Item 9

Status Update

Russian River Watershed
TMDL Development Efforts

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

July 15, 2010
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
# Russian River Watershed Listings

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

- Lake Pillsbury - Mercury
- Lake Mendocino - Mercury
- Lake Sonoma - Mercury
Russian River Watershed Listings

- Russian River Watershed
  - Sedimentation/Siltation
  - Temperature

- Lake Mendocino
  - Mercury

- Lake Pillsbury
  - Mercury

- Big Sulpher Creek Hydrologic Sub Area (HSA)
  - Specific Conductivity

- Lake Sonoma
  - Mercury
Russian River Watershed Listings

- Russian River Watershed
  - Sedimentation/Siltation
  - Temperature
- Lake Pillsbury
  - Mercury
- Lake Mendocino
  - Mercury
- Lake Sonoma
  - Mercury
- Big Sulphur Creek HSA
  - Specific Conductivity
- Laguna de Santa Rosa Watershed
  - Nitrogen and Phosphorous
  - Dissolved Oxygen
  - Mercury
  - Indicator Bacteria
- Green Valley Creek Watershed
  - Indicator Bacteria
  - Dissolved Oxygen
Russian River Indicator Bacteria Listings

Russian River Watershed

Unnamed Tributary to Russian River at Fitch Mtn

Healdsburg

Russian River mainstem

Laguna de Santa Rosa Watershed

galistoga*

Green Valley Creek Watershed

Santa Rosa

Pacific Ocean

0  5  10 Miles
Russian River Indicator Bacteria Listings

- Russian River Watershed
- Unnamed Tributary to Russian River at Fitch Mtn
- Russian River mainstem
- Laguna de Santa Rosa Watershed
- Healdsburg
- Healdsburg Memorial Beach
- Santa Rosa
- Santa Rosa Creek
- Green Valley Creek Watershed

0 5 10 Miles
Russian River Indicator Bacteria Listings

Russian River Watershed

Unnamed Tributary to Russian River at Fitch Mtn

Healdsburg

Healdsburg Memorial Beach

Laguna de Santa Rosa Watershed

Green Valley Creek Watershed

Russian River mainstem

Santa Rosa Creek

Santa Rosa

Pacific Ocean
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
Lake Pillsbury in Upper Main Eel River HA is included because portions of outflow are diverted to the Russian River.
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
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
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
Solving the Mercury Problem in Reservoirs

Sources:
- Mining Wastes
- Urban Runoff
- Atmospheric Deposition
- Soil

Dissolved Mercury -> Surface Water Impoundments

Methylmercury Production

Bioaccumulation

Numeric Targets
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
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
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
- Mercury
- Pathogens / Indicator Bacteria

Current TMDL Project
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
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
Historic & Current Hydrology

Red Lines = 1877 Streams
Blue Lines = 2010 Streams
Historic & Current Hydrology

Laguna Watershed Hydrologic Channel Modifications

Red Lines = 1877 Streams
Blue Lines = 2010 Streams
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
<table>
<thead>
<tr>
<th>Report Recommendations/Highlights</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Nutrient Load Reduction</td>
</tr>
<tr>
<td>▪ Sediment Reduction</td>
</tr>
<tr>
<td>▪ Historic Hydrology Restoration</td>
</tr>
<tr>
<td>• Stream Channel Reconfiguration</td>
</tr>
<tr>
<td>▪ Wetland Preservation &amp; Restoration</td>
</tr>
<tr>
<td>• Open Water Lakes</td>
</tr>
<tr>
<td>• Wetlands</td>
</tr>
<tr>
<td>• Vernal Pools</td>
</tr>
<tr>
<td>▪ Riparian Preservation &amp; Restoration</td>
</tr>
<tr>
<td>▪ Invasive Plant (Ludwigia) Removal</td>
</tr>
</tbody>
</table>
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
Stakeholder Involvement

- **Critical for success**

- **Stakeholder Plan**
  - [http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/laguna_de_santa_rosa](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
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
Russian River Indicator Bacteria TMDLs

Topics:

- Beneficial Use Impairments
- UC Davis Pilot Study
- TMDL Monitoring Plan
- Early Implementation
- Schedule
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*
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
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 sewer areas and areas with septic systems and manure
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?
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 \textit{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
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