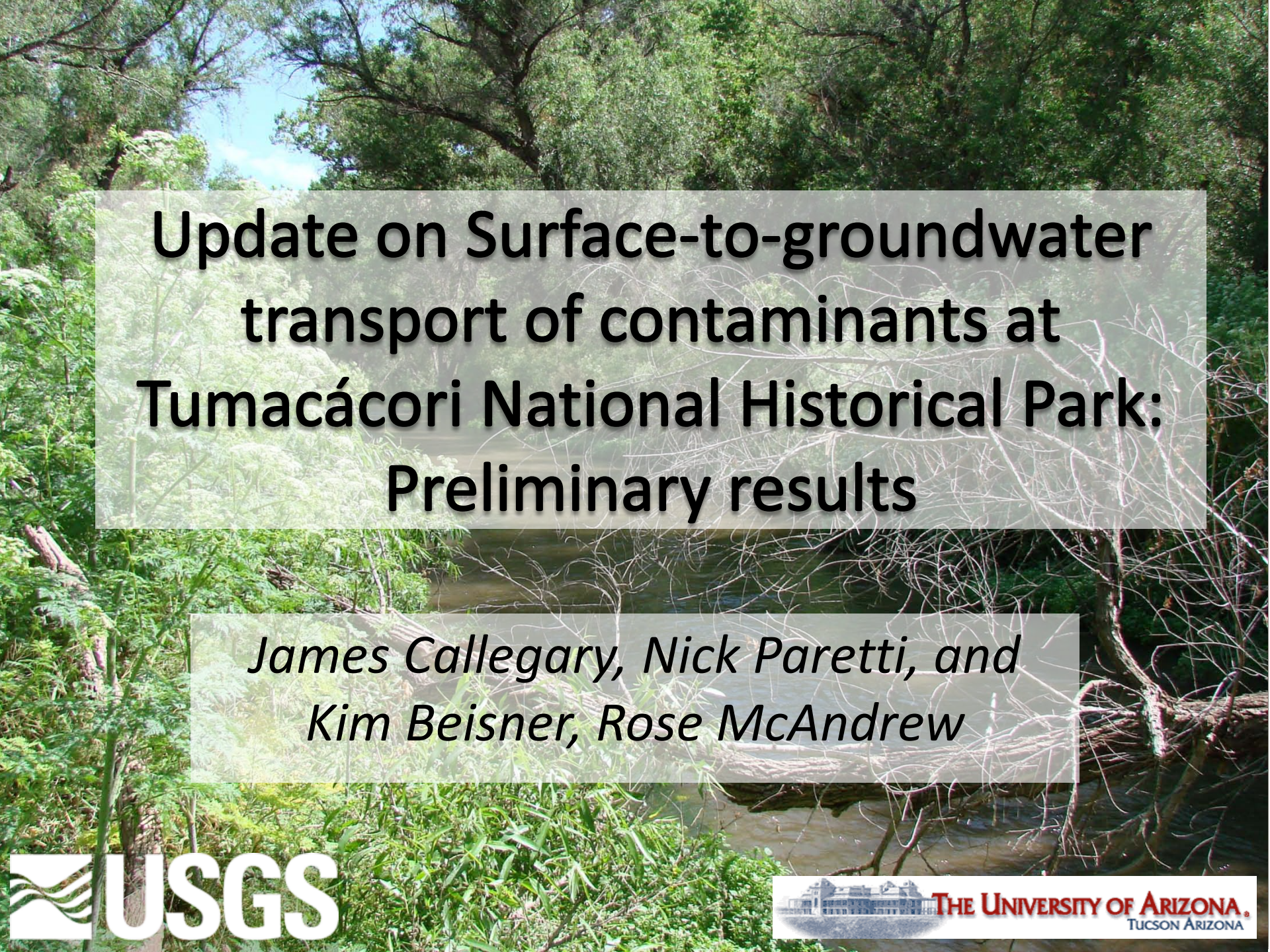
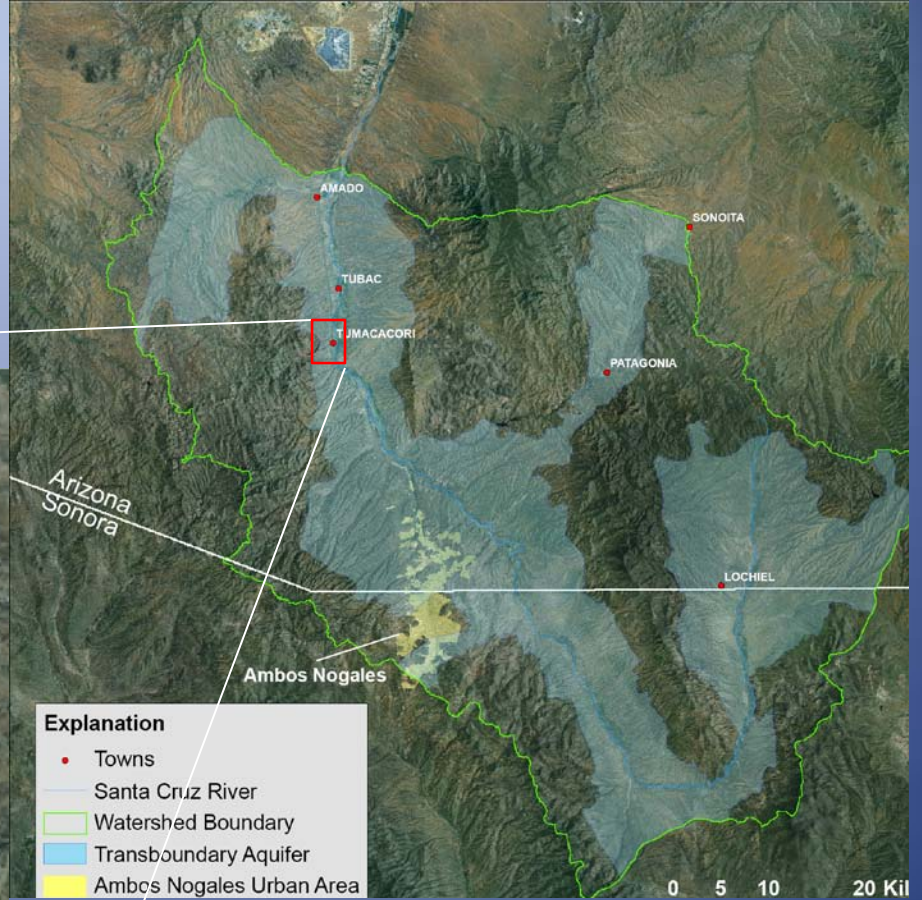
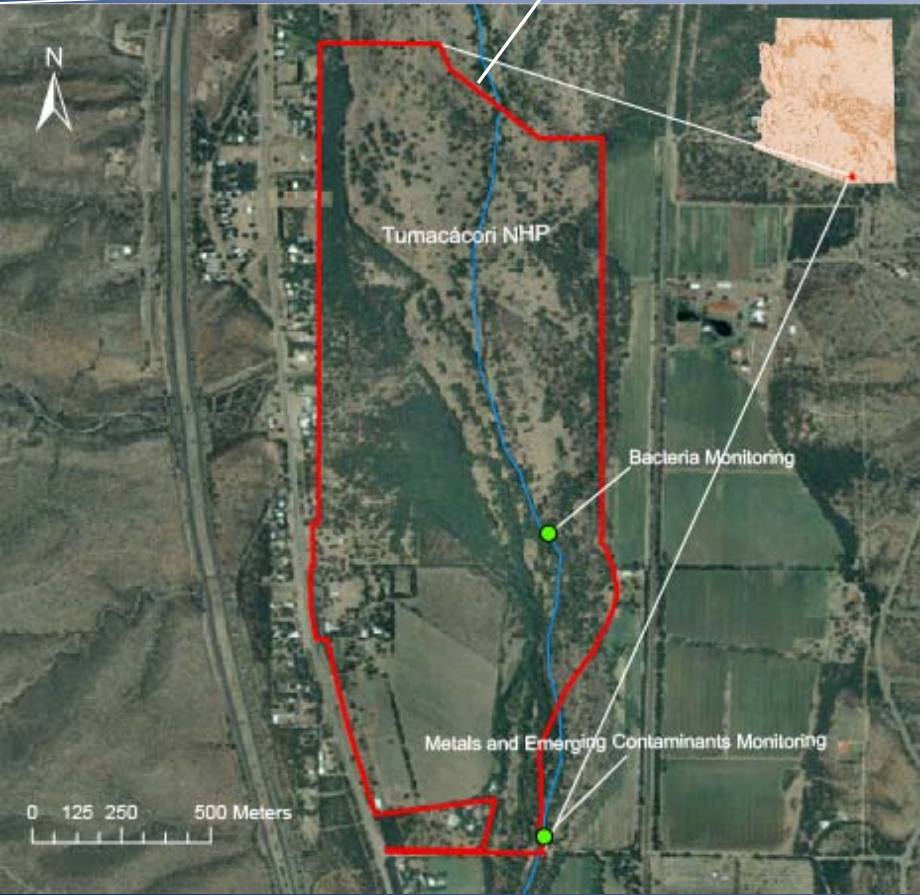




Update on Surface-to-groundwater transport of contaminants at Tumacácori National Historical Park: Preliminary results

*James Callegary, Nick Paretti, and
Kim Beisner, Rose McAndrew*

Tumacácori National Historical Park



Climate Data

- ~2000m of relief between max altitude (Santa Rita's ~2900m) and basin outlet (~900m)
- Interpolated precip data: 355mm to 914mm
- For period 1971-2000, valley bottom precip varied between 400 to 480mm at NWS Coop stations
- Average annual evapotranspiration at ~1000m = 2316mm

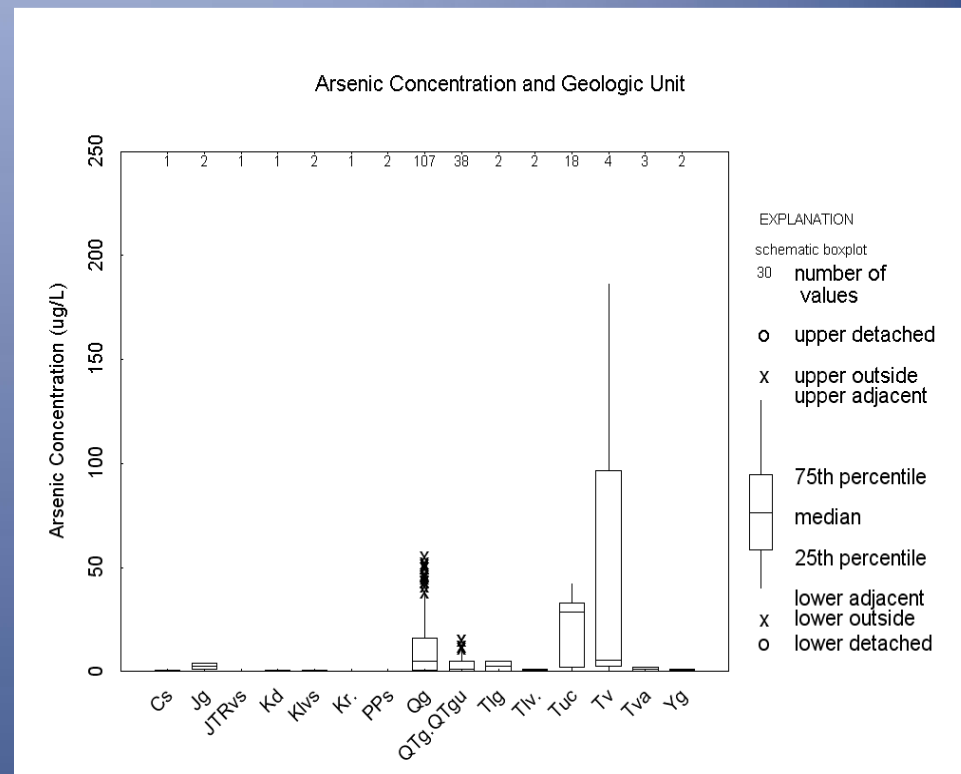
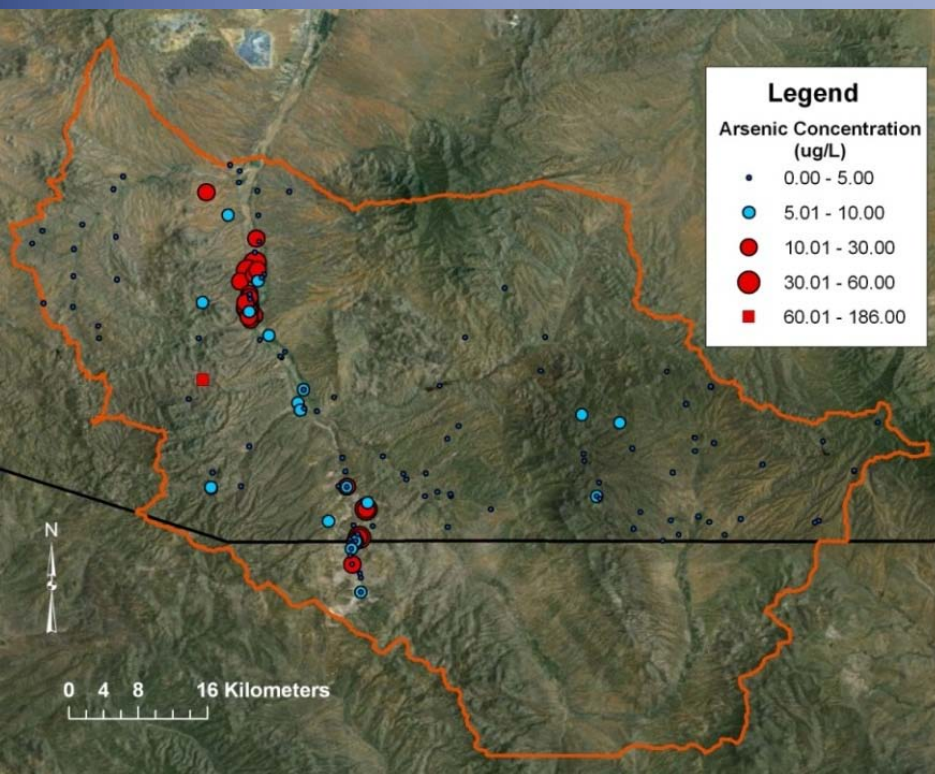
ADEQ Water Quality – San Rafael Valley

- Exceedances in wells, springs and mines reported for six sites.
- Most frequently exceeded parameters: As and Pb; also radionuclides, Cd and Sb.

ADEQ Water Quality – Santa Cruz AMA

- Drinking water standard exceedances: 45 sites
- Most frequently exceeded parameters: As and Organics; also Hg, Mn, F, Pb, radionuclides, Se, and NO_3^- .
- 3 stream reaches and one lake listed as impaired, primarily for Cu and *E. coli*; Hg in Peña Blanca Lake (now drained and dredged)

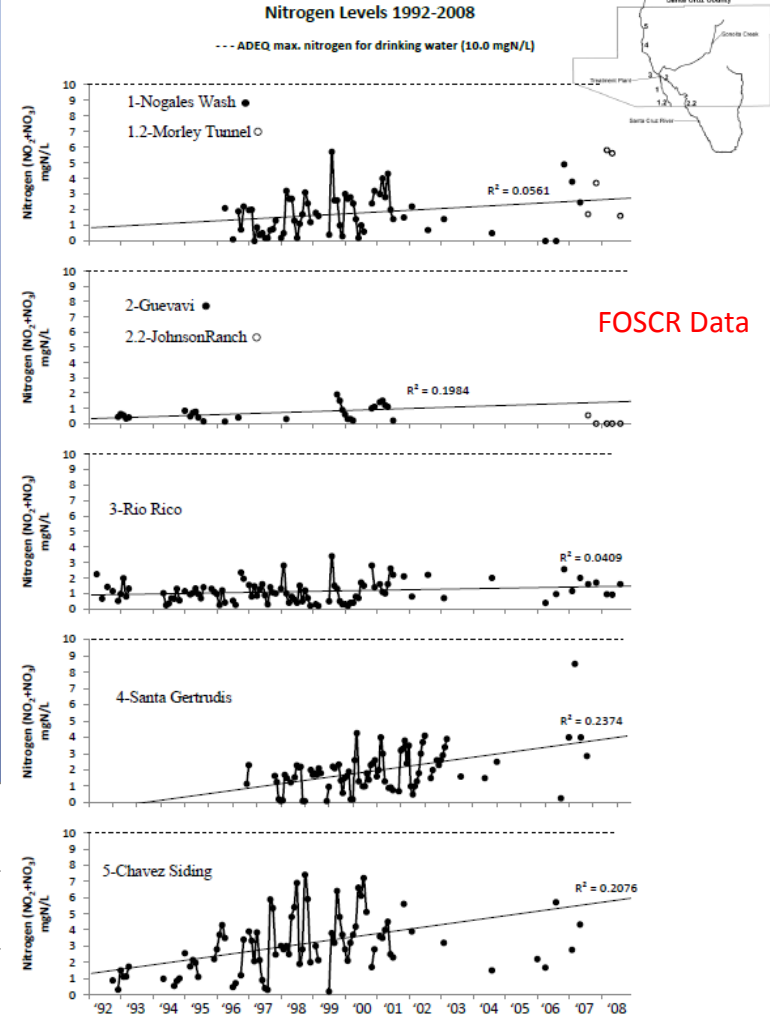
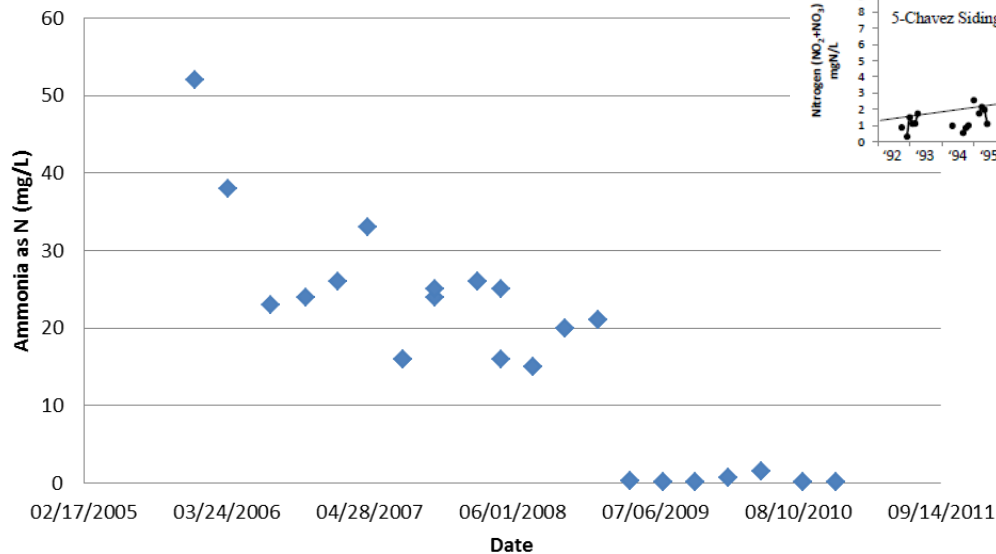
Arsenic Exceedances in the Upper Santa Cruz Watershed





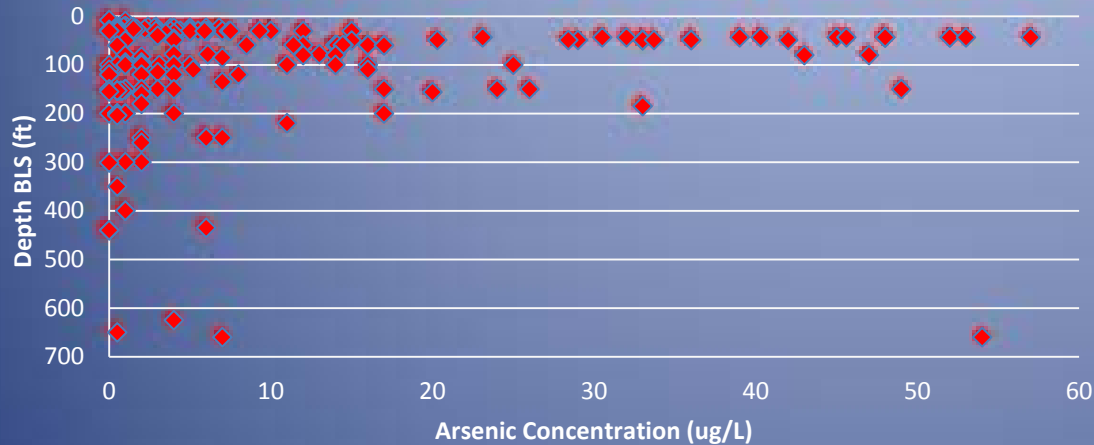
Nitrogen Species

Ammonia at Rio Rico

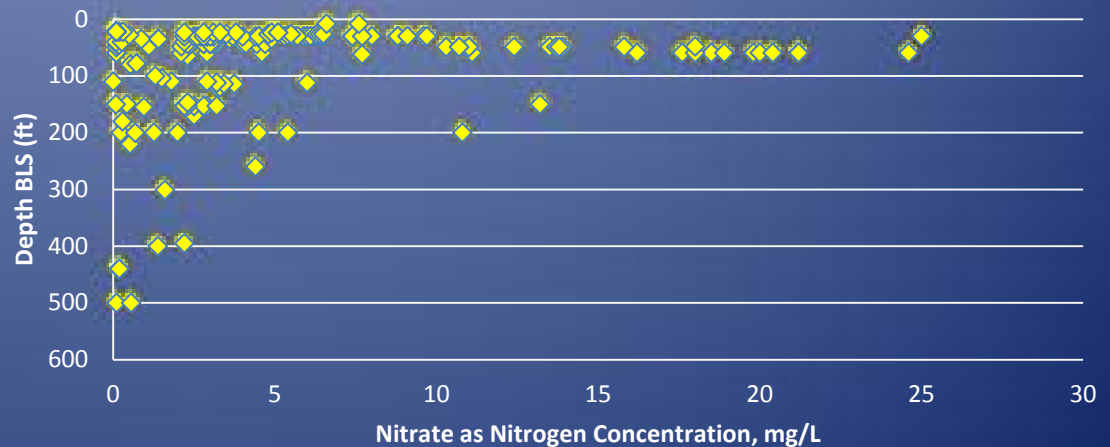


Depth frequency of contamination

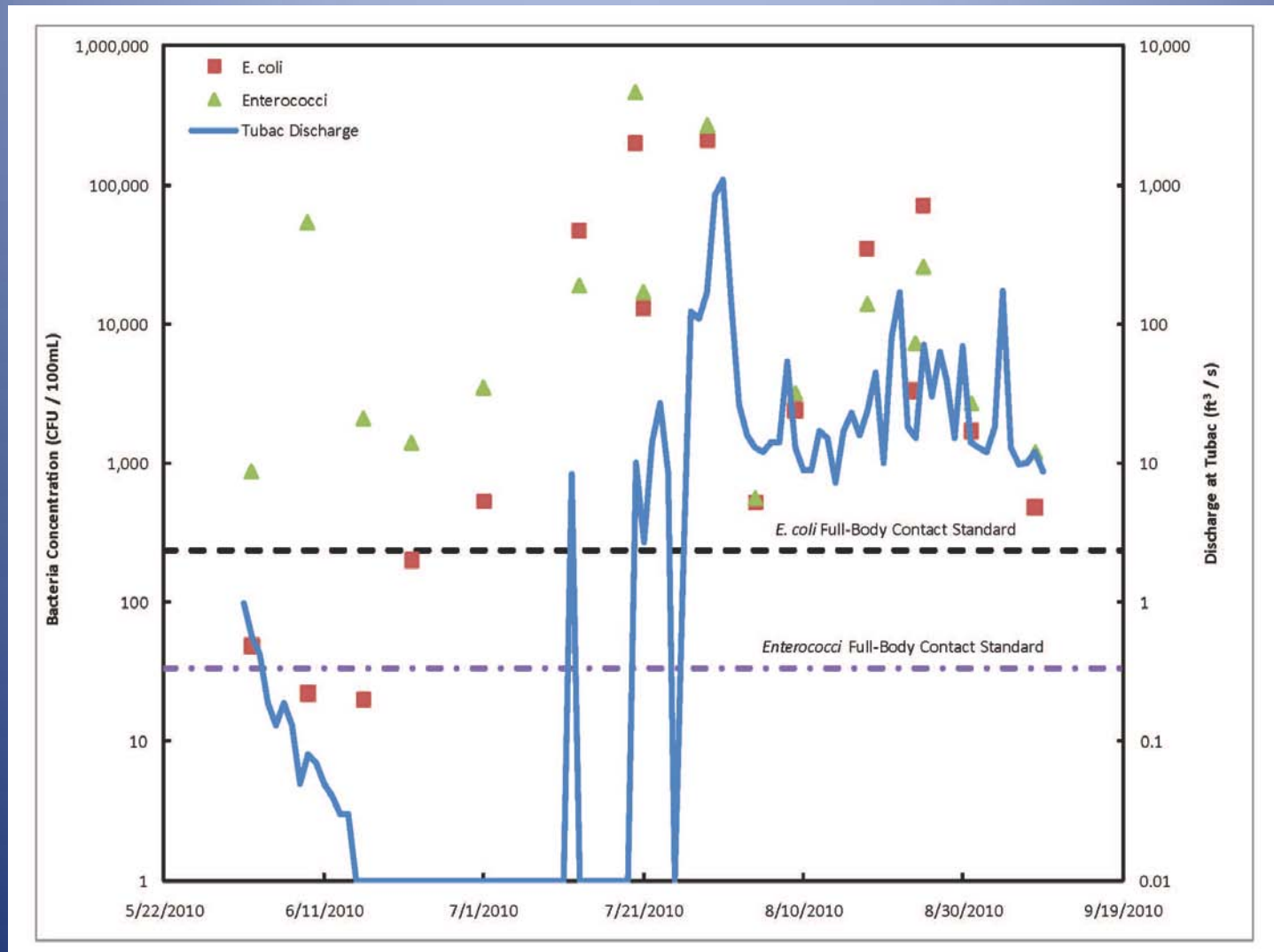
Well Depth and Arsenic



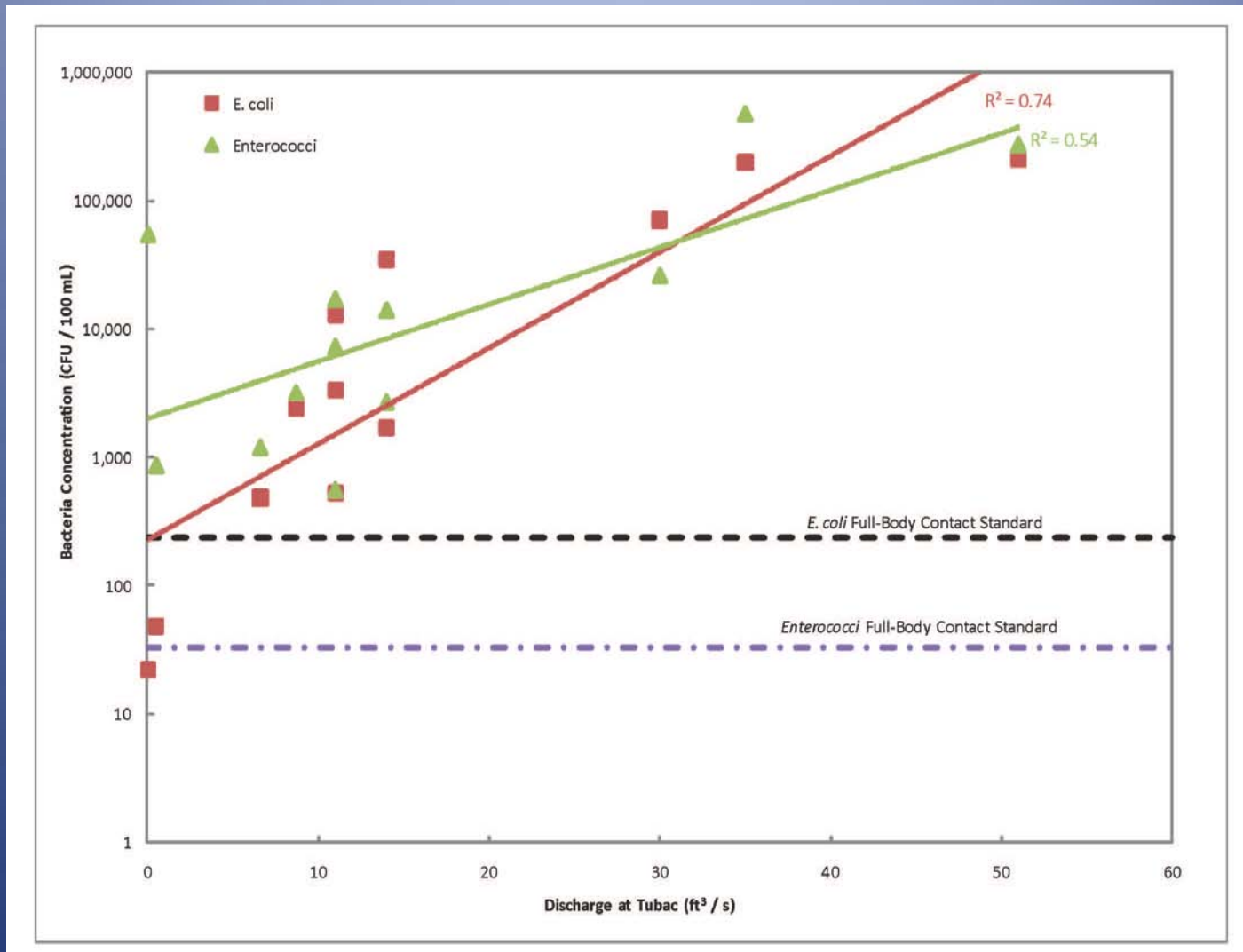
Well Depth and Nitrate



Correlation between Streamflow and Bacteria

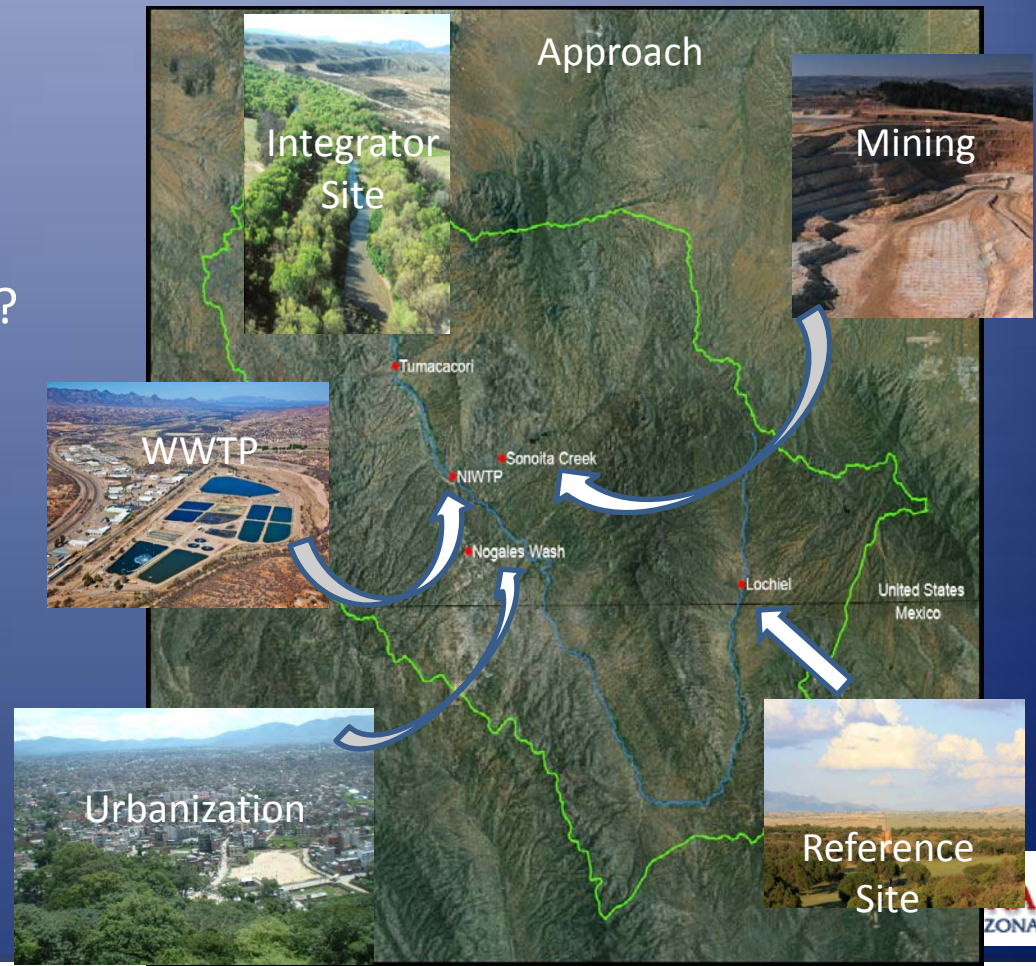


Correlation between Streamflow and Bacteria

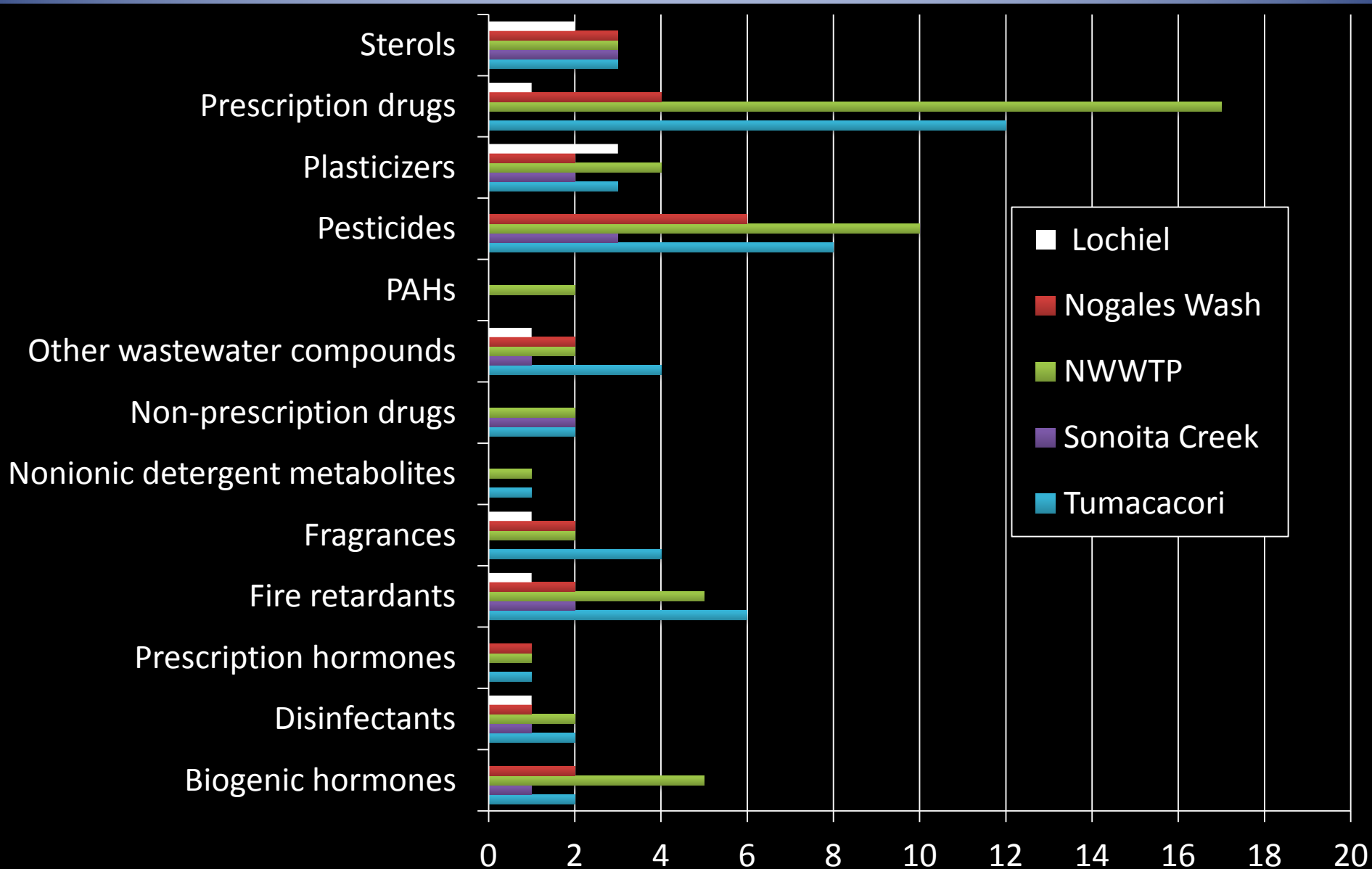


Border Environmental Health Initiative

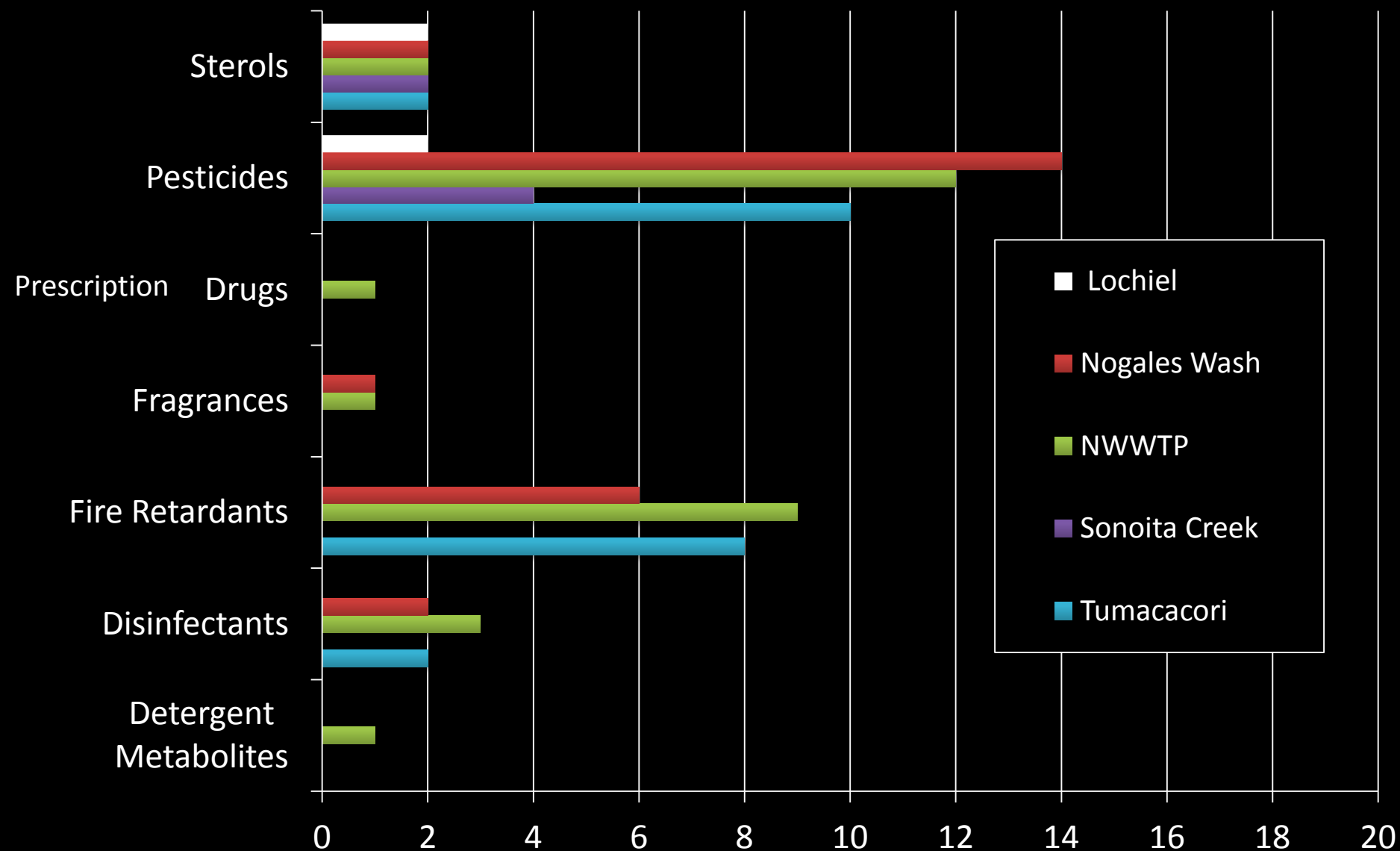
- Identify risks to water resources and the potential consequences to riparian ecosystems and ultimately human health.
- What inorganic and organic contaminants are present?
- What are the concentrations?
- What is the distribution of contaminants in the biotic and abiotic system?



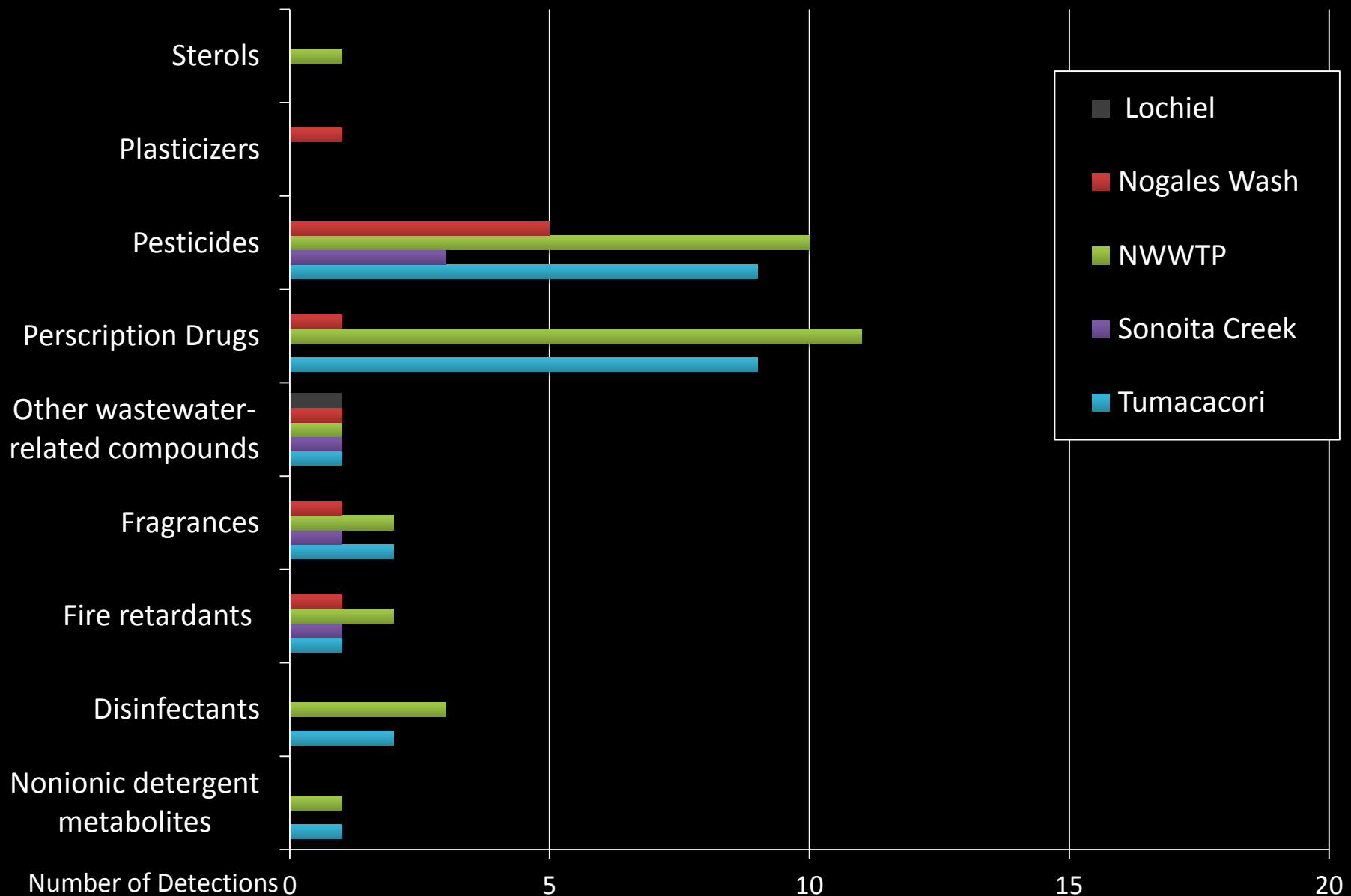
Organic Results-Water



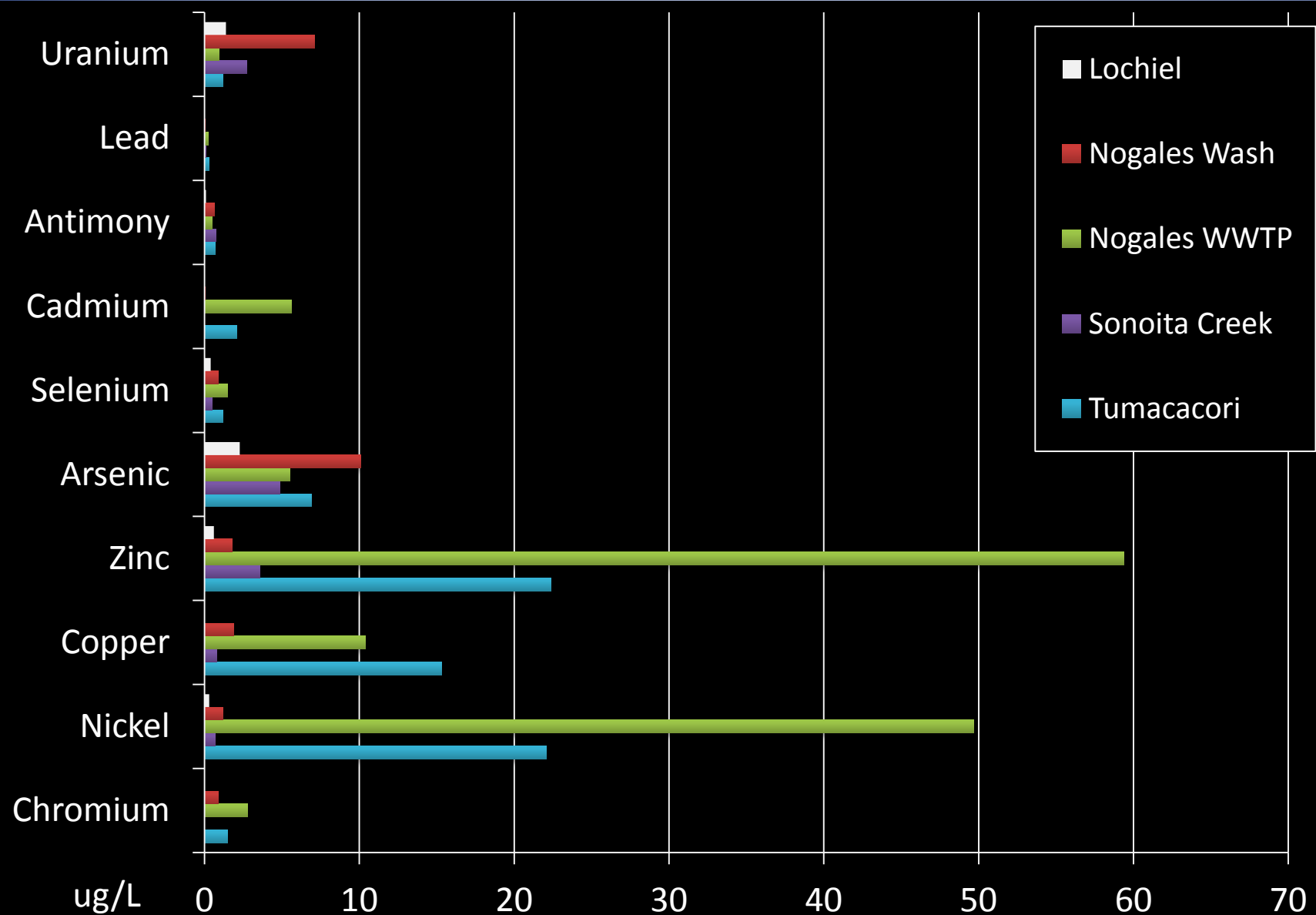
Organic Results-SPMD



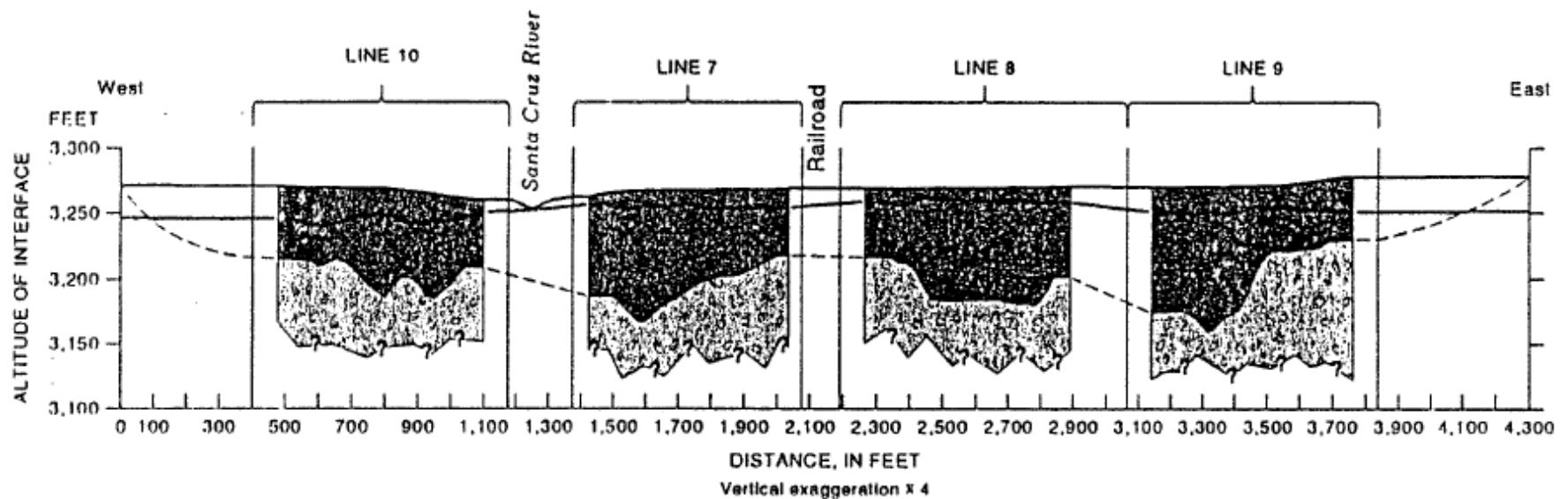
Organic Results-POCIS



Trace Metals-Water



Seismic Survey cross-section at Santa Gertrudis Lane

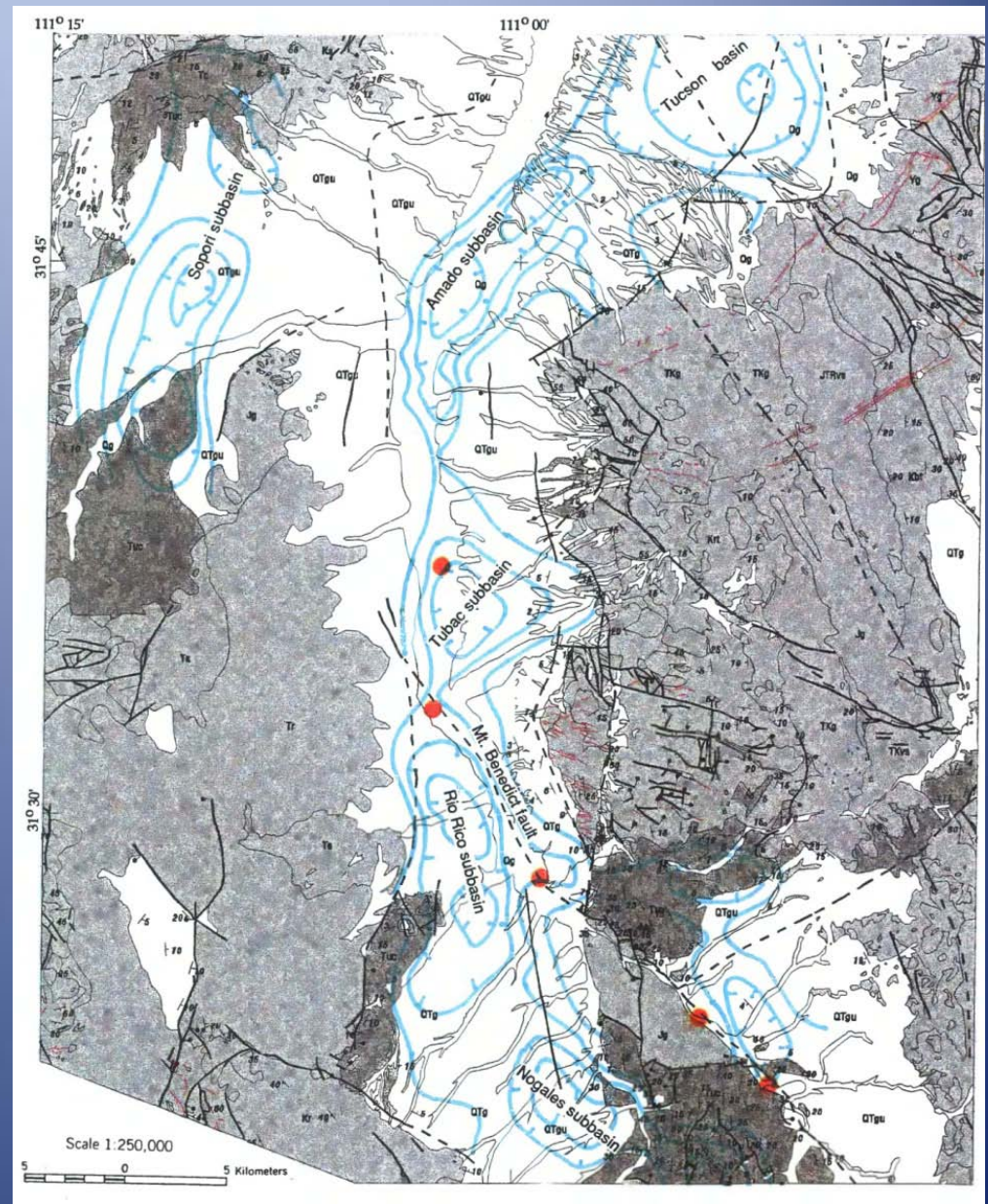


EXPLANATION

-  STREAM-CHANNEL ALLUVIUM
-  OLDER ALLUVIUM
-  CONSOLIDATED ROCKS AND TERTIARY SEDIMENTS

-  GEOLOGIC CONTACT—Dashed where inferred, queried where uncertain
-  APPROXIMATE TRACE OF SEISMIC SURVEY
-  LAND SURFACE
-  WATER TABLE—Dashed where inferred

Gravity Model of Depth to Basement (Gettings y Houser, 1997, USGS)



River Conditions



Tumacácori Site Map

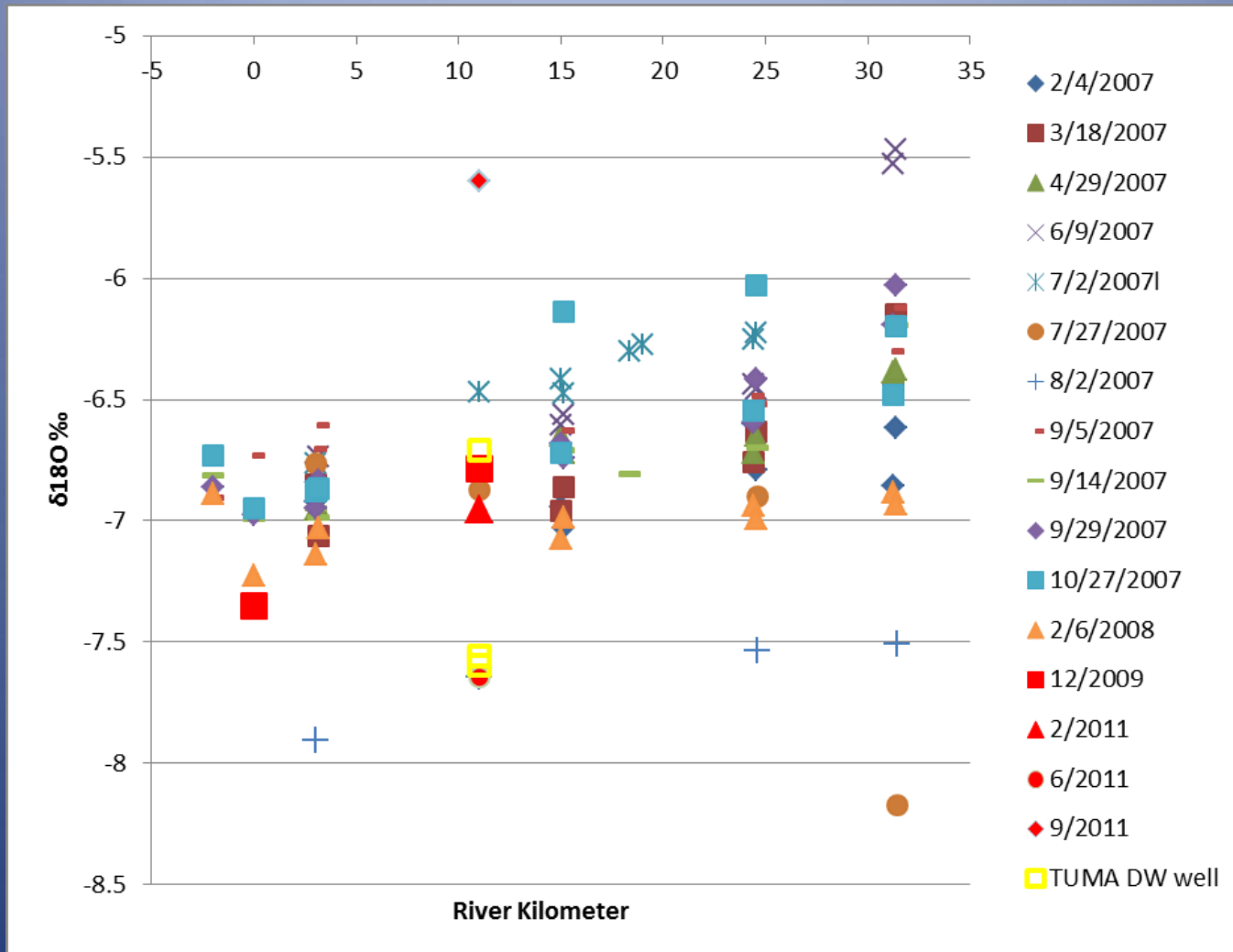


Approach

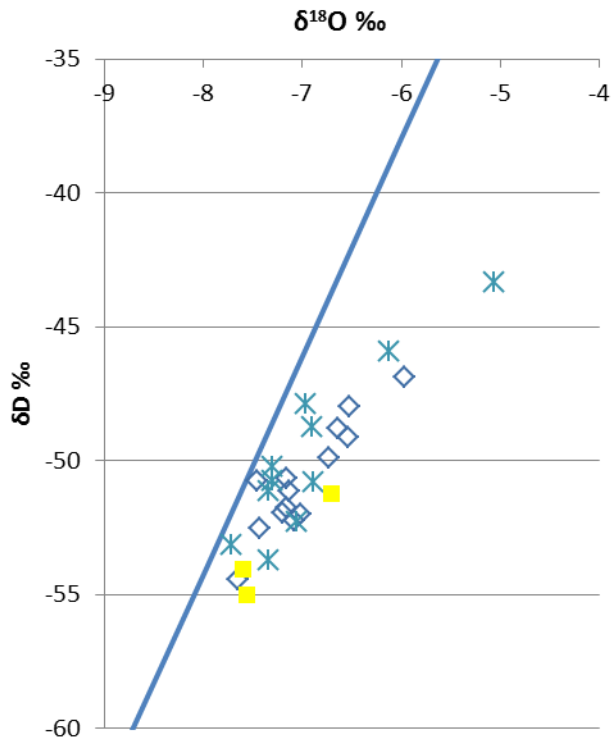
- Quantify organic and inorganic contaminants in water (including EPA DW compounds), sediment in the Santa Cruz River at Santa Gertrudis Lane and at in the main drinking water well at Tumacacori NHP
- Seasonal grab and passive sampling
- Analyze temperature, discharge, water level and stable isotope data



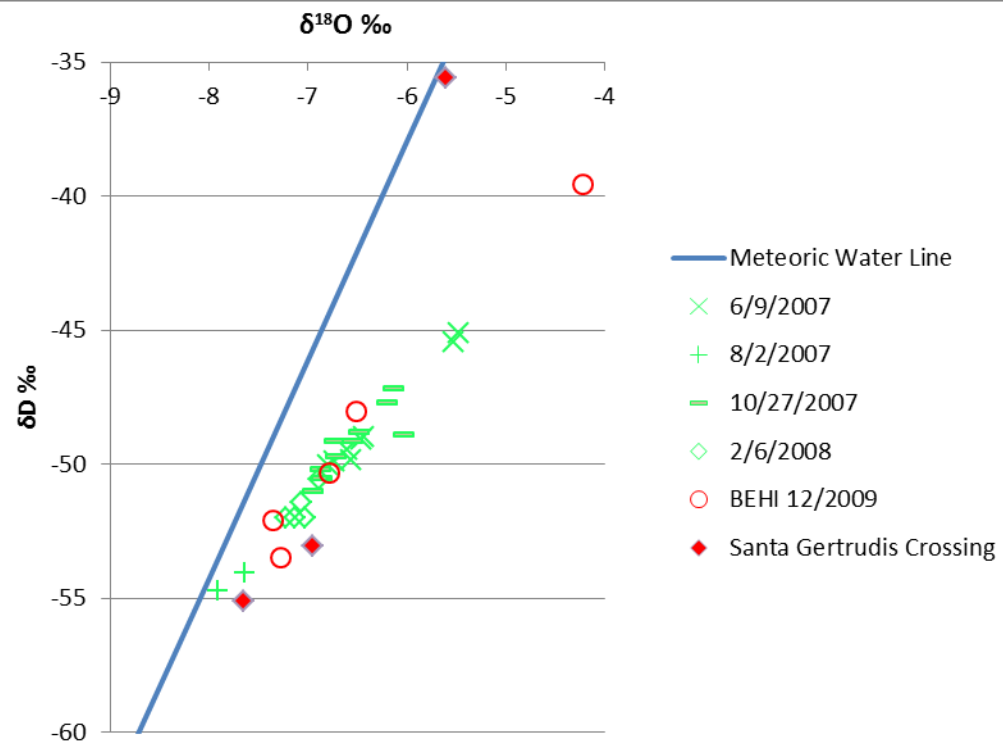
Stable Isotope Data



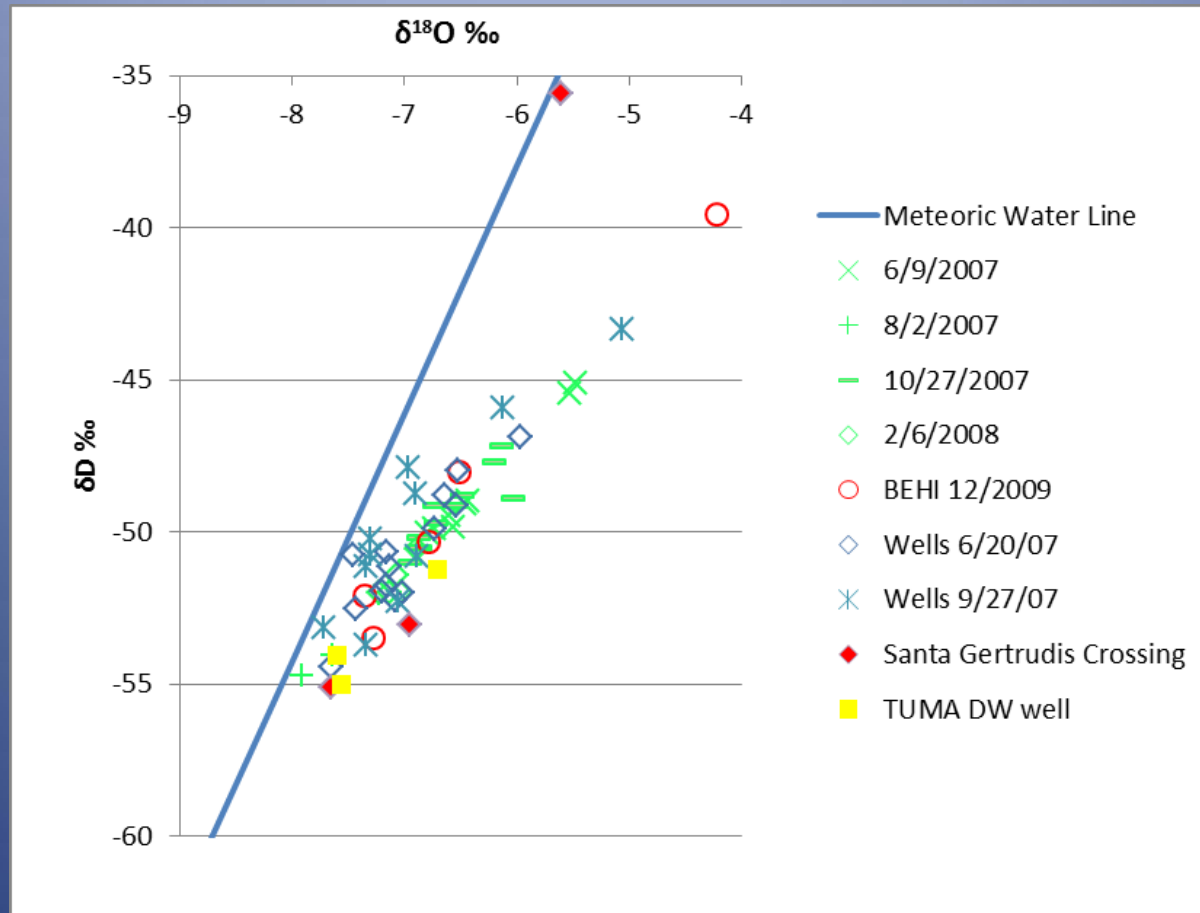
Stable Isotope Data



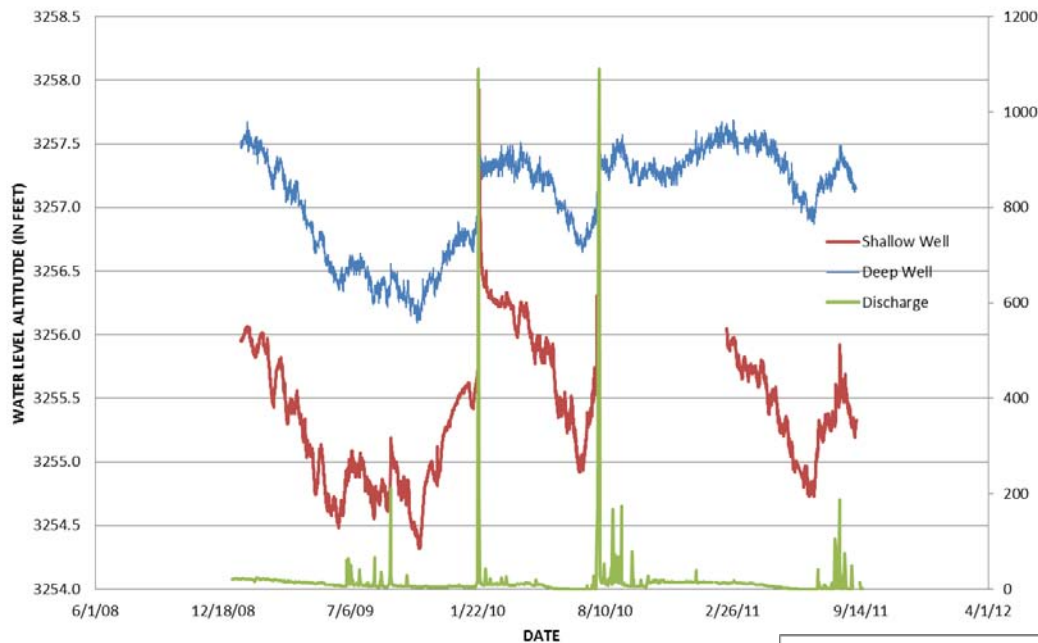
- Meteoric Water Line
- ◇ Wells 6/20/07
- * Wells 9/27/07
- TUMA DW well



Stable Isotope Data



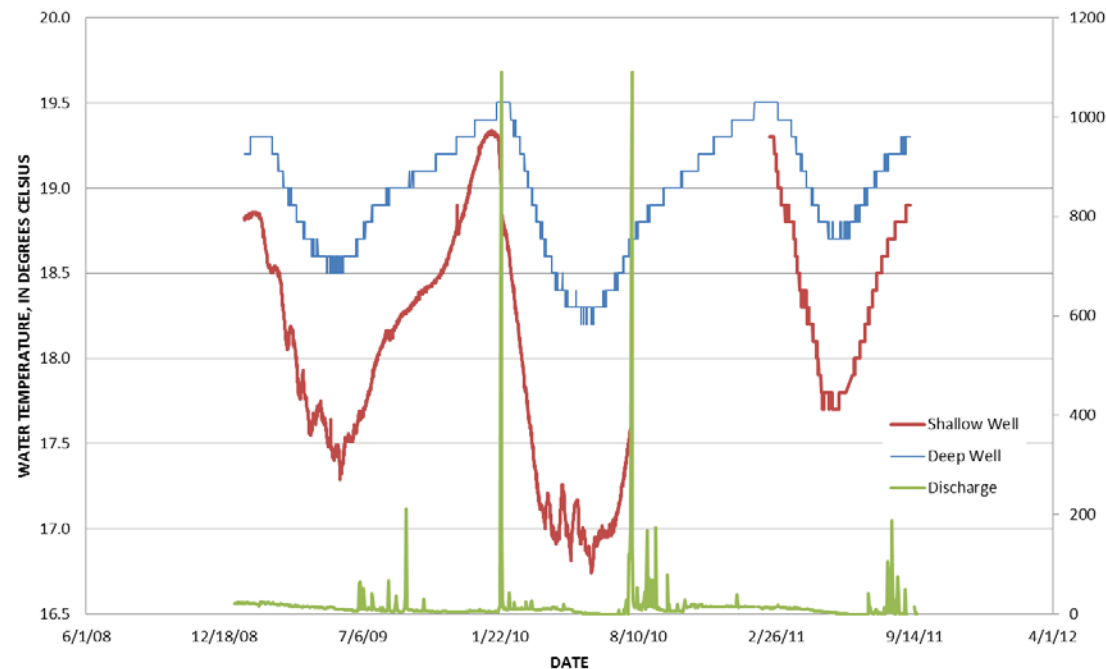
Tumacacori Monitoring Wells



Temperature and
Streamgage Data

Water Levels and
Streamgage Data

Tumacacori Monitoring Wells



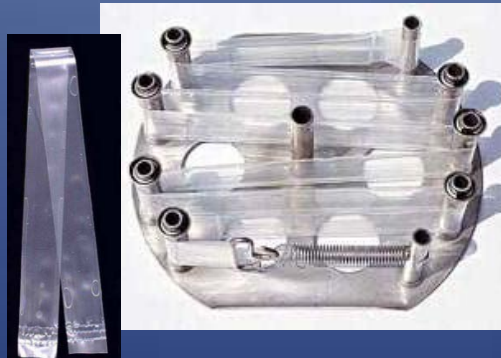
Polar Organic Chemical Integrative Sampler (POCIS)

- Consists of a solid phase sorbent contained between two sheets of a microporous polyethersulfone membrane
- Used to monitor hydrophilic contaminants
- Compounds include pesticides, prescription and OTC drugs, hormones, personal care products



Semipermeable Membrane Devices (SPMDs) aka “Fat Bags”

- Consists of a low-density polyethylene membrane tube containing a neutral lipid (triolein)
- Used as a proxy for fish and mimics the bioaccumulation of lipophilic contaminants
- Examples are PCBs, Flame retardants, pharmaceuticals, and pesticides

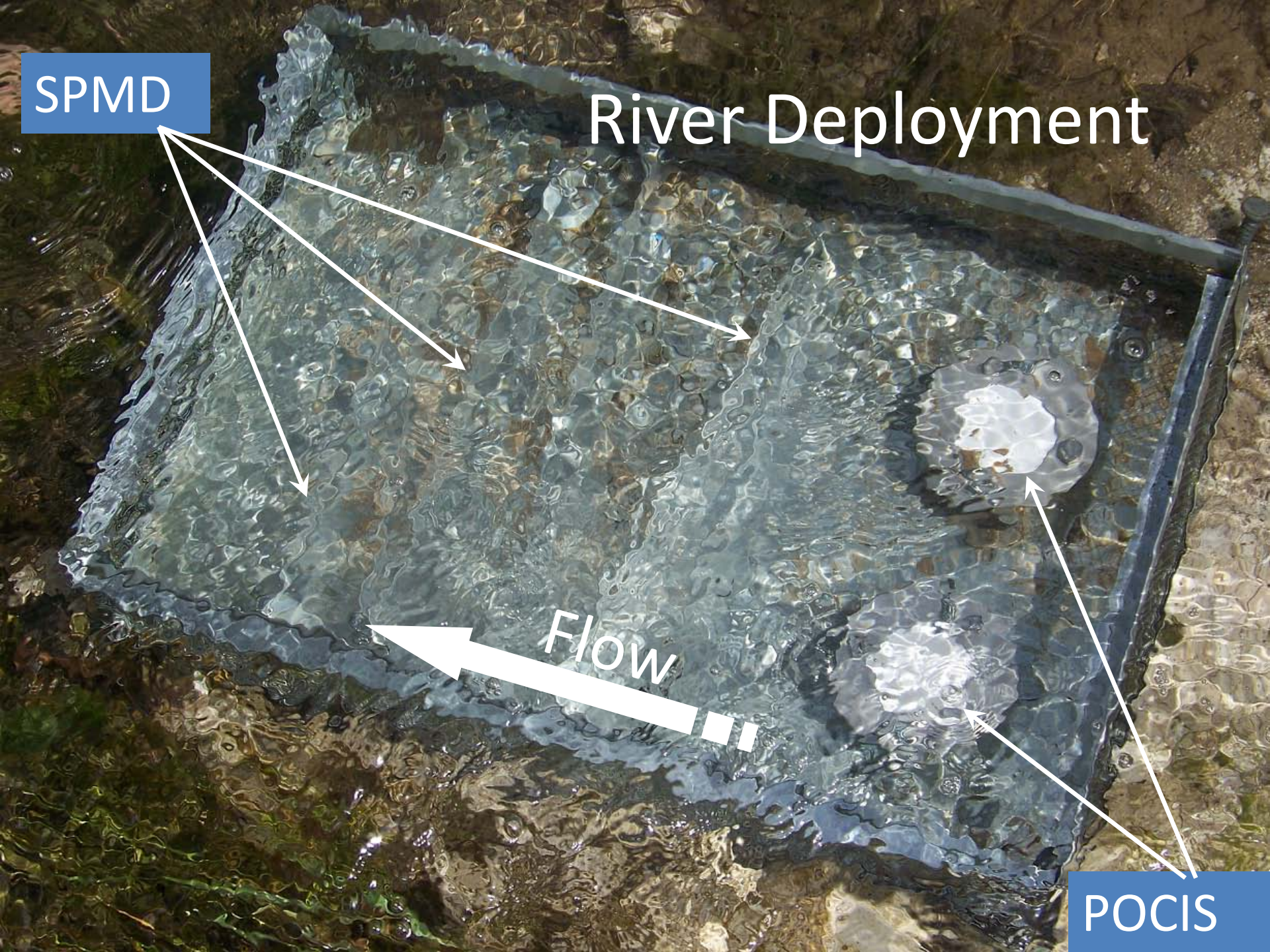


SPMD

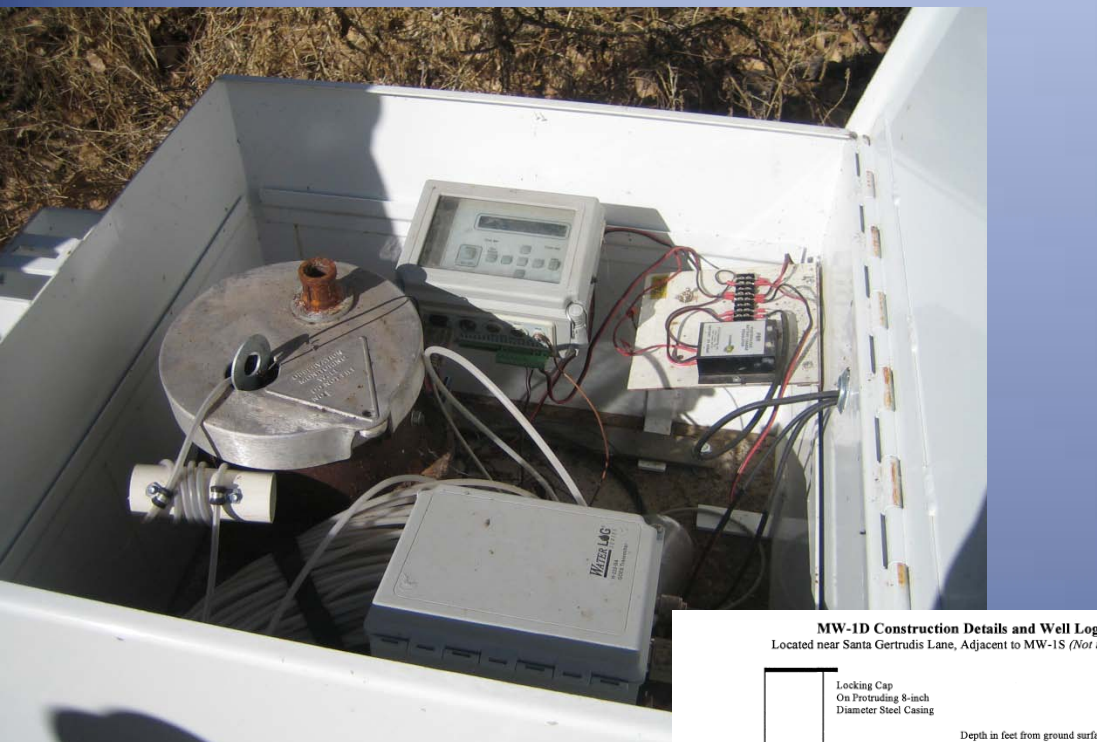
River Deployment

Flow

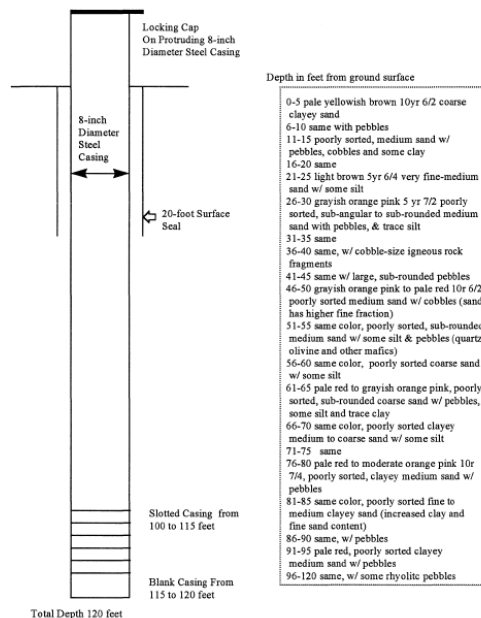
POCIS



Well Deployment



MW-1D Construction Details and Well Log
Located near Santa Gertrudis Lane, Adjacent to MW-1S (Not to Scale)



Interim Water Quality results

- Total mercury of 1-20 ng/L
- Methyl mercury ranged from 0.04 to 0.2 ng/L
- E. coli and Enterococci found in river water, but not in well
- Drinking water compounds not detected in well or below MCL except As

Organics in DW well

- 2/2011 sampling:
Detections in well of TCE, benzophenone, PBDE 47
- 6/2011 sampling: Diethyl phthalate, phenol, DEET, PBDE 47 and 99
- 10/2011 sampling: no detections