Item 9

Status Update

Russian River Watershed TMDL Development Efforts

Matt St. John, Rebecca Fitzgerald, Charles Reed & Steve Butkus

July 15, 2010

Water Boards

Topics

I. 303(d) List of Water Quality Limited Segments

II. Russian River Watershed Impairments

III. TMDL Development Projects

1. Reservoir Mercury TMDLs
2. Laguna de Santa Rosa TMDLs
3. Lower Russian Indicator Bacteria TMDLs

2008/2010 303(d) List

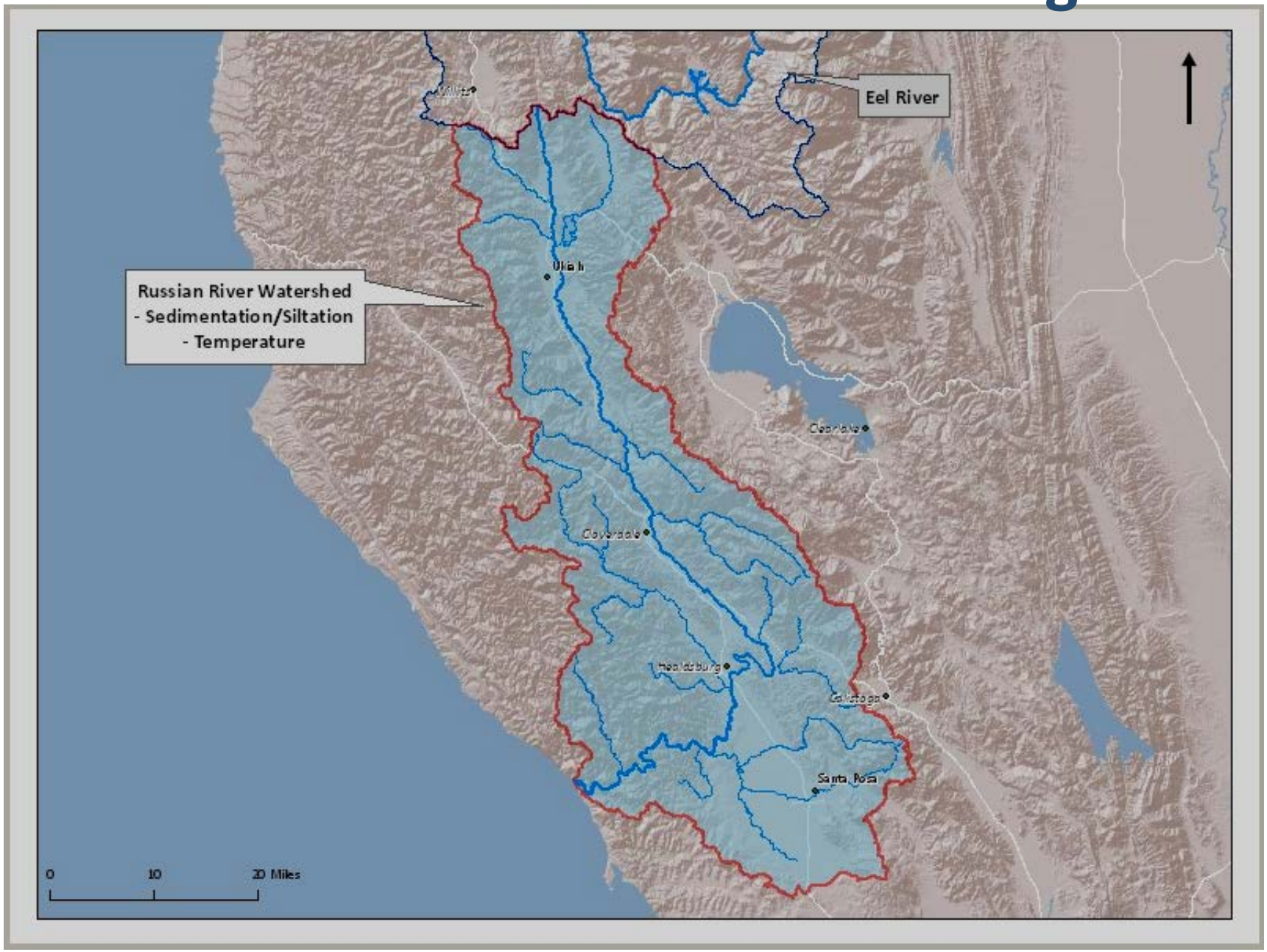
- **June 3, 2009:**
  Regional Water Board Adopted
- **August 4, 2010:**
  State Water Board Hearing
- **USEPA expected to approve soon after State Board adoption**

Water Boards

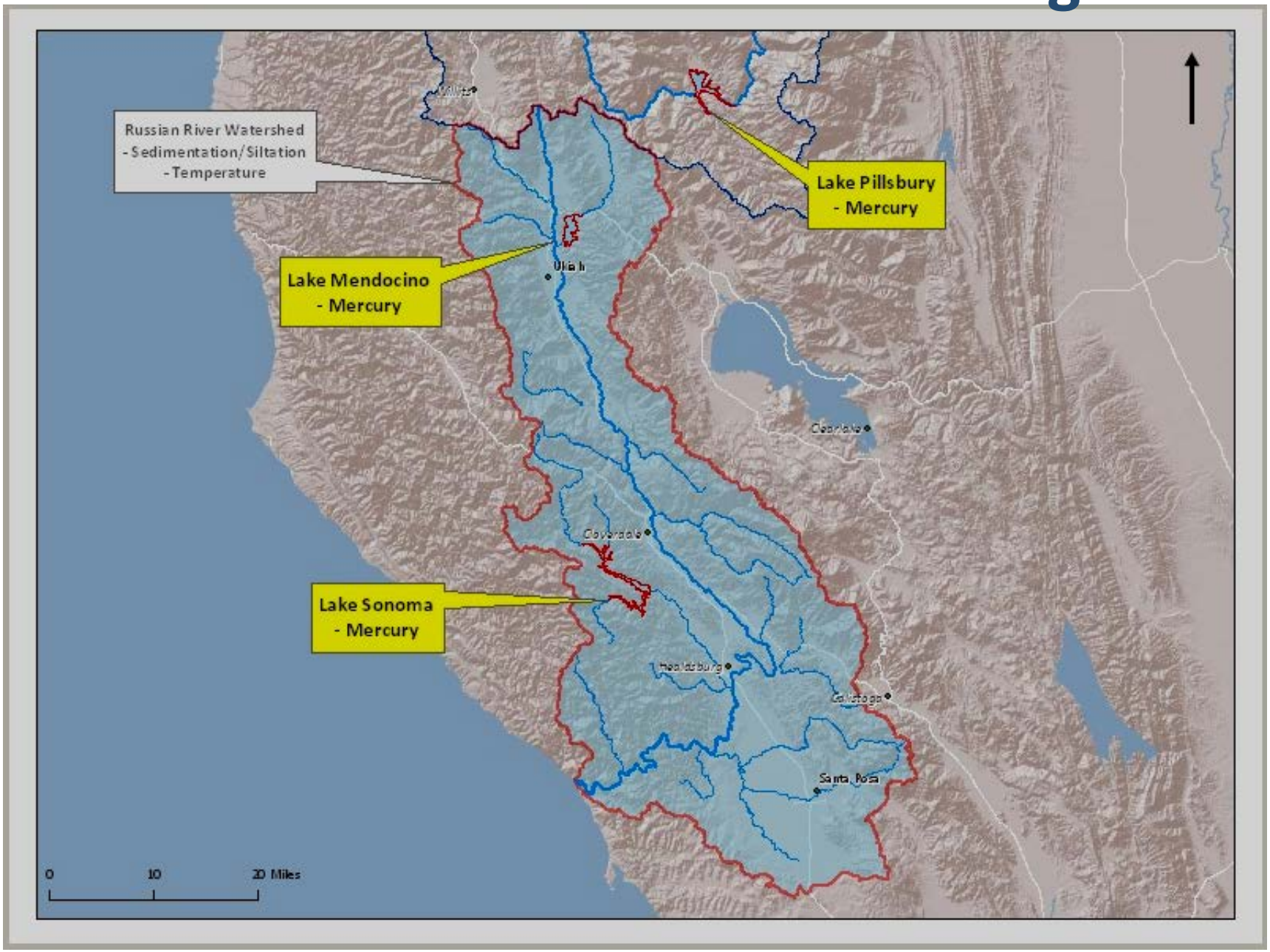
Russian River Watershed Listings

Waterbody Name	Pollutant/Stressor
Russian River Hydrologic Unit	Sedimentation/Siltation Temperature
Laguna de Santa Rosa	Nitrogen and Phosphorus Dissolved Oxygen Mercury Indicator Bacteria
Santa Rosa Creek	Indicator Bacteria
Russian River – Healdsburg Memorial Beach	Indicator Bacteria
Unnamed Tributary to Russian (Stream 1) at Fitch Mtn	Indicator Bacteria
Russian River – Fife Creek to Dutch Bill Creek	Indicator Bacteria
Green Valley Creek Watershed	Indicator Bacteria Dissolved Oxygen
Lake Mendocino	Mercury
Lake Sonoma	Mercury
Lake Pillsbury	Mercury
Big Sulphur Creek Hydrologic Sub-Area	Specific Conductivity

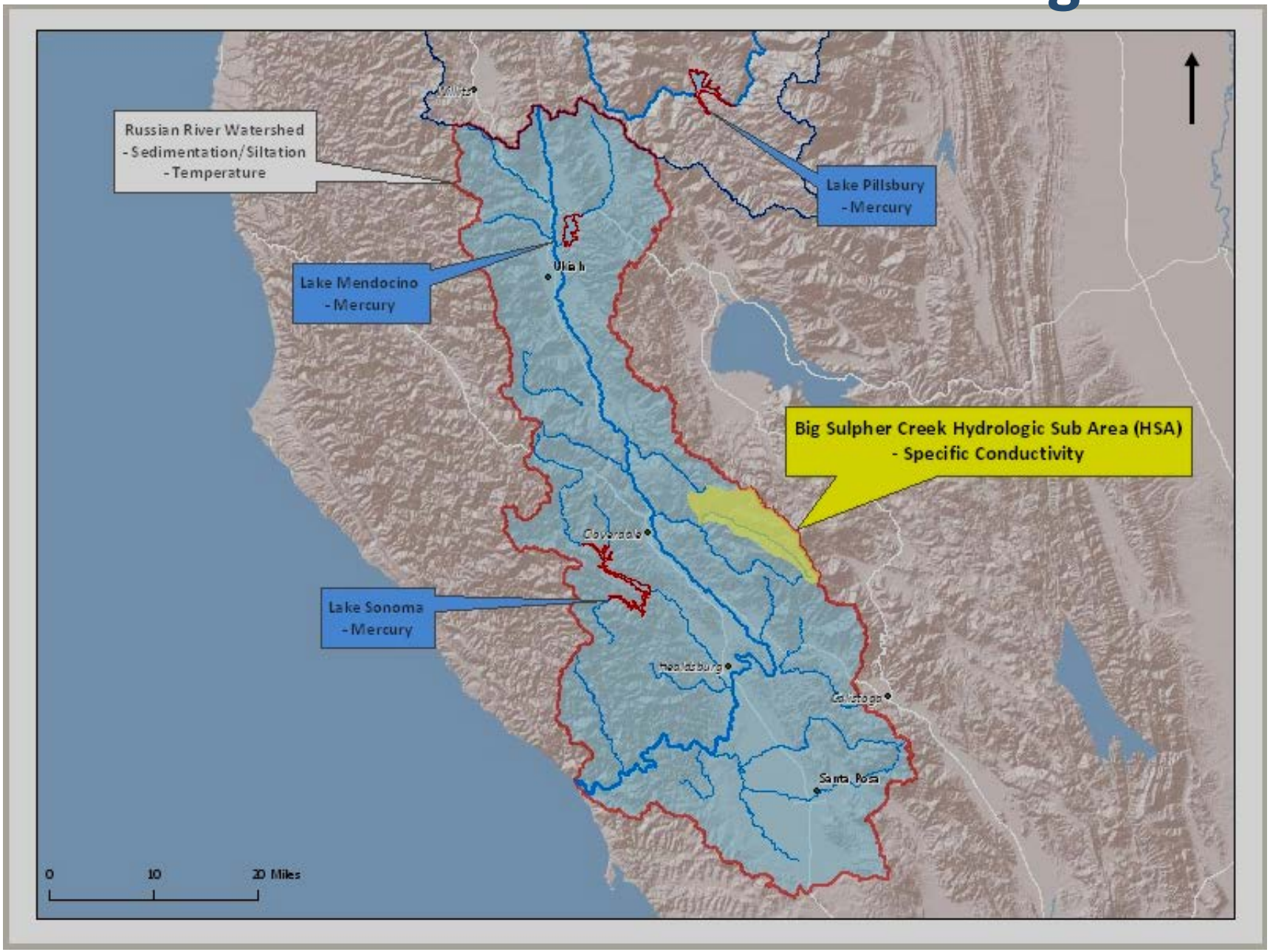
Russian River Watershed Listings



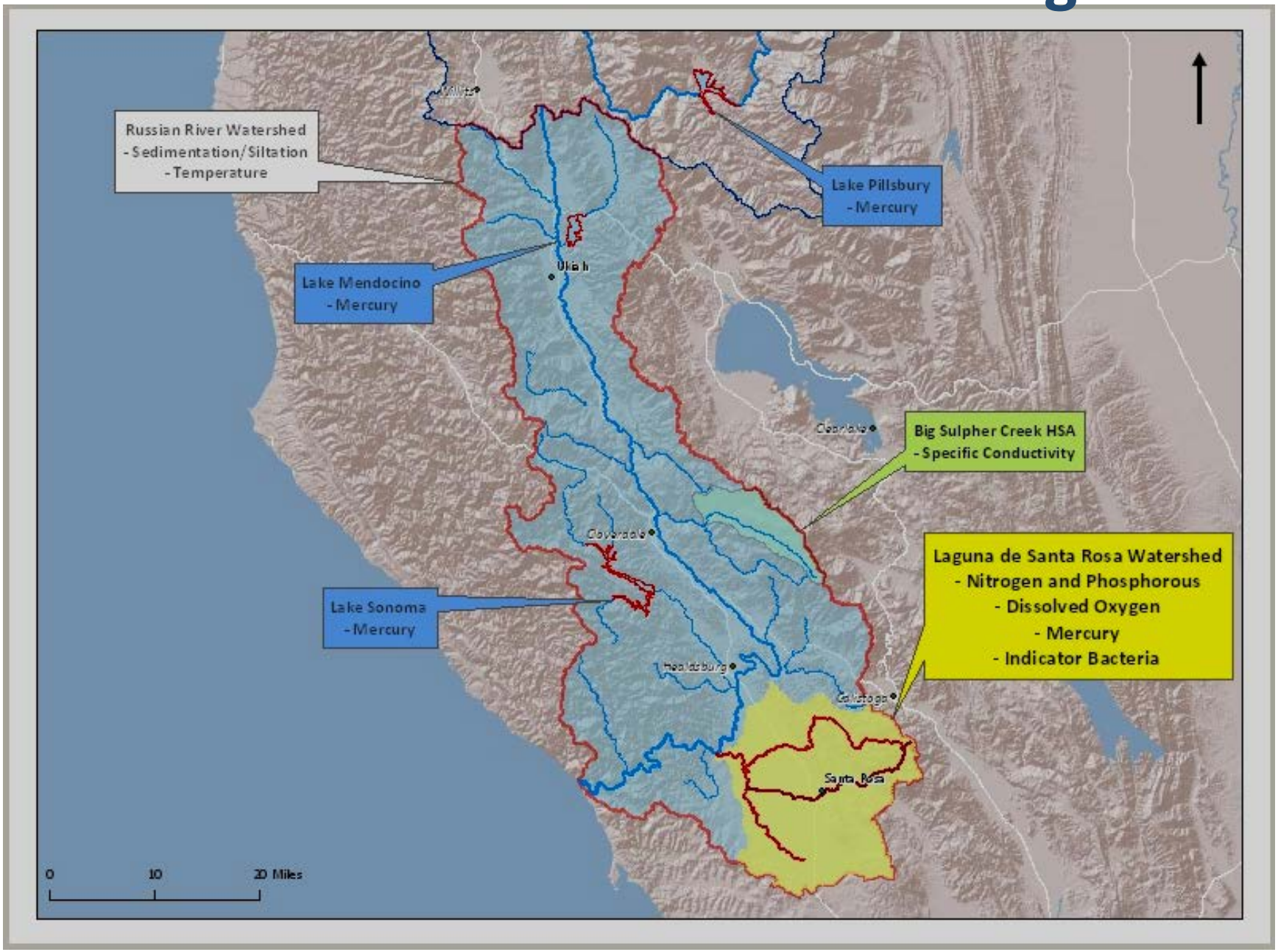
Russian River Watershed Listings



Russian River Watershed Listings



Russian River Watershed Listings



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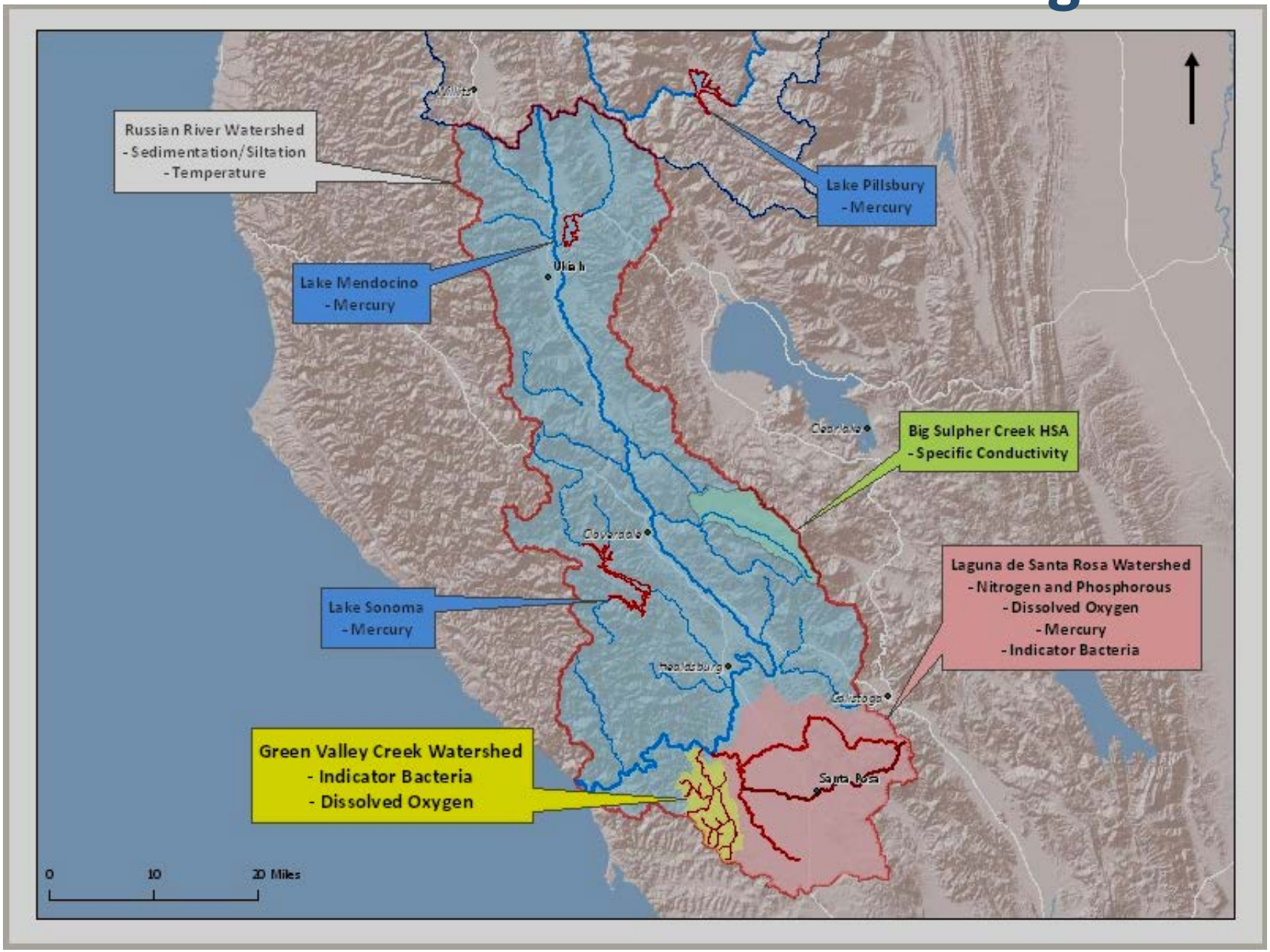
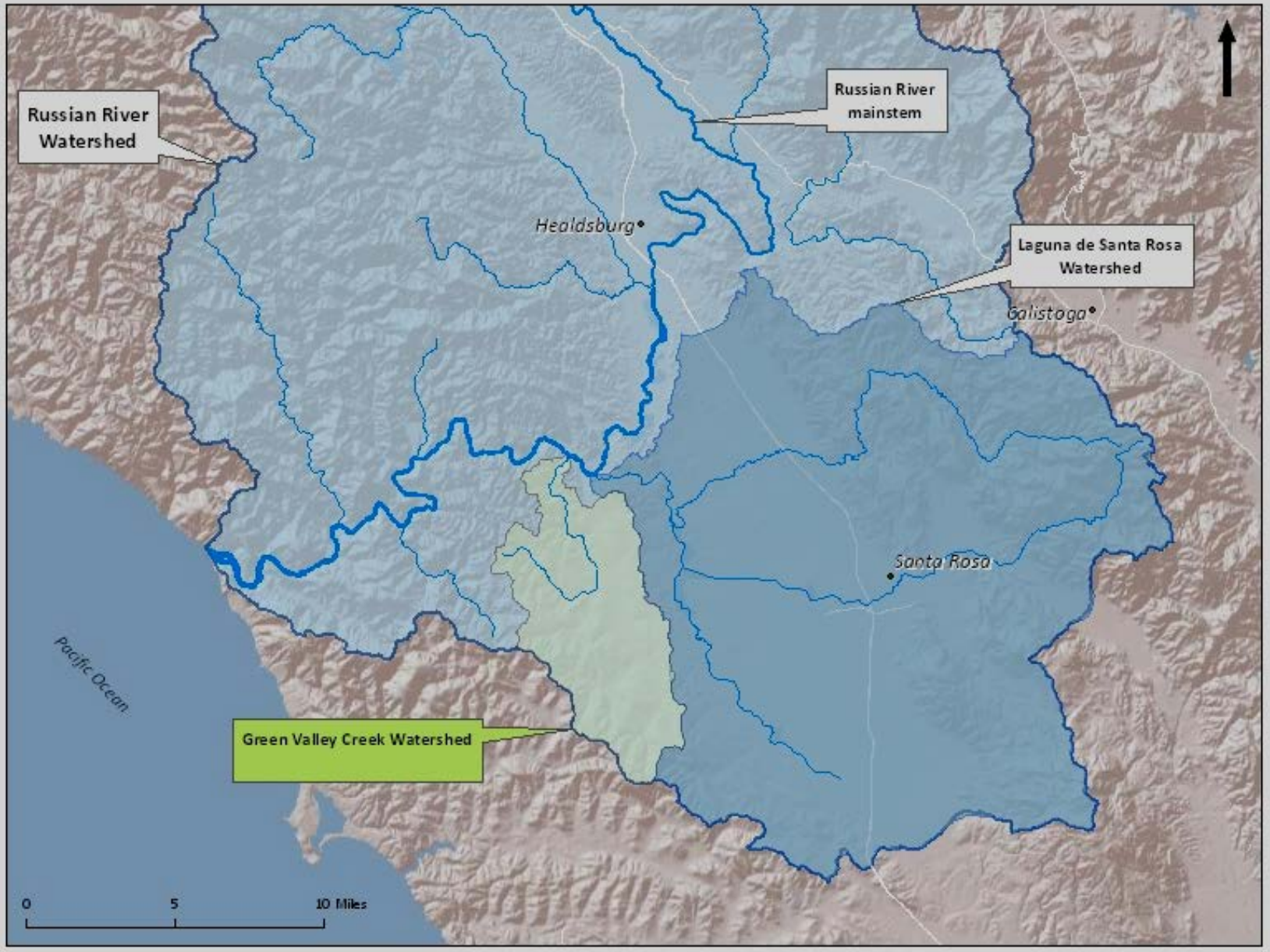


Russian River Indicator Bacteria Listings



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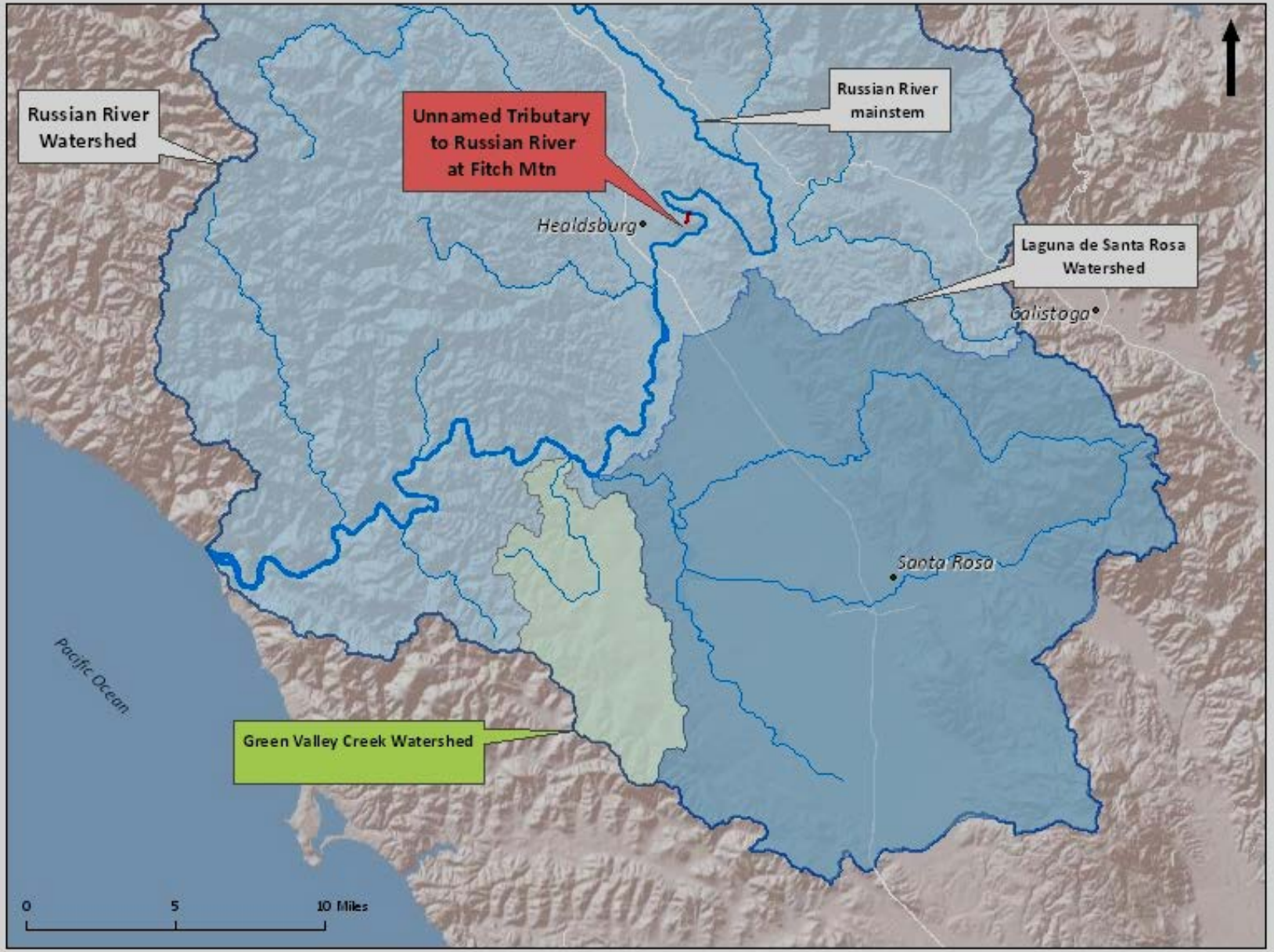
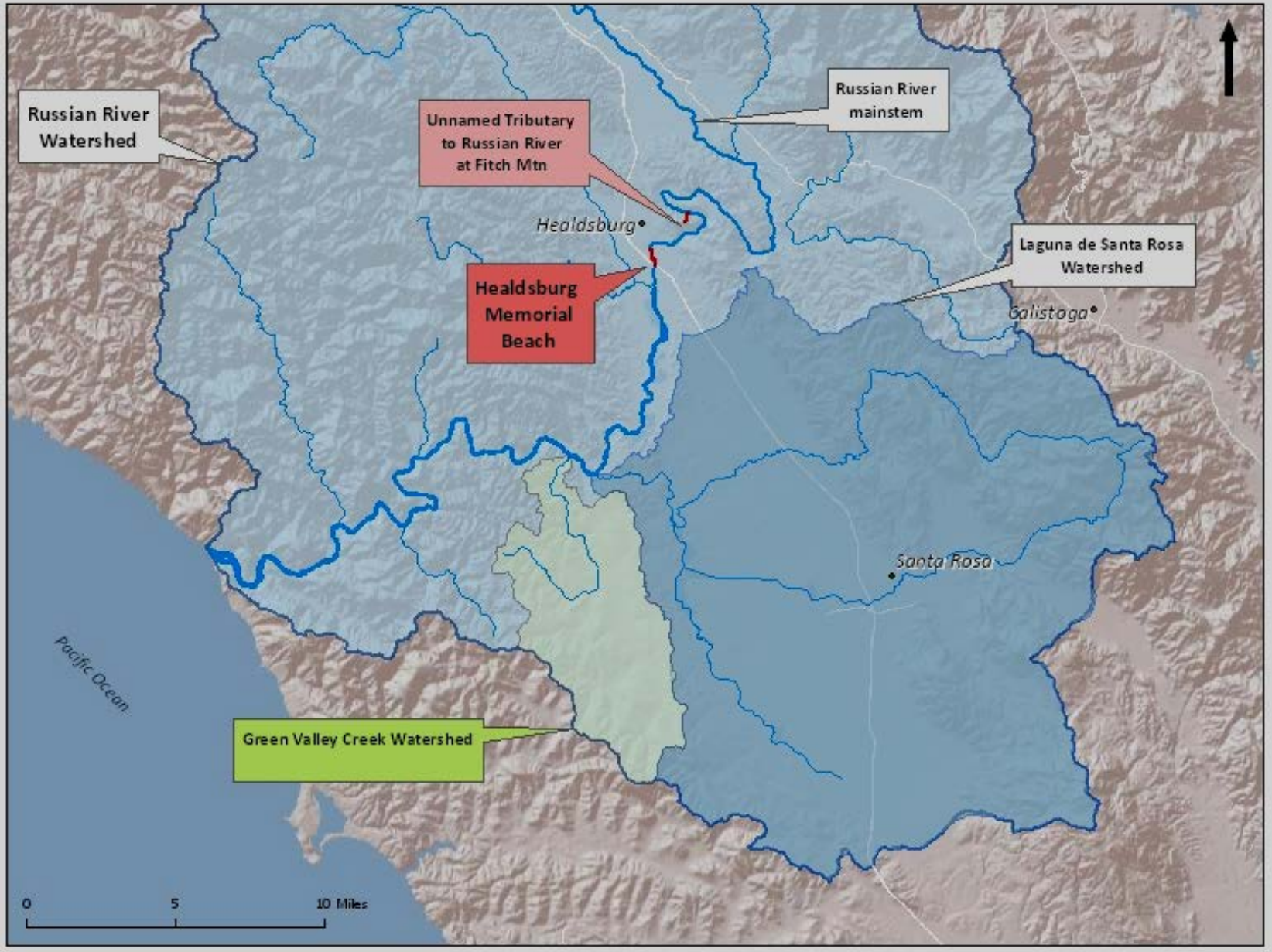
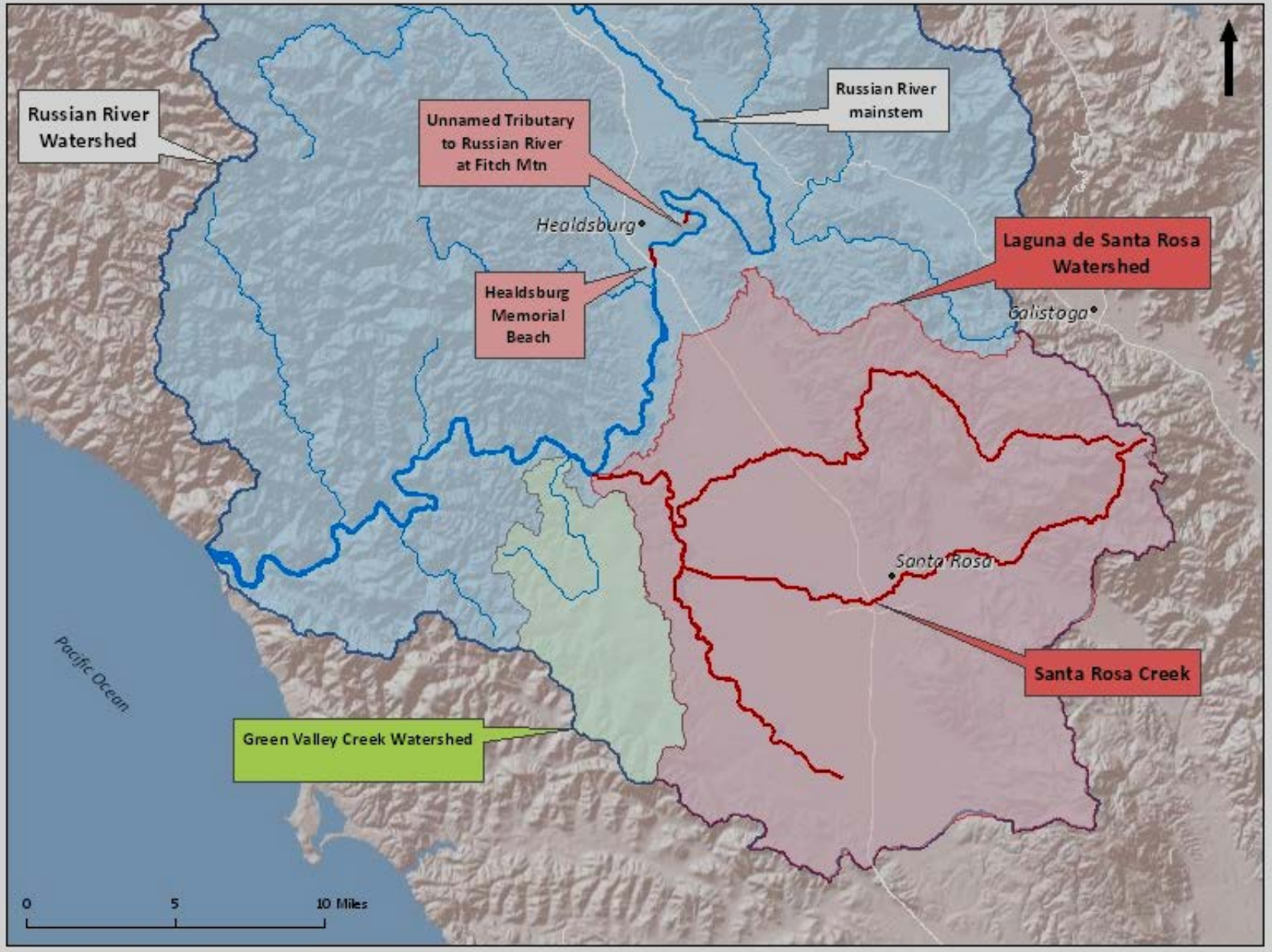


Russian River Indicator Bacteria Listings



Russian River Indicator Bacteria Listings



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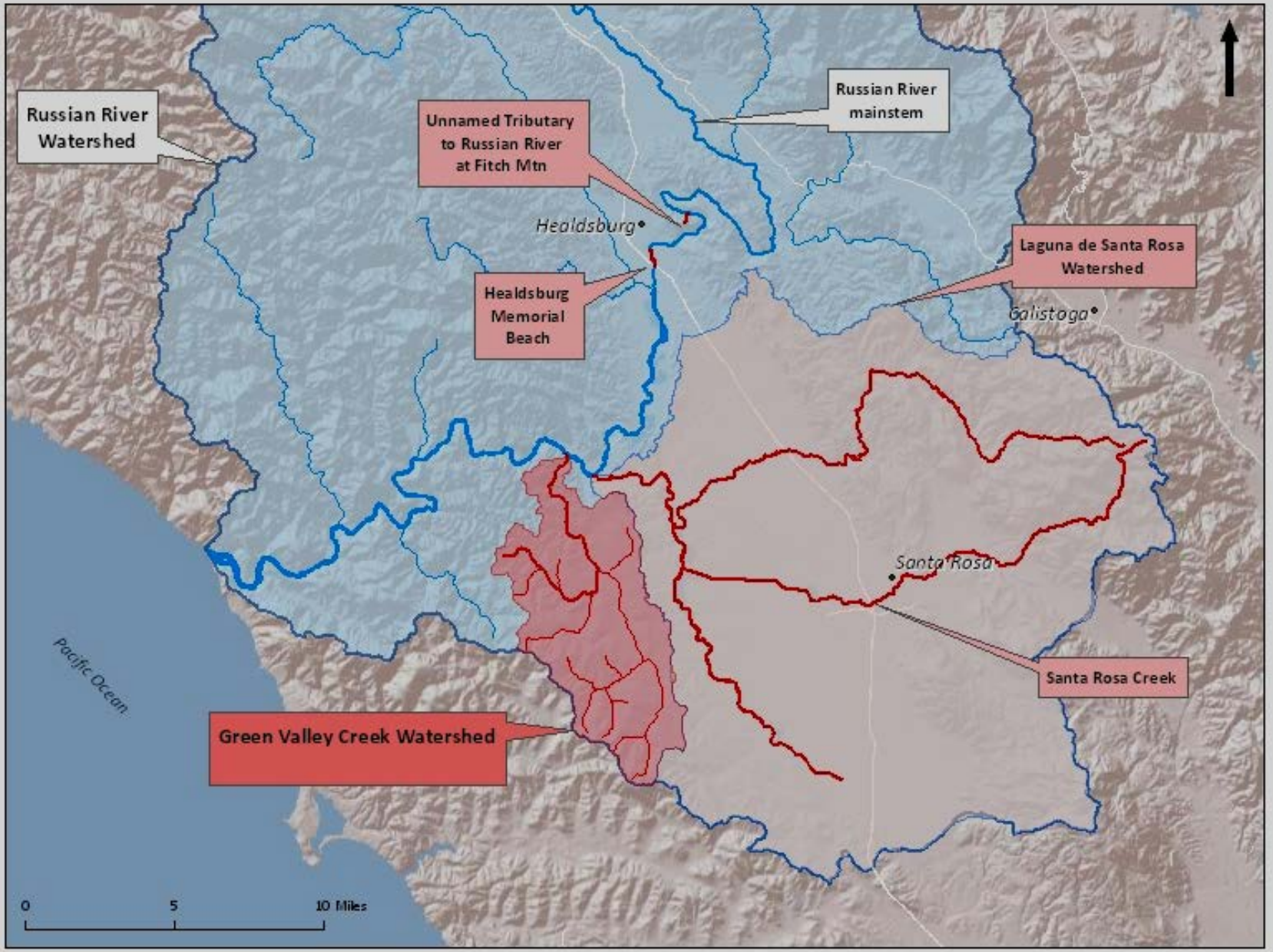
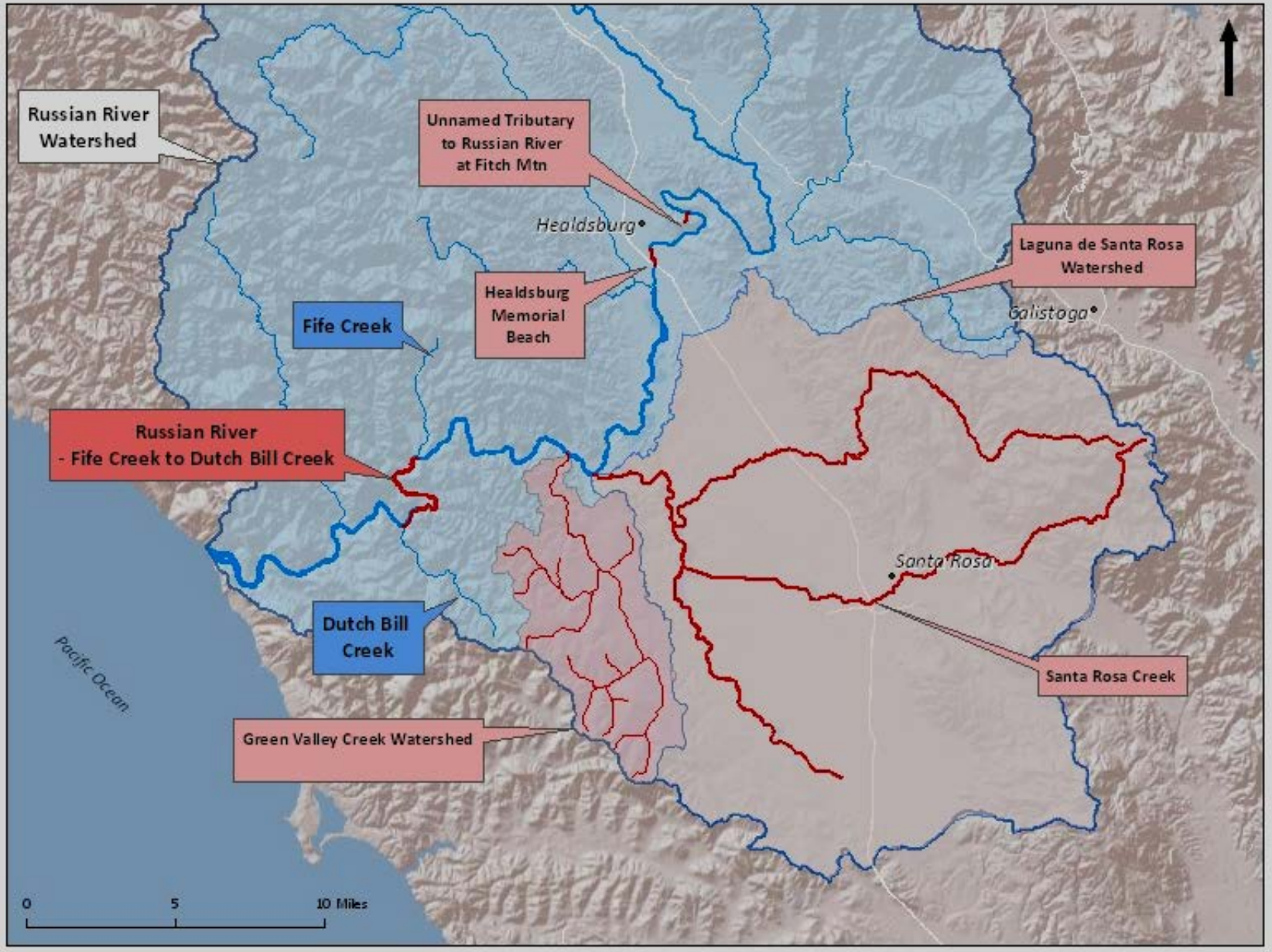


Russian River Indicator Bacteria Listings

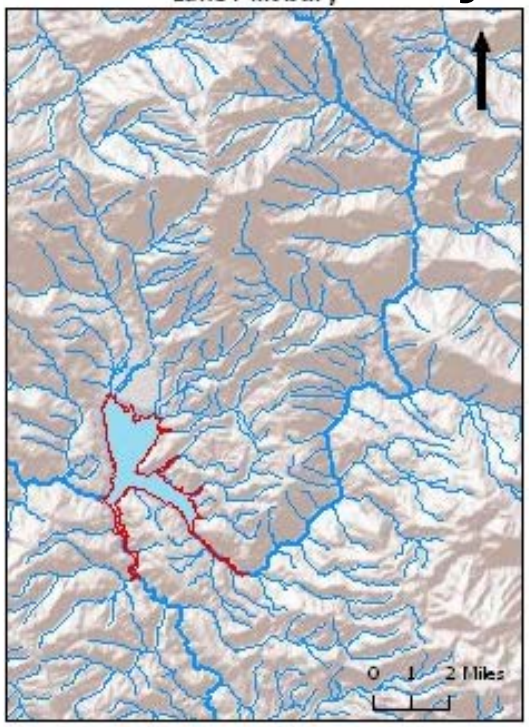


Three Active TMDL Projects

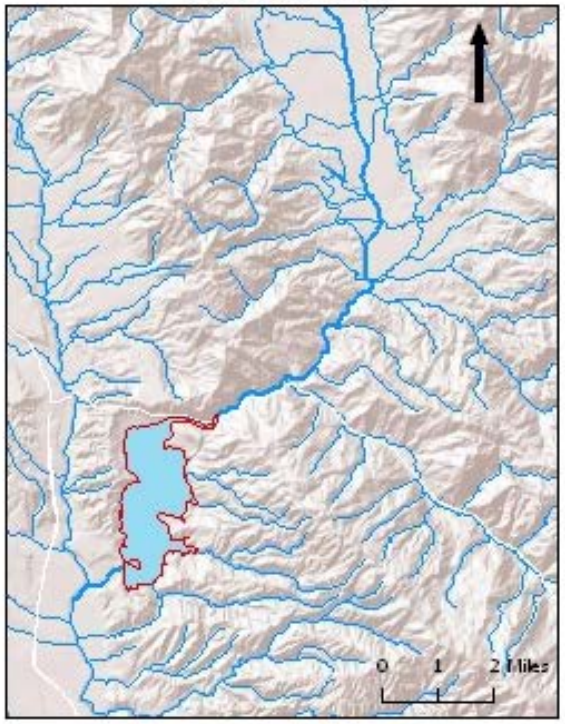
1. Reservoir Mercury TMDLs
2. Laguna de Santa Rosa TMDLs
3. Lower Russian Indicator Bacteria TMDLs

Reservoir Mercury TMDLs

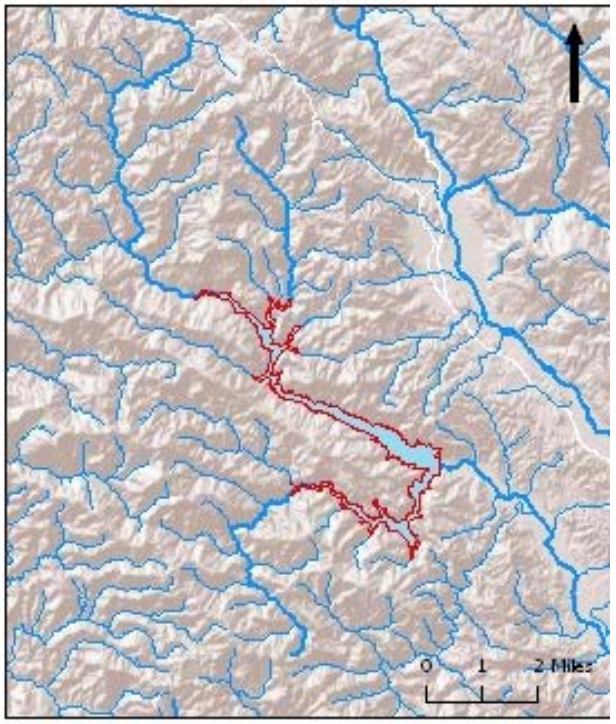
Lake Pillsbury



Lake Mendocino



Lake Sonoma



Lake Pillsbury in Upper Main Eel River HA is included because portions of outflow are diverted to the Russian River.

Water Boards

Reservoir Mercury TMDLs
- Background -

- **Listings based on USEPA standard for mercury in fillet tissue of game fish of legal size**

- **Consistent exceedence of standard**
  - **Health Advisory in effect in Lake Pillsbury**
  - **Draft Health Advisory for Lakes Mendocino & Sonoma**
  - **May 2010 SWAMP study confirms impairment**

Reservoir Mercury TMDLs
- Assessment Approach -

- **TMDL assessment focus on human health and wildlife protection**

- **Approach:**
  - **Evaluate spatial and temporal extent of mercury in reservoirs and their tributaries**
  - **Quantify natural and anthropogenic sources of total and methyl mercury**
  - **Assess linkage of observed conditions to protection of human health and wildlife**

Water Boards

Reservoir Mercury TMDLs Samples Collected 2007-2009

- **Water in reservoirs, inflows, and outflows**
  - **Total-Hg and methyl-Hg**
  - **TSS**
  - **Temperature, Dissolved Oxygen, pH**
- **Fine sediment in streams**
  - **Inflows and upland tributaries**
- **Upland watershed soils**
- **Mercury mine and prospect workings**

Water Boards

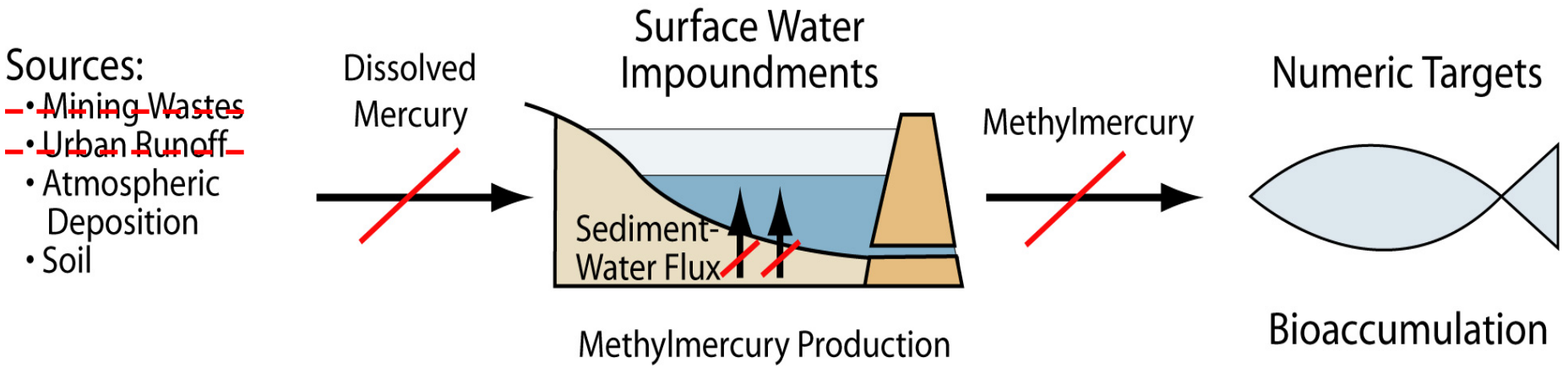
Reservoir Mercury TMDLs
- Preliminary Results -

- No “smoking gun” anthropogenic sources
  - Exceptions = Atmospheric deposition

    Warm Springs Mine in Lake Sonoma
- Mercury is part of the geology of the watersheds
- Reservoir stratification promotes production of toxic form of mercury

Water Boards

Solving the Mercury Problem in Reservoirs



Citation: figure prepared by Tetra Tech

Reservoir Mercury TMDLs
- Next Steps -

- Continue data analyses for source assessment
- Need to conduct linkage analysis to inform implementation measures
- Work with state-wide team to develop multi-waterbody reservoir/lake mercury TMDLs

Laguna de Santa Rosa TMDLs

for Nitrogen, Phosphorus, Dissolved Oxygen, Temperature and Sediment

Topics:

- **Scope**
- **History**
- **Source Analysis Approach**
- **Early Implementation**
- **Stakeholder Involvement**
- **Schedule**

Water Boards

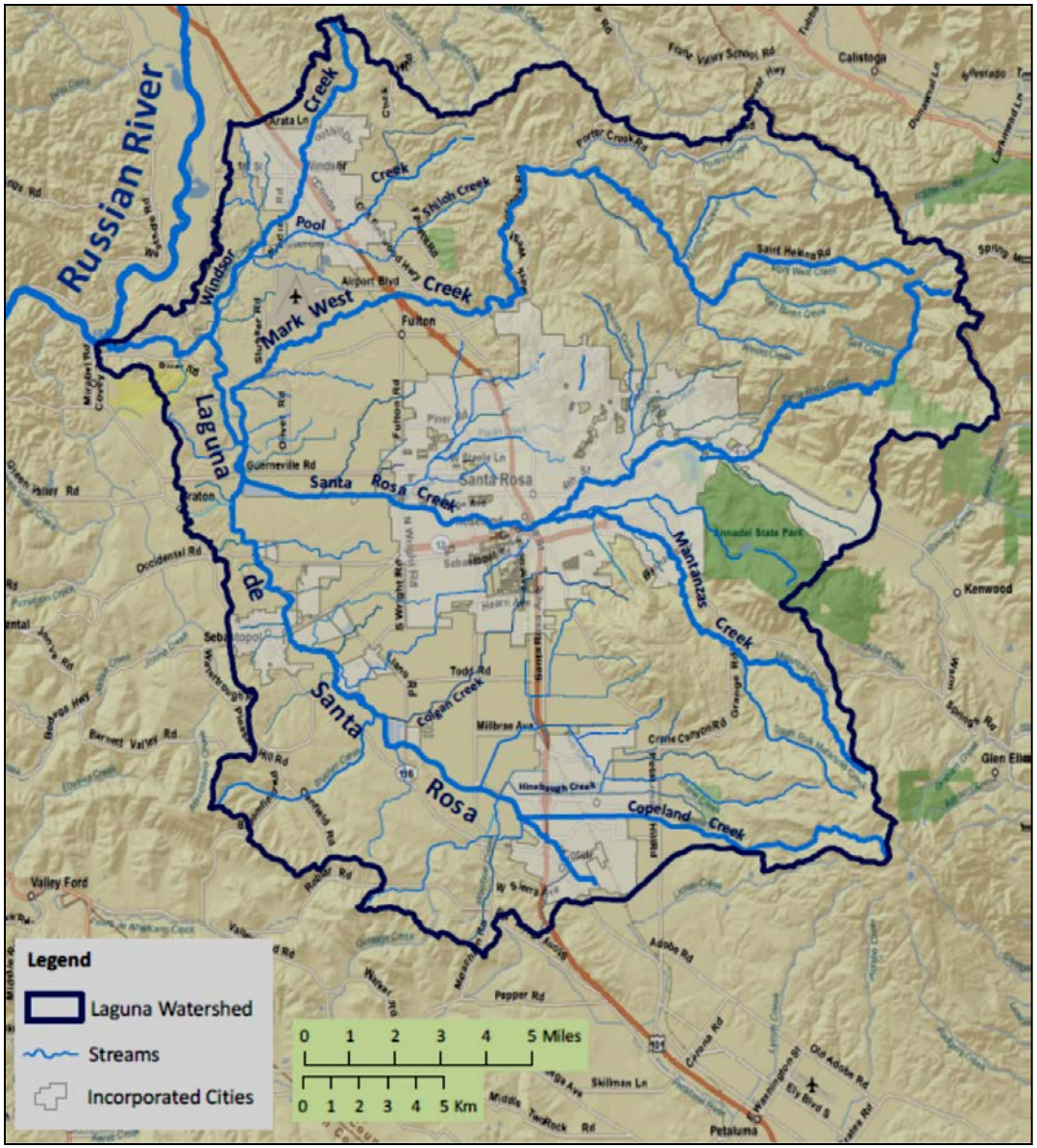
Includes

Waterbodies:

Laguna de Santa Rosa
Windsor Creek
Mark West Creek
Santa Rosa Creek
Blucher Creek
Copeland Creek

Cities:

Windsor
Santa Rosa
Rohnert Park
Cotati
Sebastopol



Listing History

1976: Listed for Nutrients, Dissolved Oxygen, and Coliform

1990: Listed for Ammonia and Dissolved Oxygen

1995: Waste Reduction Strategy (TMDL) Completed

1998: Delisted for Nutrients

1998: Listed for Sediment

2002: Listed for Nitrogen, Phosphorus, Dissolved Oxygen, and Temperature

2006: Listed for Mercury (fish tissue)

2010: Listed for Indicator Bacteria

303(d) Listed Impairments

- **Nitrogen**
- **Phosphorus**
- **Low Dissolved Oxygen**
- **High Temperature**
- **Sediment**

Current TMDL Project

- Mercury
- Pathogens / Indicator Bacteria

Water Boards

Waste Reduction Strategy

- EPA approved in 1995 – Our 1st TMDL
- Focused on Nitrogen
- Set Loads and Load Reductions
  - Total Nitrogen
  - Total Ammonia
  - Interim Loads by 1996
  - Final Loads by 2000
- Implementation
  - Reduce sources from dairies through 319(h) Grants and City of Santa Rosa funding
  - Implement urban storm water program
  - Improve wastewater treatment to reduce nitrogen loads
  - Work with stakeholders

Water Boards

Did the Strategy Work?

- **Yes**
  - Ammonia toxicity levels dropped
  - Improvements at Laguna Wastewater Treatment Plant
  - Improvements in dairy waste disposal
  - Strategy's interim goals attained
  - Delisted for ammonia and dissolved oxygen in 1998
- **But**
  - Dissolved oxygen objectives continued to be violated
  - Nutrients caused algae and aquatic plant growth
- **Therefore**
  - Listed for nitrogen, phosphorus, and dissolved oxygen in 2002

Source Analysis

- **Temperature**
  - **Conduct *Sensitivity Analysis* for representative stream and lake reaches**
- **Sediment**
  - **Watershed Sediment Budget Study for US Army Corp Engineers (PWA,2004)**
- **Nutrients and DO**
  - **Empirical Lines-of-Evidence Approach**

Nutrient Source Analysis

Step 1: Spatial Distribution of Loading

- 2008 nutrient sampling of major tributaries
- Dry weather samples only

Step 2: Specific Land Use Loading

- 2009 nutrient sampling of 7 general land uses
- Dry & wet weather samples

Nutrient Source Analysis

Laguna Specific Land Use Loading Estimates

- Seven (7) land uses assessed based on the 2006 National Land Cover Map

Derived from Several Lines of Evidence:

- Laguna tributary sampling in 2008
- Land use runoff sampling in 2009
- Published scientific literature values
- Estimates derived for the 1995 TMDL & WRS

Nutrient Source Analysis

- **Compare to Historical Loading**
  - Current loading estimates will be compared to European Pre-settlement loading estimates as a point of reference
- **Pre-settlement Land Cover Map was prepared based on:**
  - Historical Maps
  - Public Land Surveyor Notes from 1860s
  - Soil Surveys
  - Previous Historical Mapping by David W. Smith Consulting (1990)

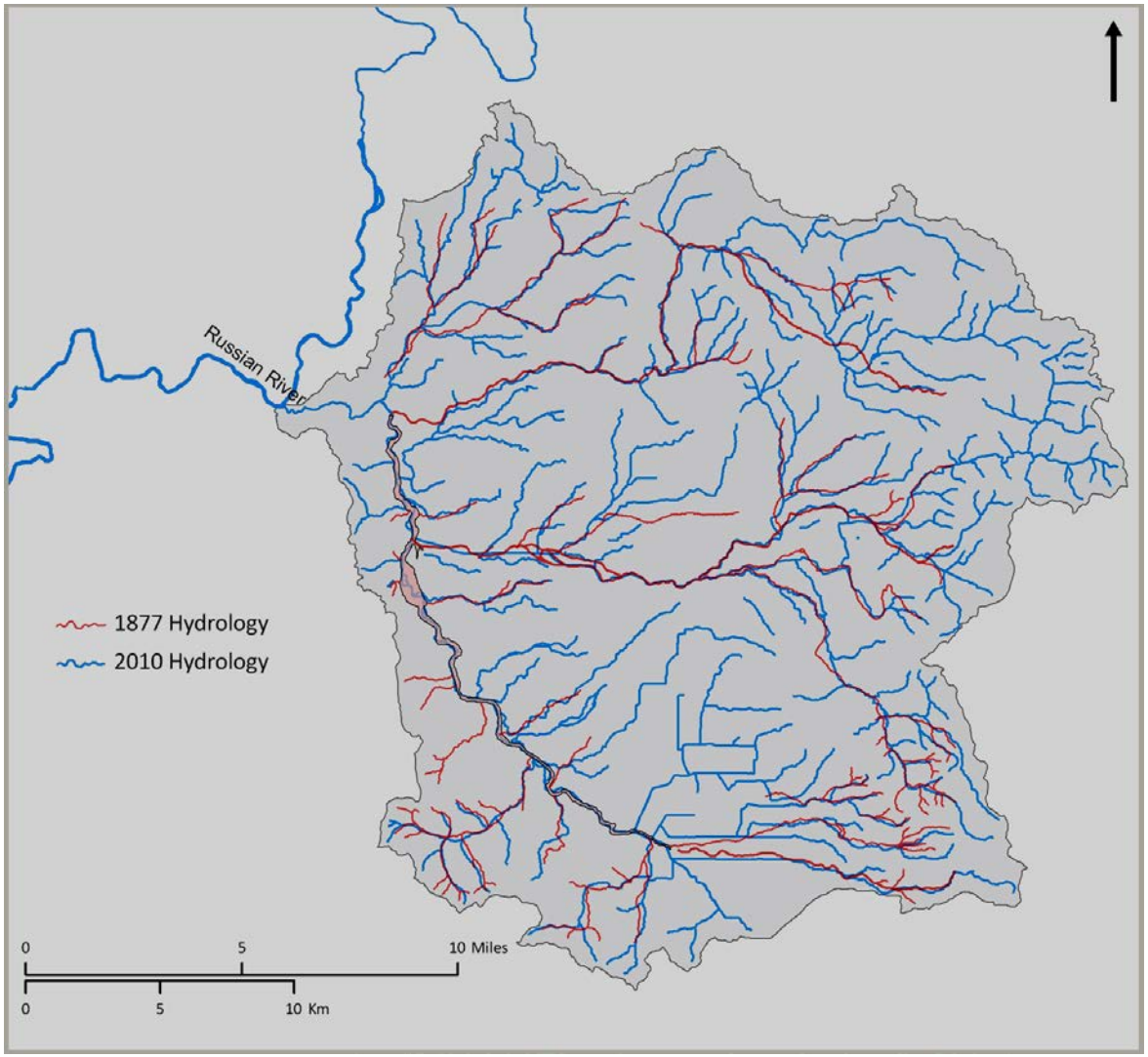
Historical Maps

Historical Atlas of Sonoma County (1877)

Overlaid with Laguna watershed boundary

Water Boards

Historic & Current Hydrology

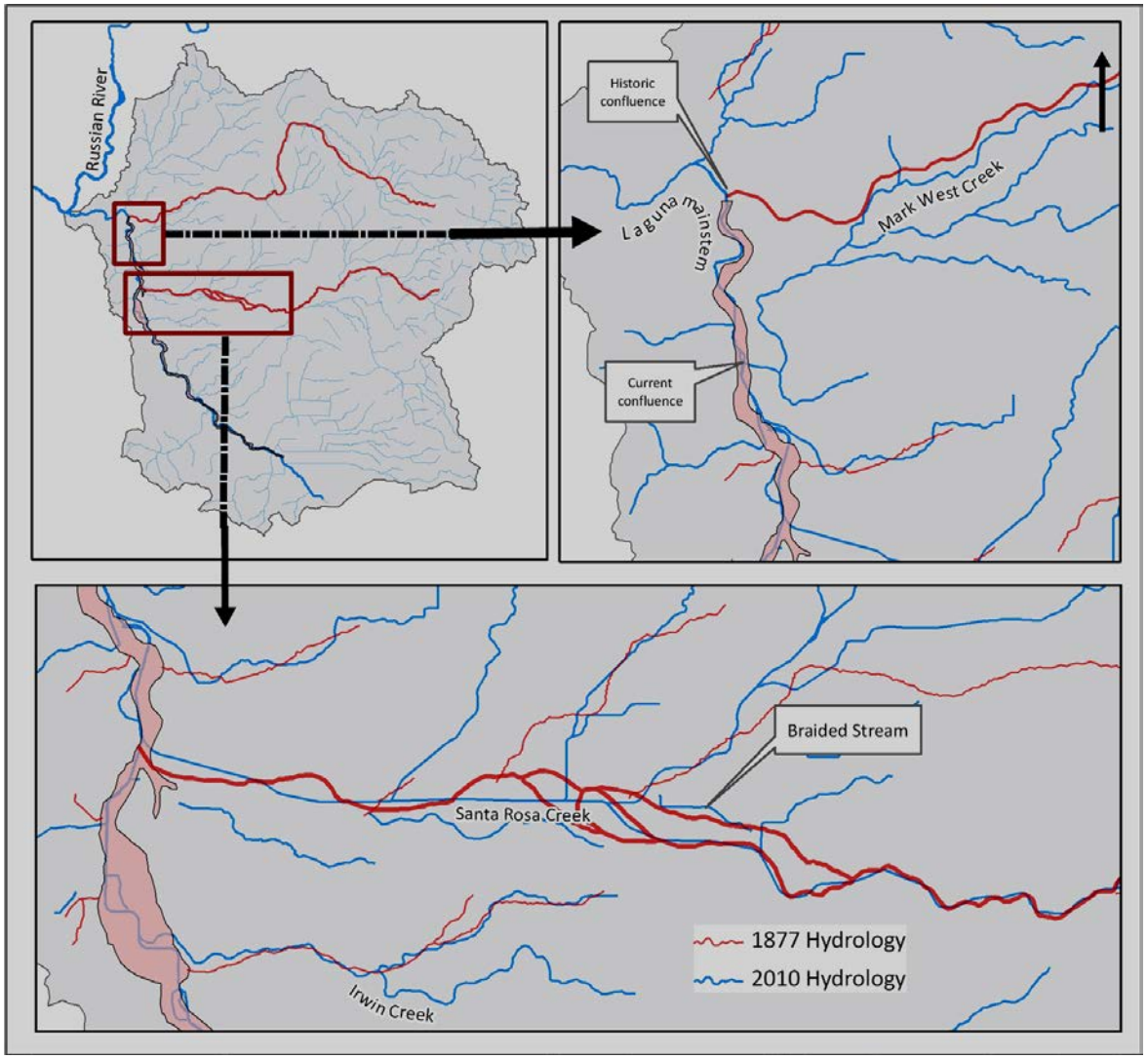


Red Lines = 1877 Streams

Blue Lines = 2010 Streams

Water Boards

Historic & Current Hydrology



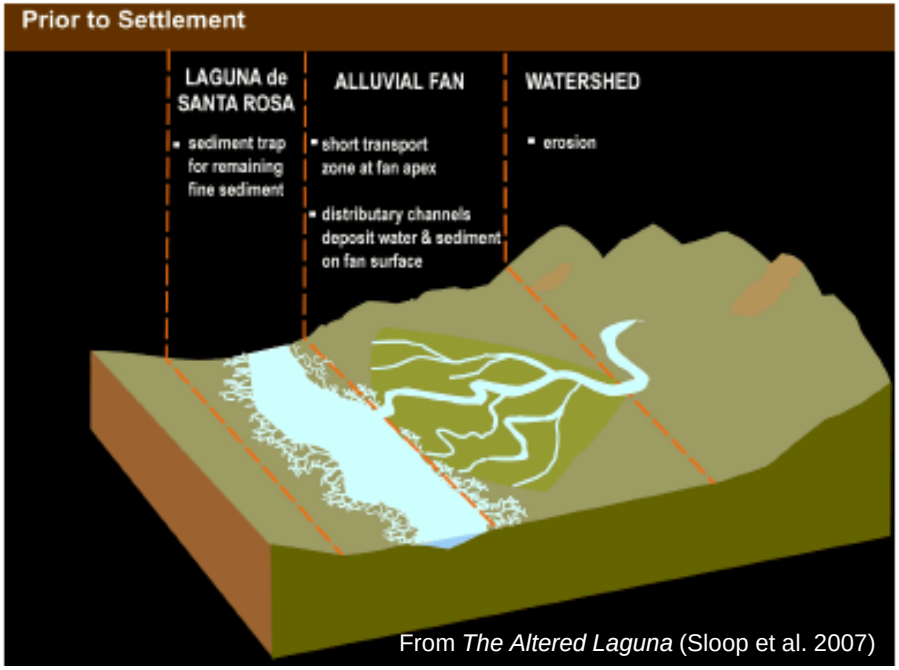
Laguna Watershed Hydrologic Channel Modifications

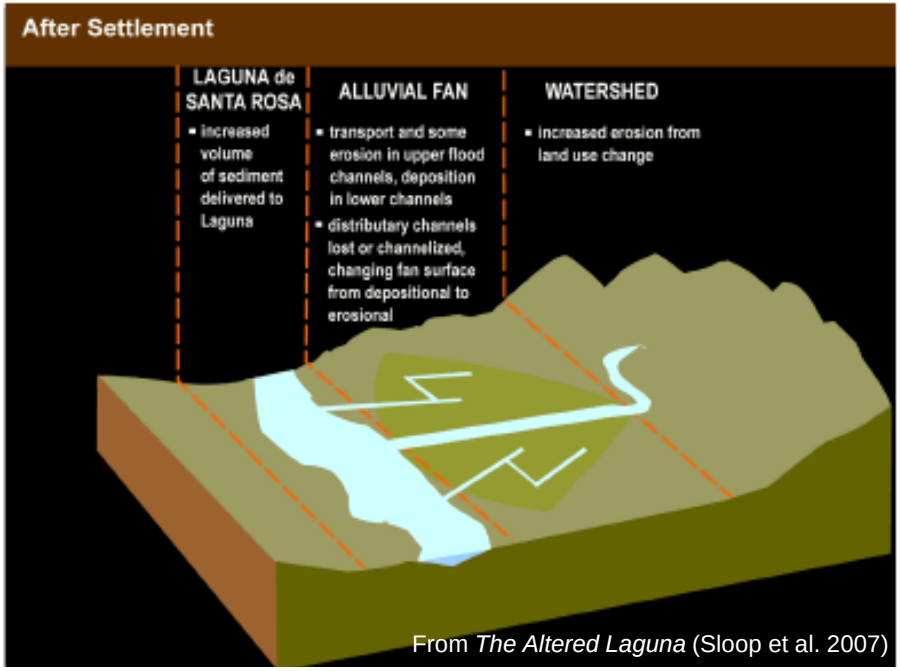
Red Lines = 1877 Streams

Blue Lines = 2010 Streams

Water Boards

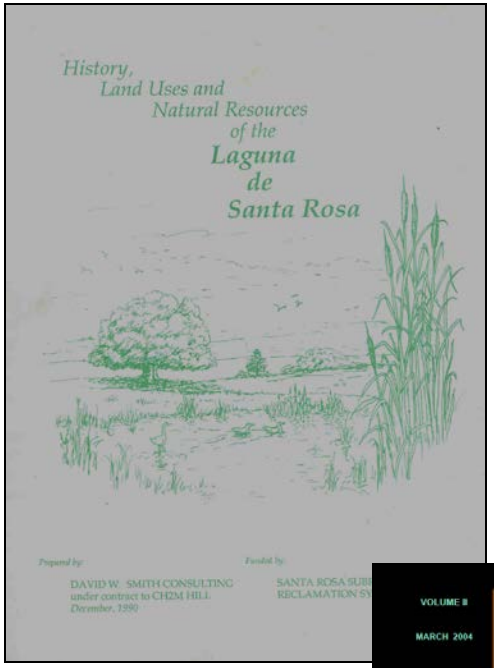
Physical Processes & Changes

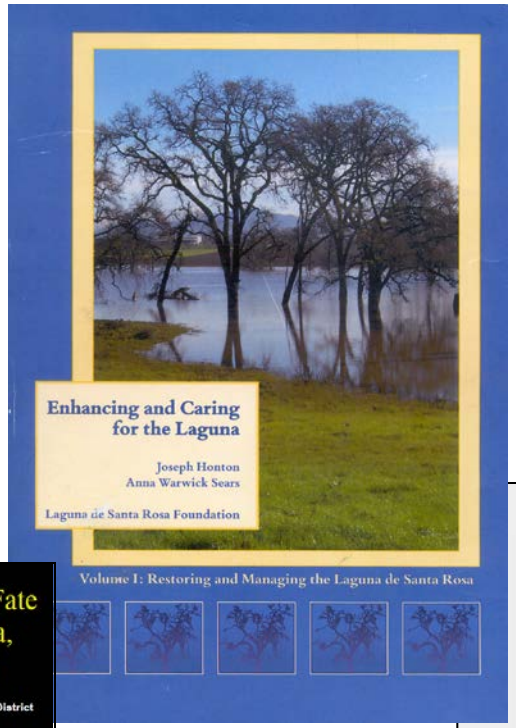


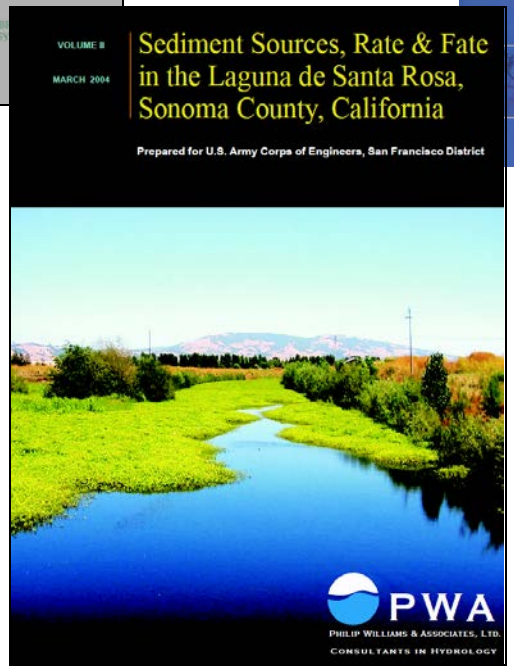


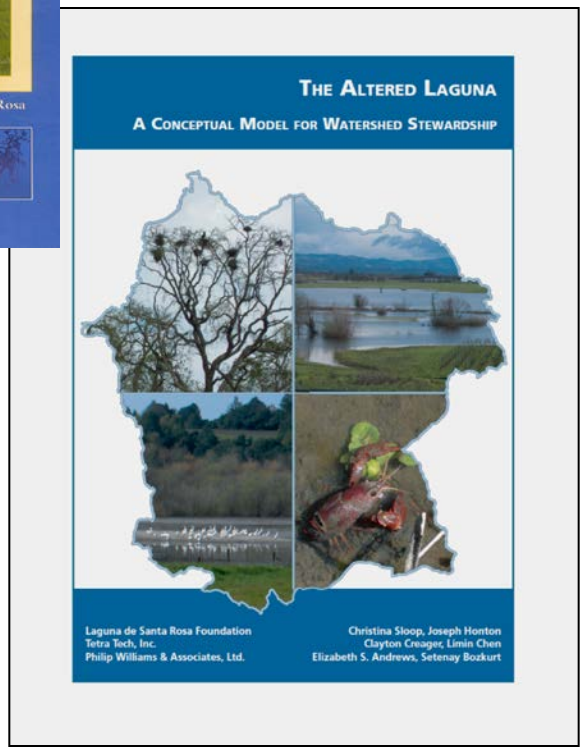
Next Analysis Steps

- **Linkage Analysis**
  - Model representative Lake and Stream reaches (both empirical and mechanistic models)
  - Assess model sensitivity to changes in critical conditions and seasonal variation
- **Numeric Targets**
  - Estimate stream and lake water quality conditions using Pre-settlement land cover nutrient loading

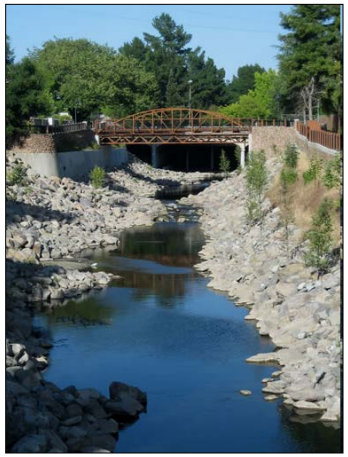

History,
Land Uses and
Natural Resources
of the
Laguna
de
Santa Rosa
DAVID W. SMITH CONSULTING
under contract to CH2M HILL
December, 1990


Enhancing and Caring
for the Laguna
Joseph Honton
Anna Warwick Sears
Laguna de Santa Rosa Foundation
Volume I: Restoring and Managing the Laguna de Santa Rosa


VOLUME II
MARCH 2004
Sediment Sources, Rate & Fate
in the Laguna de Santa Rosa,
Sonoma County, California
Prepared for U.S. Army Corps of Engineers, San Francisco District
PWA
PHILIP WILLIAMS & ASSOCIATES, LTD.
CONSULTANTS IN HYDROLOGY


THE ALTERED LAGUNA
A CONCEPTUAL MODEL FOR WATERSHED STEWARDSHIP
Laguna de Santa Rosa Foundation
Tetra Tech, Inc.
Philip Williams & Associates, Ltd.
Christina Sloop, Joseph Honton
Clayton Creager, Limin Chen
Elizabeth S. Andrews, Setenay Bozkurt

Report Recommendations/Highlights



- Nutrient Load Reduction
- Sediment Reduction
- Historic Hydrology Restoration
  - Stream Channel Reconfiguration
- Wetland Preservation & Restoration
  - Open Water Lakes
  - Wetlands
  - Vernal Pools
- Riparian Preservation & Restoration
- Invasive Plant (Ludwigia) Removal

Water Boards

Early Implementation

- City of Santa Rosa Wastewater Nutrient Offset Program
- Urban Storm Water Program
- Dairy Permitting
- Restoration Activities
  - Laguna Foundation
  - City of Santa Rosa
  - Resource Conservation Districts
  - Others

Water Boards

Stakeholder Involvement

- **Critical for success**
- **Stakeholder Plan**
  - http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/laguna_de_santa_rosa
- **Goals**
  - **Communicate with and inform stakeholders**
  - **Solicit and receiving useful input**
  - **Community support**

Water Boards

Stakeholder Involvement

- Stakeholder Meetings
- Webpage
- Fact Sheets / Newsletters
- E-mail & Mail
- Status Updates to the Board
- Public Review of TMDL documents

Laguna TMDLs Schedule

Ongoing	Stakeholder Involvement
Dec 2010	Technical Analysis (Draft)
2011	Implementation Plan Development
Summer 2011	Peer Review
Nov 2011	Santa Rosa Wastewater Permit Renewal
Summer 2012	Public Review of Draft TMDLs
Fall 2012	Regional Board Hearing
Fall 2013	State Board Hearing
2014	EPA Approval

Water Boards

Russian River Indicator Bacteria TMDLs

Topics:

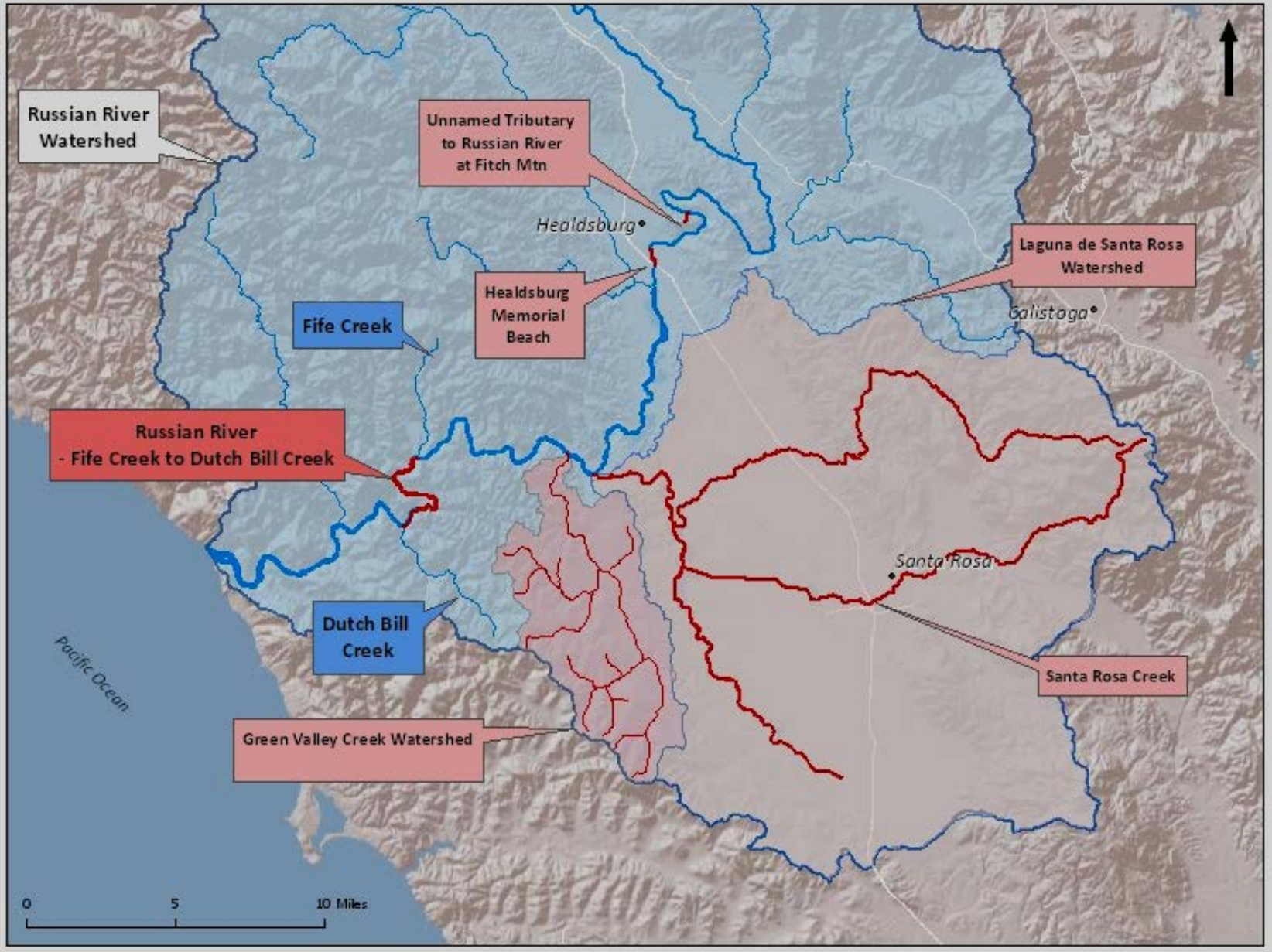
- Beneficial Use Impairments
- UC Davis Pilot Study
- TMDL Monitoring Plan
- Early Implementation
- Schedule

Water Boards

Beneficial Use Impairment

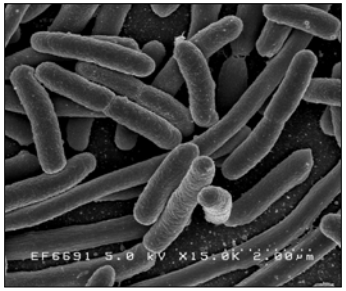
- **Impaired Uses: REC-1, SHELL**
- **2008/2010 Section 303(d) Indicator Bacteria Impaired Waters:**
  - Russian River from Guerneville to Monte Rio
  - Russian River at Healdsburg Memorial Beach
  - Unnamed Stream near Healdsburg
  - Santa Rosa Creek watershed
  - Laguna de Santa Rosa watershed
  - Green Valley Creek watershed

Russian River Indicator Bacteria Listings

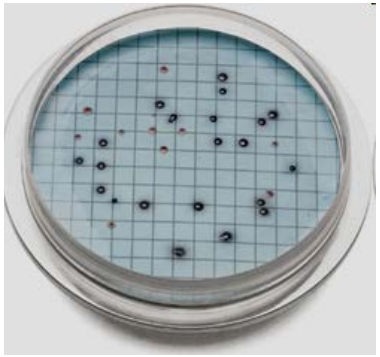


Pathogenic Indicator Bacteria

- **Waterborne Human Pathogenic Microorganisms:**
  - **Bacteria – *V. cholerae, salmonella, shigella***
  - **Protozoa – *giardia, cryptosporidium***
  - **Viruses – *hepatitis A, rotavirus***
  - **Helmiths *(parasitic worms)***
- **Limitations to Direct Measurement of Pathogens**
- **Use of Indicator Organisms as *'Indicators'* of contamination by pathogenic microorganisms**
- **Section 303(d) listings based on these Indicator Bacteria concentrations:**
  - ***Total coliform bacteria***
  - ***Fecal coliform bacteria***
  - ***E. coli***
  - ***Enterococcus***



E. coli



Total & Fecal Coliform

Water Boards

TMDL Pilot Study

- **UC Davis Researchers investigated various Microbial Source Tracking (MST) approaches for application in the Russian River watershed**

- **Developed Monitoring Recommendations for TMDL development:**
  1. **Increase number of locations monitored**
  2. **Increase monitoring frequency during wet periods**
  3. **Evaluate sampling variability**
  4. **Assess land use influence**
  5. **Analyze for *Bacteroides* and stable N & O isotopes**

TMDL Pilot Study

Recommended MST Analyses:

- **Bacteroides Bacteria**
  - Bacteroides bacteria live in intestines of warm-blooded animals
  - Bacteroides are short-lived in ambient water conditions without re-growth
  - Bacteroides genetic markers are specific to the host animal
  - Quantitative polymerase chain reaction (qPCR) with host-specific genetic markers can distinguish between human, cows, canines and bird sources
- **Stable Isotope Analysis (SIA)**
  - Measures the difference between the sources of oxygen and nitrogen used for bacterial nitrification
  - SIA can distinguish between runoff from sewered areas and areas with septic systems and manure

TMDL Monitoring Plan

Management Questions:

1. **Are Basin Plan Water Quality Objectives being met?**
2. **What is the variability of indicator bacteria?**
   - Sampling variability
   - Analytical laboratory variability
   - Spatial variability
   - Temporal variability
3. **What are the most significant sources?**
4. **What are the natural background levels of indicator bacteria?**
5. **Do beach areas pose a higher risk to REC-1 than non-beach reaches?**

Water Boards

TMDL Monitoring Plan

Fecal Indicator Bacteria

- In-house laboratory certification underway for Colilert® and Enterolert® analyses
- Allows sampling for storm events and weekends
- Analysis cost is 30% of contract lab cost
- Sonoma County Health Services analyzing QA samples

Bacteroides

- Sonoma County Health Services analyzing *Bacteroides* samples
- UC Davis Aquatic Ecosystem Analysis Lab under contract for QA and instrument optimization

Stable Isotope Analysis

- UC Davis Stable Isotope Facility under State Lab Contract

New MST Technology

Phylochip®

- Developed by Berkeley National Lab with Homeland Security funding
- Rapid, repeatable, and standardized method
- New commercial lab ready to receive samples
- Results provide a full census of the entire microbial community
- Quantifies over 50,000 different bacteria in a single sample ***including*** all Human pathogens (but not viruses)
- Measured micro-biome communities can be used to identify specific sources of pathogens
- Recent Phylochip applications in ambient water include:
    - Tracking the 2009 sewage spill in Richardson Bay
    - Projects conducted under the Proposition 50 Clean Beaches Initiative
    - 15 international studies

Staff ideas for TMDL Early Implementation Options

- Regulatory Actions
  - Correction of non-compliant septic systems
  - Requirements for dairies
  - Enforcement of requirements for sanitary sewers systems
  - Implementation of Supplemental Environmental Projects (SEPs)
- Public Outreach
  - Signage for public education at recreation areas
  - Portable toilets in “unofficial” recreation areas
  - Coordinate with relevant government agencies and NGOs on homeless encampments
  - Outreach and education on horse waste management
- Outreach to Regulated Community
  - Russian River Watershed Association

Indicator Bacteria TMDL Schedule

Summer 2010 – Fall 2011	Conduct Monitoring
October 2011 – June 2012	Develop TMDLs
2013	Regional Board Hearing

Water Boards

Contact Information

Webpage:

http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/

Mailing List:

http://www.waterboards.ca.gov/resources/email_subscriptions/reg1_subscribe.shtml

Phone:

(707) 576-2220

E-mail:

Matt St. John, TMDL Unit Lead	**mstjohn@waterboards.ca.gov**
Rebecca Fitzgerald, Laguna TMDL Project Manager	**rfitzgerald@waterboards.ca.gov**
Charles Reed, Russian River TMDL Project Manager	**creed@waterboards.ca.gov**
Steve Butkus, Laguna and Russian Technical Specialist	**sbutkus@waterboards.ca.gov**