

Staff Report
for the
Action Plan for Pathogens
in the Russian River Watershed



August 2025
California Regional Water Quality Control Board
North Coast Region



Adopted by the
California Regional Water Quality Control Board
North Coast Region
on August XX, 2025

Approved by the
State Water Resources Control Board
on _____, 202x

and the
Office of Administrative Law
on _____, 202x

and the
United States Environmental Protection Agency
on _____, 202x

**CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
NORTH COAST REGION**

5550 Skylane Boulevard, Suite A; Santa Rosa, California 95403

Phone: (707) 576-2220

[North Coast Regional Water Quality Control Board Home Page](http://www.waterboards.ca.gov/northcoast/)

(<http://www.waterboards.ca.gov/northcoast/>)

Documents are available at:

[Russian River TMDLs Webpage](http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/russian_river)

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

STATE OF CALIFORNIA

GAVIN NEWSOM, Governor

Yana Garcia, Agency Secretary, California Environmental Protection Agency



State Water Resources Control Board

E. Joaquin Esquivel, *Chair*
Dorene D'Adamo, *Vice Chair*
Laurel Firestone
Sean Maguire
Nichole Morgan

Eric Oppenheimer, Executive Director

**California Regional Water Quality Control Board
North Coast Region**

Hector Bedolla, *Chair*
Alexandra Hart, *Vice Chair*
Greg Giusti
Jake Mackenzie
Ryan Sundberg

Valerie Quinto, *Executive Officer*
Joshua Curtis, *Assistant Executive Officer*
Claudia Villacorta, *Assistant Executive Officer*

This report was prepared with assistance from
Matt St. John, Environmental Program Manager and former Executive Officer
Alydda Mangelsdorf, Environmental Program Manager
Charles Reed, Supervising Water Resource Control Engineer
Katharine Carter, Environmental Program Manager
Lisa Bernard, Senior Environmental Scientist
Kelsey Cody, Senior Environmental Scientist

Prachi Kulkarni, *Water Resources Control Engineer*
Mary Bartholomew, *Environmental Scientist*
Lance Le, *Water Resources Control Engineer*
Steve Butkus, *Water Resource Control Engineer*
Jeremiah Puget, *Senior Environmental Scientist*
James Heinz, *Environmental Scientist*
Carrieann Hurtado-Lopez, *Environmental Scientist*
Izaac Russo, *Engineering Geologist*
Alex Liebert, *Scientific Aid*

With counsel from

Nathan Jacobsen, *Staff Counsel*

TABLE OF CONTENTS

Staff Report for the Action Plan for Pathogens in the Russian River Watershed	1
LIST OF ACRONYMS AND SHORTHAND NAMES	xi
Chapter 1	1-1
INTRODUCTION	1-1
1.2 PROJECT HISTORY	1-4
1.3 REGULATORY FRAMEWORK	1-6
Chapter 2	2-1
WATERSHED SETTING	2-1
2.1 LOCATION	2-1
2.2 HYDROLOGY	2-4
2.3 LAND USES	2-6
2.4 RECREATIONAL USES	2-9
2.5 CLIMATE	2-12
2.6 GEOLOGY AND SOILS	2-14
2.7 SUMMARY	2-17
Chapter 3	3-1
BACTERIA STANDARDS AND OTHER INDICATORS OF PATHOGEN POLLUTION	3-1
3.1 WATER QUALITY STANDARDS FOR BACTERIA	3-1
3.2 OTHER INDICATORS OF PATHOGEN POLLUTION	3-8
3.3 SUMMARY	3-16
Chapter 4	4-1
EVIDENCE OF POLLUTION	4-1
4.1 OVERVIEW	4-1
4.2 ASSESSMENT OF <i>E. COLI</i> BACTERIA CONCENTRATIONS	4-9
4.3 ASSESSMENT OF ENTEROCOCCI BACTERIA CONCENTRATIONS	4-17
4.4 ASSESSMENT OF <i>BACTEROIDES</i> BACTERIA CONCENTRATIONS	4-27
4.5 MICROBIOLOGICAL SOURCE IDENTIFICATION	4-33
4.6 ASSESSMENT OF PATHOGENIC SPECIES	4-42

4.7 PUBLIC HEALTH ADVISORIES	4-44
4.8 SUMMARY	4-45
Chapter 5	5-1
NUMERIC TARGETS.....	5-1
5.1 OVERVIEW	5-1
5.2 PROPOSED NUMERIC TARGETS	5-1
5.3 SUMMARY	5-2
Chapter 6	6-1
SOURCE ANALYSIS	6-1
6.1 OVERVIEW	6-1
6.2 SOURCES BY LAND COVER TYPE	6-2
6.3 POINT SOURCE FACILITIES AND ACTIVITIES	6-9
6.4 WASTE DISCHARGES TO LAND	6-35
6.4.7 ONSITE WASTEWATER TREATMENT SYSTEMS	6-48
6.5 NONPOINT SOURCES.....	6-51
6.6 SOURCE ANALYSIS CONCLUSIONS	6-60
Chapter 7	7-1
TMDL CALCULATIONS AND ALLOCATIONS	7-1
7.1 OVERVIEW	7-1
7.2 LOADING CAPACITY, TMDL AND MARGIN OF SAFETY	7-1
7.3 WASTELOAD AND LOAD ALLOCATIONS	7-1
7.4 SEASONAL VARIATION.....	7-3
7.5 REQUIRED REDUCTIONS.....	7-4
7.6 TMDL SCHEDULE	7-4
Chapter 8	8-1
LINKAGE ANALYSIS	8-1
8.1 SOURCES OF FECAL WASTE ON THE LANDSCAPE	8-1
8.2 EVIDENCE OF FECAL WASTE DISCHARGE	8-1
8.3 RISK OF CONTACT WITH FECAL WASTE	8-2

8.4 RISK OF PATHOGEN-RELATED ILLNESS	8-3
8.5 ATTAINMENT OF WATER QUALITY OBJECTIVES	8-4
8.6 CONCLUSION	8-5
Chapter 9	9-1
PROGRAM OF IMPLEMENTATION	9-1
9.1 FECAL WASTE DISCHARGE PROHIBITION	9-1
9.2 IMPLEMENTATION ACTIONS	9-3
Chapter 10	10-1
WATERSHED MONITORING	10-1
10.1 OVERVIEW	10-1
10.2 MONITORING PURPOSE	10-1
10.3 RUSSIAN RIVER REGIONAL MONITORING PROGRAM	10-2
10.4 INDIVIDUAL MONITORING & REPORTING REQUIREMENTS	10-3
10.5 MONITORING RECREATIONAL USE	10-3
10.6 AMBIENT WATER QUALITY MONITORING	10-4
10.7 SPECIAL STUDIES	10-6
10.8 REPORTING AND ASSESSMENT	10-6
Chapter 11	11-1
CEQA SUBSTITUTE ENVIRONMENTAL ANALYSIS	11-1
11.1 SUMMARY OF PROPOSED ACTION PLAN	11-3
11.2 ALTERNATIVES ANALYSIS	11-6
11.3 REASONABLY FORESEEABLE MEANS OF COMPLIANCE	11-8
11.4 ENVIRONMENTAL CHECKLIST	11-11
I. AESTHETICS	11-34
II. AGRICULTURE AND FOREST RESOURCES	11-35
III. AIR QUALITY	11-36
IV. BIOLOGICAL RESOURCES	11-38
V. CULTURAL RESOURCES AND TRIBAL CULTURAL RESOURCES	11-40
VI. GEOLOGY AND SOILS	11-43

VII. GREENHOUSE GAS EMISSIONS	11-44
VIII. HAZARDS AND HAZARDOUS MATERIALS	11-46
IX. HYDROLOGY AND WATER QUALITY	11-47
X. LAND USE PLANNING	11-50
XI. MINERAL RESOURCES	11-50
XII. NOISE	11-50
XIII. POPULATION AND HOUSING	11-52
XIV. PUBLIC SERVICES	11-53
XV. RECREATION	11-54
XVI. TRANSPORTATION/TRAFFIC	11-54
XVII. UTILITIES AND SERVICE SYSTEMS	11-56
XVIII. WILDFIRE	11-57
XIX. MANDATORY FINDINGS OF SIGNIFICANCE	11-58
Chapter 12	12-1
ECONOMIC CONSIDERATIONS	12-1
12.1 OVERVIEW	12-1
12.2 ESTIMATED COST OF COMPLIANCE	12-2
12.3 SOURCES OF FUNDING	12-29
Chapter 13	13-1
ANTIDEGRADATION ANALYSIS	13-1
13.1 OVERVIEW	13-1
13.2 STATE AND FEDERAL ANTIDEGRADATION POLICIES	13-1
13.3 APPLICABILITY TO THE RUSSIAN RIVER WATERSHED PATHOGEN INDICATOR TMDL ACTION PLAN AND WASTE DISCHARGE PROHIBITION	13-2
Chapter 14	14-1
PUBLIC PARTICIPATION SUMMARY	14-1
14.1 STAKEHOLDER AND PUBLIC OUTREACH	14-2
14.2 PRESENTATIONS TO THE NORTH COAST WATER BOARD	14-10
14.3 PRESENTATIONS TO COUNTY SUPERVISORS	14-10

14.4 PEER REVIEW	14-11
14.5 PUBLIC REVIEW DRAFTS	14-11
Chapter 15	15-1
NINE KEY ELEMENTS	15-1
15.1 OVERVIEW	15-1
15.2 SUMMARY	15-4
Chapter 16	16-1
REFERENCES	16-1

LIST OF TABLES

Table 1.1: Summary of Staff Report Revisions Since 2021 Adoption	1-2
Table 1.2: Basin Plan Hydrologic Area and Subareas in the Russian River Watershed	1-9
Table 2.1: Hydrologic Areas and Subareas of the Russian River	2-4
Table 2.2: Land Cover in the Russian River Watershed	2-6
Table 2.3: Population of Cities in the Russian River Watershed	2-9
Table 2.4: Popular Swimming Beaches along the Russian River	2-9
Table 2.5: Average Annual Precipitation	2-12
Table 2.6: Hydrologic Soil Characteristics of the Russian River Watershed	2-15
Table 3.1: Beneficial Uses Designated for Protection in Surface Waters of the Russian River Watershed, Part 1	3-1
Table 3.2: Beneficial Uses Designated for Protection in Surface Waters of the Russian River Watershed, Part 2	3-3
Table 3.3: Beneficial Uses Designated for Protection in Surface Waters of the Russian River Watershed, Part 3	3-5
Table 3.4: Statewide Bacteria Objectives for the Protection of REC-1	3-7
Table 3.5: Pathogenic Bacteria, Protozoan, and Virus of Concern to Water Quality	3-9
Table 4.1: Sample Locations for <i>E. coli</i> , enterococci, and <i>Bacteroides</i>	4-4
Table 4.2: <i>E. coli</i> Bacteria Data – Comparison of Results to STV Water Quality Objectives	4-9
Table 4.3: <i>E. coli</i> Bacteria Data – Comparison of Results to Geometric Mean Water Quality Objectives	4-14
Table 4.4: Enterococci Bacteria Data – Comparison of Results to STV Water Quality Objectives and Criteria	4-18
Table 4.5 Enterococci Bacteria Data – Comparison of Results to Geometric Mean Water Quality Objectives and Criteria	4-24
Table 4.6 Human-specific <i>Bacteroides</i> in the Russian River	4-28
Table 4.7 Bovine-specific <i>Bacteroides</i> in the Russian River	4-32
Table 4.8 Bacteria DNA sequences – Human Fecal Waste	4-35
Table 4.9: Bacteria DNA sequences – Grazer Fecal Waste	4-38
Table 4.10 Bacteria DNA sequences – Bird Fecal Waste	4-40
Table 4.11 Potential Human Pathogens Detected in the Russian River Watershed	4-43

Table 4.12 Cryptosporidium and Giardia Detections in the Russian river near Wohler Bridge .	4-44
Table 4.13: Russian River Beach Advisories Issued by the Sonoma County Department of Health Services from 2013-2018	4-45
Table 4.14: Water Sampling and Public Health Advisories Summary	4-46
Table 5.1: Statewide Bacteria Objectives for the Protection of REC-1	5-1
Table 6.1: Municipal NPDES Wastewater Treatment Facilities in the Russian River Watershed and Percent Compliance with Total Coliform Effluent Limitations	6-15
Table 6.2: Sanitary Sewer Systems in the Russian River Watershed	6-19
Table 6.3: Sanitary Sewer Overflows in the Russian River Watershed from 2007 to July 2017	6-22
Table 6.4: Other NPDES Facilities in the Russian River Watershed	6-26
Table 6.5 Permitted Storm Water Facilities in the Russian River Watershed	6-28
Table 6.6: Municipal WDR Wastewater Treatment Facilities in the Russian River	6-37
Table 6.7: Private Domestic WDR Wastewater Treatment Facilities in the Russian River Watershed (with flow greater than 1,500 gallons per day)	6-40
Table 6.8 Private Food Processors Individual WDR Wastewater Treatment Facilities in the Russian River Watershed	6-43
Table 6.9: Unsewered Mobile Home Parks and Campgrounds in the Russian River Watershed .	6-45
Table 6.10: Estimates of Houses, Population & Acres of Sewered and Non-Sewered Areas in the Russian River Watershed	6-48
Table 6.11: Popular Swimming Beaches along the Russian River	6-51
Table 6.12: Inventory of Livestock Animals in Mendocino and Sonoma Counties	6-56
Table 7.1: Source Category Allocations	7-2
Table 11.1: Environmental Checklist	11-12
Table 12.1: Estimated Cost Range for Centralized Wastewater Treatment Compliance Measures Advanced Treatment and Disinfection	12-5
Table 12.2: Estimated Cost Range for Wastewater Treatment Compliance Measures Individual OWTS	12-11
Table 12.3: Estimated Cost Range for Wastewater Treatment Compliance Measures Decentralized OWTS – Cost to Property Owner	12-16
Table 12.4: Estimated Cost Range for Wastewater Treatment Compliance Measures Decentralized OWTS – Cost to Wastewater Utility	12-17
Table 12.5: Estimated Cost for Construction of Public Restroom Facilities	12-22

Table 12.6: Estimated Cost Range for Incremental Costs for Bacteria Control Measures Municipal Separate Storm Sewer Systems (MS4s) Hydrologic Subarea Crosswalk.....	12-24
Table 12.7: Estimated Costs of Reasonably Foreseeable Compliance Measures Associated with Storm Water Control	12-26
Table 12.8 Estimated Cost Range for Incremental Costs for Bacteria Control Measures Owners of Non-dairy Livestock and Farm Animals	12-26
Table 12.9: Summary of Federal Funding Programs	12-35
Table 14.1: Stakeholder and Public Meetings for the Russian River Watershed Pathogen TMDL and Action Plan.....	14-3
Table 14.2: Presentations to County Supervisors	14-10

LIST OF FIGURES

Figure 1.1: Russian River Watershed Hydrologic Areas and Subareas	1-8
Figure 2.1: Russian River Watershed Overview Map	2-2
Figure 2.2: Hydrologic Subareas Of The Russian River Watershed	2-3
Figure 2.3: Land Cover In The Russian River Watershed	2-8
Figure 2.4: Popular Swimming Beaches On The Russian River	2-11
Figure 2.5: Average Annual Precipitation Patterns In The Russian River Watershed	2-13
Figure 2.6: Hydrologic Soil Characteristics Of The Russian River Watershed	2-16
Figure 4.1 Fecal Indicator Bacteria Monitoring Locations	4-8
Figure 4.2 Exceedance of STV Bacteria Objectives for E. Coli	4-13
Figure 4.3: Exceedances of Geometric Mean Bacteria Objectives For E. Coli	4-16
Figure 4.4: Exceedances of STV Bacteria Objectives and Criteria for Enterococcus	4-23
Figure 4.5: Exceedances of Geometric Mean Bacteria Objectives and Criteria for Enterococcus	4-26
Figure 4.6: Median Concentration of Human-Specific Bacteroides	4-30
Figure 4.7: Median Concentration of Bovine-Specific Bacteroides	4-31
Figure 4.8: PhyloChip™ Monitoring Locations in the Russian River Watershed	4-34
Figure 6.1: Monitoring Locations for the Land Cover Study (NCRWQCB 2012, Butkus 2013a, Butkus 2014c)	6-3
Figure 6.2 Data Example: Reading A Box And Whisker Plot	6-5
Figure 6.3: E. Coli Bacteria Concentrations Measured In The Russian River Watershed By Land Cover Category	6-7
Figure 6.4: Enterococci Bacteria Concentrations Measured In The Russian River Watershed By Land Cover Category	6-8
Figure 6.5: Human-Specific Bacteroides Bacteria Concentrations Measured In The Russian River Watershed By Land Cover Category.	6-8
Figure 6.6: Bovine-Specific Bacteroides Bacteria Concentrations Measured In The Russian River Watershed By Land Cover Category.	6-9
Figure 6.7: Municipal NPDES Wastewater Treatment Facilities in The Russian River Watershed	6-12
Figure 6.8: <i>E. Coli</i> Bacteria Concentrations In A Recycled Water Holding Pond At Vintage Greens In Windsor	6-14

Figure 6.9: Municipal WDR Wastewater Treatment Facilities In The Russian River Watershed...	6-36
Figure 6.10: Unsewered Mobile Home Parks And Campgrounds.....	6-47
Figure 6.11: Comparison Of The Distribution Of E. Coli, Enterococci And Bacteroides Bacteria Concentrations By Parcel Densities.....	6-50
Figure 6.12: Popular Swimming Beaches Along The Russian River.....	6-53
Figure 6.13: Counts Of People Recreating At Veterans Memorial Beach In Healdsburg.....	6-54
Figure 6.14: Locations Of The Bovine-Source Bacteroides Results And Dairies In The Middle Russian River Watershed.	6-58
Figure 6.15: Locations Of The Grazer Waste Results And Dairies In The Middle Russian River Watershed	6-59

LIST OF ACRONYMS AND SHORTHAND NAMES

APMP	Advanced Protection Management Plan
Basin Plan	Water Quality Control Plan for the North Coast Region
BLRP	Bacteria Load Reduction Plan
BMP	Best Management Practice
BAV	Beach Action Value
CAFO	Confined Animal Feeding Operation
Caltrans	California Department of Transportation
CDFW	California Department of Fish and Wildlife
CDHCD	California Department of Housing and Community Development
CDPH	California Department of Public Health
CEDEN	California Environmental Data Exchange Network
CEQA	California Environmental Quality Act
CIWQS	California Integrated Water Quality System
cfu	colony forming units
CSD	Community Service District
CWA	Clean Water Act
CWC	California Water Code
DNA	Deoxyribonucleic acid
EIR	Environmental Impact Report
EL	Effluent Limitation
I/I	inflow and infiltration
Impaired Waters Policy	California Water Quality Control Policy for Addressing Impaired Waters: Regulatory Structure and Options
gpd	gallons per day
LA	Load Allocation
mgd	million gallons per day
MPN	Most Probably Number
MOS	Margin of Safety
MS4	Municipal Separate Storm Sewer Systems

NGI.....	Near Gastrointestinal Illness (includes diarrhea without the requirement of a fever)
NOAA Fisheries	National Oceanic and Atmospheric Administration, National Marine Fisheries Service
NPDES.....	National Pollutant Discharge Elimination System
NPS.....	Non-point Source
NRCS	Natural Resources Conservation Service
OWTS	Onsite Wastewater Treatment Systems
qPCR.....	Quantitative Polymerase Chain Reaction
QA/QC.....	Quality Assurance / Quality Control
REC-1	Water Contact Recreation Beneficial Use
REC-2	Non-Contact Water Recreation Beneficial Use
North Coast Water Board ..	North Coast Regional Water Quality Control Board
RCD	Resource Conservation District
rRNA	Ribosomal Ribonucleic Acid
ROWD.....	Report of Waste Discharge
SSO.....	Sanitary Sewer Overflow
State Water Board.....	State Water Resources Control Board
STV	Statistical Threshold Value or 90 th percentile
TMDL	Total Maximum Daily Load
U.S. EPA	United States Environmental Protection Agency
USFS.....	United States Forest Service
USFWS	United States Fish and Wildlife Service
Waiver	Waiver of Waste Discharge Requirements
WDRs.....	Waste Discharge Requirements
WLA	Wasteload Allocation
WWTP	Wastewater Treatment Plant

CHAPTER 1

INTRODUCTION

The purpose of this revised final *Staff Report for the Action Plan for Pathogens in the Russian River Watershed* 2025 revise (2025 revise or Staff Report) is to present the information and analyses that support a revised *Action Plan for Pathogens in the Russian River Watershed* (Action Plan), which includes both the Russian River Watershed Pathogen Total Maximum Daily Load (Russian River Pathogen TMDL) and a program of implementation, as authorized under state law. Two previous versions of the Action Plan have been adopted by the North Coast Regional Water Quality Control Board (North Coast Water Board); one in 2019 and the second in 2021. Neither the 2019 nor the 2021 Action Plan were considered by the State Water Resources Control Board (State Water Board), the California Office of Administrative Law (OAL), or the United States Environmental Protection Agency (U.S. EPA) and have therefore never been amended into the Water Quality Control Plan for the North Coast Region (Basin Plan).

Development of an action plan to address pathogen pollution within the Russian River Watershed has a long history that pre-dates the 2019 and 2021 adoptions by several years. One element arising from this history is the regulatory framework for onsite waste treatment systems (OWTS) applicable to the Russian River Watershed that differs from the rest of the North Coast Region. This difference in OWTS regulations arose when the Water Quality Control Policy for Siting, Design, Operation, and Maintenance of Onsite Wastewater Treatment Systems (OWTS Policy) was amended into the Basin Plan and came into effect across the region upon approval from OAL on July 14, 2016. At that time, pursuant to language in the OWTS Policy, an exception was made for the Russian River Watershed in anticipation of an action plan that would address pathogen controls at the watershed level. That exception therefore retained the existing regional requirements for the Russian River Watershed in section *4.1.11 Policy On The Control Of Water Quality With Respect To On-Site Waste Treatment And Disposal Practices Specific To The Russian River Watershed, Including The Laguna De Santa Rosa* (section 4.1.11). Section 4.1.11 will remain in effect until such time as an action plan implementing the Russian River Pathogen TMDL is amended into the Basin Plan and takes effect. Among other siting and design requirements in section 4.1.11 that currently apply across the Russian River Watershed are two prohibitions: one against the use of cesspools, and the other against the use of holding tanks for the purposes of managing domestic waste.

The 2025 revise continues to document the presence of fecal waste indicators and associated fecal waste sources that require control across the Russian River Watershed. As with the prior Action Plans, the 2025 Action Plan establishes a watershed-wide fecal waste discharge prohibition that applies to all fecal waste sources. The implementation requirements for each fecal waste source category are for the purpose of eliminating fecal waste discharges and compliance with the prohibition. This

2025 revise, and the Action Plan it supports, maintain identical requirements and implementation strategies for all sources and potential sources of pathogens as the previous 2021 version, with one exception. This exception is to the approach to implementation for OWTS source controls. Prior Action Plans incorporated an advanced protection management program (APMP) wherein special requirements and conditions applied to OWTS. The geographic extent of the 2019/2021 APMP was predicated upon assessment of data according to HUC-12 subwatershed grouping. In contrast, the information and conclusions presented in this 2025 revise applies the data and other assessment results based upon individual stations, land uses, and hydrologic subareas (HSAs) across the Russian River Watershed. The data and assessment presented in this Staff Report conforms to that which was submitted for scientific peer review in 2015. The Action Plan points to the OWTS Policy as the foundation for the geographic scope of an APMP in the Russian River Watershed, consistent with the processes available for defining other APMP scopes across the North Coast Region.

Based upon the information contained in this supporting document, the Action Plan will be proposed to the North Coast Water Board for re-adoption as an amendment to the Basin Plan. The proposed revisions to the 2021 Action Plan are supported by this Staff Report and include revisions to Chapters 1, 2, 3, 4, 6, 8, 9, 10, 11, 12, and 14, and removal of Appendix C, which previously described data analyses in support of an APMP derived from HUC-12 data assessment.

Table 1.1: Summary of Staff Report Revisions Since 2021 Adoption

Chapter Number	Revisions Since 2021 Adoption
Chapter 1 Introduction	Revised descriptions of the project purpose, history, and Staff Report revisions
Chapter 2 Watershed Setting	Removed descriptions and references to HUC-12 subwatersheds
Chapter 3 Bacteria Standards and Other Indicators of Pathogen Pollution	Minor editorial changes to remove reference to HUC-12 subwatersheds, the 2020 Technical Report (Appendix C), and align information with revisions to Chapter 4 Evidence of Pollution
Chapter 4 Evidence of pollution	Removed HUC-12 data analyses results and figures that were replaced with HSA and location specific data analyses results tables and figures. Revised evidence of pollution summary.
Chapter 5 Numeric Targets	No revisions
Chapter 6 Source Analysis	Added Table 6.9, listing mobile homes parks and campgrounds within the scope of the TMDL and Action Plan
Chapter 7	No revisions

Chapter Number	Revisions Since 2021 Adoption
TMDL Calculations and Allocations	
Chapter 8 Linkage Analysis	Removed descriptions and references to HUC-12 subwatersheds, including references to APMP development
Chapter 9 Program of Implementation	Revised section 9.2.7 Individual Onsite Wastewater Treatment Systems
Chapter 10 Watershed Monitoring	Removed descriptions and references to HUC-12 subwatersheds
Chapter 11 CEQA Substitute Environmental Analysis	Revised Foreseeable Alternatives to reflect 2025 proposed Action Plan
Chapter 12 Economic Considerations	Minor modification acknowledging potential impacts of inflation upon implementation costs
Chapter 13 Antidegradation Analysis	No revisions
Chapter 14 Public Participation Summary	Update to reflect public engagement activities since the 2021 hearing
Chapter 15 Nine Key Elements	Minor revision pointing to 2014 technical memorandum that calculates percent reductions needed by land cover type
Chapter 16 References Cited	Added 2014 technical memorandum that calculates percent reductions needed by land cover type
Appendices	Remove Appendix C – 2020 Data Reassessment

The North Coast Water Board is undertaking this action under its authority in the state Porter-Cologne Water Quality Control Act (Wat. Code §13000 et seq.)(Porter Cologne). Under California Water Code section 13242, the North Coast Water Board may establish a program of implementation to address beneficial use protections and/or water quality problems (i.e., pollution, as described in Porter Cologne), including waters identified in the development of the TMDL that are not yet listed on the Clean Water Act Section 303(d) list of impaired waters (303(d) List). Pursuant to California Water Code section 13243, the North Coast Water Board may specify certain conditions or areas where the discharge of waste, or certain types of waste, will not be permitted. Porter Cologne defines the term “pollution” to mean an alteration of the quality of the waters of the state by waste to a degree which unreasonably affects either of the following: (A) The waters for beneficial uses or (B) facilities which serve these beneficial uses. (Wat.Code §13050 (I)(1).) Analysis of the multiple lines of evidence indicate that the water contact recreation (REC-1) beneficial use is not supported in the Russian River Watershed in all locations. The program of implementation described in the Action Plan includes a prohibition against the discharge of fecal waste to the surface waters of the

Russian River Watershed to be implemented through existing and newly proposed waste discharge requirements (WDRs) or waivers of WDRs. Any reference or use of Federal Clean Water Act terms and concepts in the development of this program of implementation does not limit the North Coast Water Board's authority under state law to protect beneficial uses or address the pollution identified. The Action Plan, with support from this Staff Report, includes all of the elements required by U.S. EPA for approval as a TMDL. It also includes the nine key elements of a watershed plan, as required by U.S. EPA to support 319(h) grant solicitations.

The Action Plan will be presented to the North Coast Water Board in a public hearing as a proposed amendment to the Basin Plan. Because the basin planning process is certified as an exempt regulatory program, meeting the requirements of Public Resources Code section 21080.5 (Cal. Code Regs., tit.14, § 15251), the North Coast Water Board is not required to prepare an initial study, a Negative Declaration, or an Environmental Impact Report. Instead, the basin planning process uses substitute environmental documentation (SED). This Staff Report and its attachments fulfill the requirements of an SED.

Should the North Coast Water Board adopt the Action Plan, the State Water Board will hold a hearing and undertake associated public processes to consider approval of the decision. Basin Plan amendments are not effective until they are approved by the State Water Board and the regulatory provisions are approved by OAL.

The U.S. EPA reviews and approves only the technical elements of the TMDL, not the program of implementation.

1.2 PROJECT HISTORY

In January 2015, a *Peer Review Draft Staff Report for the Action Plan for the Russian River Watershed Pathogen Indicator Bacteria Total Maximum Daily Load* (Peer Review Draft Staff Report)¹ was submitted to two external scientific peers to conduct a review of the scientific basis for the Action Plan for the Russian River Pathogen TMDL. The statutory mandate for external scientific review (Health and Safety Code Section 57004) states that it is the reviewer's responsibility to determine whether the scientific work product is "based upon sound scientific knowledge, methods, and practices." The Cal/EPA Scientific Peer Review Program manager identified two external scientific peers who conducted the review:

Patricia A. Holden

¹ [Staff Report Peer Review Draft](http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/russian_river/pdf/150821/150116_StaffReport_PeerReviewDraft.pdf)

(http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/russian_river/pdf/150821/150116_StaffReport_PeerReviewDraft.pdf)

Professor, Bren School of Environmental Science & Management
University of California, Santa Barbara

Nicholas J. Ashbolt
Professor, School of Public Health
University of Alberta, Edmonton

Staff summarized Professors Holden's and Ashbolt's comments and provided written responses in a Response to Peer Review Comments document². The Staff Report was revised to accommodate the scientific peers' recommendations in August 2015 and the revised report was released for public review as the *Draft Staff Report for the Action Plan for the Russian River Watershed Pathogen Indicator Bacteria Total Maximum Daily Load* (2015 Staff Report), which was accompanied by a draft Action Plan (2015 draft Action Plan).

In total, prior to the 2025 revise, the Action Plan and accompanying staff report for this project have undergone four unique iterations made available for public review (2015, 2017, 2019, and 2021). Each revision of the program of implementation (Action Plan) and supporting documentation (Staff Report) have been undertaken in order to be responsive to public comment, to account for changes within the regulatory framework applicable to the pathogen TMDL, such as the 2018 adoption of statewide bacteria objectives, or to document data reassessment and resulting impacts to implementation. A robust description of this history was provided in the 2021 Staff Report in support of the 2021 Action Plan that was adopted by the North Coast Water Board on December 2, 2021, via Resolution No. R1-2021-0055. Persons interested may access the 2021 materials through the 2021 Board meeting agenda posted on the North Coast Water Board website or request a copy of the 2021 Staff Report for review if desired.

In January 2022, North Coast Water Board staff initiated a process for the State Water Board to consider approval of two amendments adopted by the North Coast Water Board for incorporation into the Basin Plan; one which removed the *Policy On The Control Of Water Quality With Respect To On-Site Waste Treatment And Disposal Practices Specific To The Russian River Watershed, Including The Laguna De Santa Rosa*, and the other adding the (2021) Action Plan. During this process and as an outcome of discussions with State Water Board staff, North Coast Water Board staff decided to revise the data assessment and in turn, revise the Action Plan's program of implementation for OWTS. This 2025 revise considers the data collected across the watershed, associated sources and potential sources of fecal waste discharge, affirms

² [Peer Review Response to Comments](http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/russian_river/pdf/150821/150827_Peer_Review_Response_to_Comments_MSJ.pdf)

(http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/russian_river/pdf/150821/150827_Peer_Review_Response_to_Comments_MSJ.pdf)

evidence of watershed-wide fecal pollution, as was considered by the independent peer reviewers. The Action Plan maintains a program of implementation predicated upon compliance with a watershed-wide fecal waste discharge prohibition and provides a method of compliance with that prohibition for each source category identified during source assessment. Changes from the 2021 Action Plan that are being proposed in this Staff Report and the accompanying Action Plan focus upon removal of the HUC-12 data assessment and revisions to the program of implementation for OWTS. No changes are being proposed for other sectors representing potential fecal waste sources across the watershed.

The 2025 revised Action Plan and Staff Report went out for public review and comment on March 24, 2025, followed by a public workshop held on April 1, 2025. The public review and comment period closed on May 8, 2025. This Staff Report includes changes made in response to public comments. A strikeout-underline version of the Action Plan and written response to comments were made available on the North Coast Water Board website.

1.3 REGULATORY FRAMEWORK

Several laws and regulations govern the development and implementation of TMDLs, most notably the federal Clean Water Act (CWA) and the state Porter-Cologne Water Quality Control Act. This section describes the framework and context of these laws and regulations with respect to the Action Plan. Consistent with the Clean Water Act, the Porter-Cologne Water Quality Control Act, and the Water Quality Control Policy for Developing California's Clean Water Act section 303 (d) List (Listing Policy), the term "impaired" as used in this staff report and the TMDL Action Plan refers to waters that do not meet ambient water quality standards³. The Listing Policy describes multiple procedures by which to determine the impairment status of a given waterbody for the specific purpose of listing or delisting a waterbody on the 303(d) list. The 303(d) listing process is a screening tool by which to identify impaired waters for which more thorough TMDL analyses are required. This staff report is presented in support of the TMDL Action Plan. California Water Code section 13050 subdivision (l) defines "pollution" to mean: an alteration of waters of the state by waste to a degree, which unreasonably affects either of the following: (A) the waters for beneficial uses; or (B) facilities which serve these beneficial uses. For this TMDL, studies were designed to assess the degree to which suspected sources of fecal waste discharge were associated with exceedances of water quality standards, including exceedances of objectives and direct impacts to beneficial uses. The TMDL relies on multiple lines of evidence of pollution

³ Under the Clean Water Act, water quality standards are made up of designated uses (i.e., beneficial uses), water quality criteria (i.e., water quality objectives) and the antidegradation policy.

that establish the appropriate boundaries of the TMDL and the program of implementation for all fecal waste sources.

1.3.1 Section 303(d) Listing

Section 303(d) of the CWA requires states to develop a list of waterbodies where required pollution control mechanisms are not sufficient or stringent enough to meet water quality standards applicable to such waters (known as the Clean Water Act Section 303(d) list or 303(d) List). Per state policy the 303(d) List applicable to a given region of the State is updated once every 6 years.

The 2012 update to the 303(d) List included multiple watershed reaches within the Russian River Watershed, which were identified as impaired due to fecal indicator bacteria. These waterbodies included: an unnamed tributary on Fitch Mountain, the mainstem Laguna de Santa Rosa, tributaries to the Laguna de Santa Rosa, the mainstem Santa Rosa Creek, tributaries to Santa Rosa Creek, the mainstem Russian River at Veterans Memorial beach from the Railroad Bridge to Highway 101, the mainstem Russian River from Fife Creek to Dutch Bill Creek, the mainstem Butch Bill Creek, and the Green Valley Creek Watershed.

The 2012 303(d) List relied on fecal coliform data, as well as evidence generated through the TMDL. The 303(d) Listings for fecal indicator bacteria in the Russian River Watershed were scheduled to be updated in 2020, as part of changes for the 2018 303(d) List, using the new statewide bacteria objectives. But, the State Water Board chose to postpone its consideration of the impairment status. An updated 303(d) list of Russian River pathogen impairments is scheduled for 2026 and may be adjusted in 2028 based upon assessment of pathogen data that was not considered during the 2026 cycle. Until the listings for the Russian River Watershed are reconsidered, the 2024 303(d) List (which reflects the listings as made in 2012) stands as the current list of impaired waters.

The Basin Plan delineates all waterbodies, including the Russian River, utilizing Hydrologic Subareas (HSA's) and designates the beneficial uses associated with those HSA's. The 2024 303(d) List of pathogen-impaired waters is based upon HSAs identified in the Basin Plan. For the purposes of this TMDL, water quality data were collected and evaluated to support a land cover model, an OWTS study, a Recreation Study and, to determine evidence of pollution. The HSAs located within the Russian River Watershed are listed in Table 1.2 and illustrated in Figure 1.1.

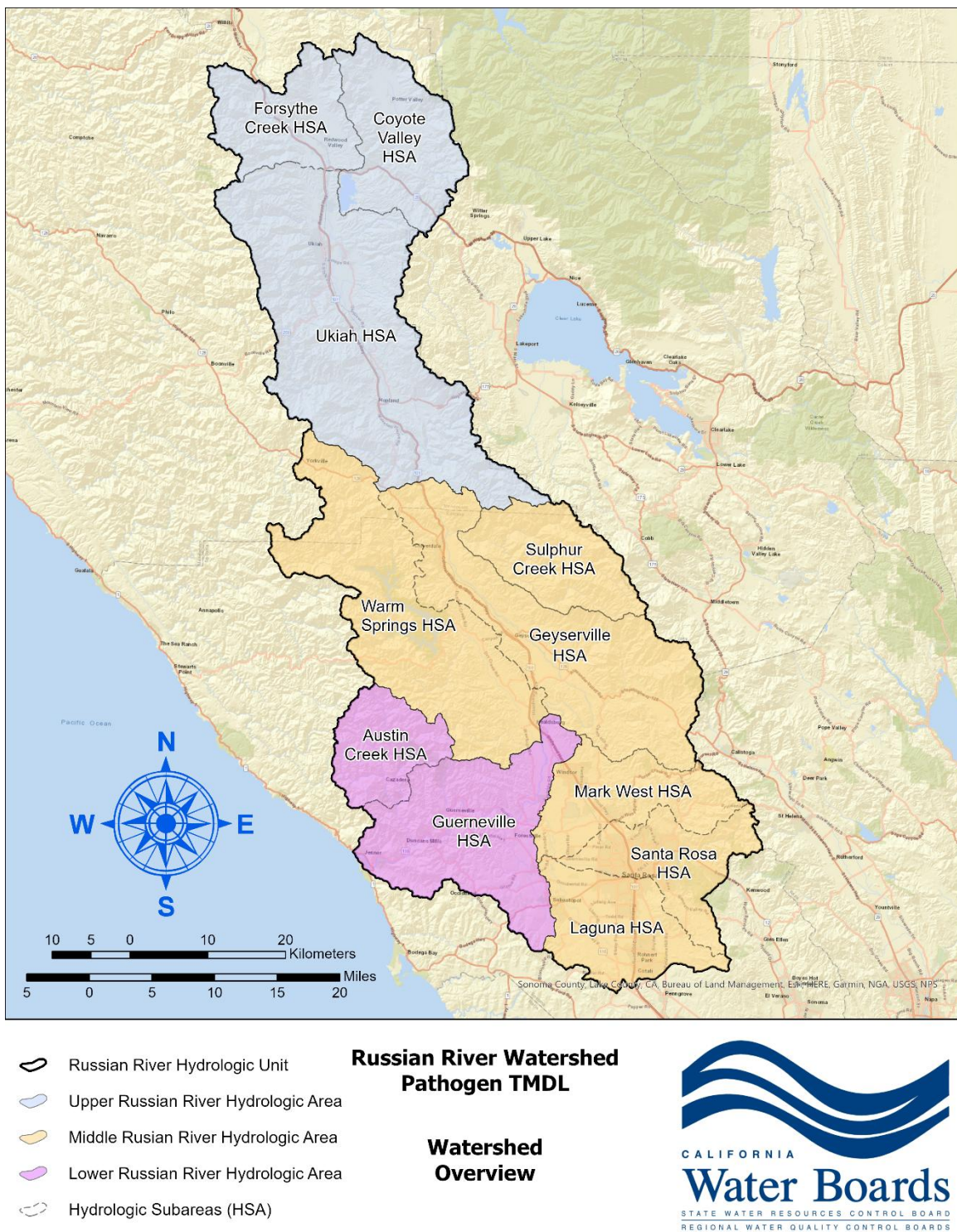


Figure 1.1: Russian River Watershed Hydrologic Areas and Subareas

Table 1.2: Basin Plan Hydrologic Area and Subareas in the Russian River Watershed

Hydrologic Area Name	Hydrologic Subarea
Upper Russian River	Coyote Valley
Upper Russian River	Forsythe Creek
Upper Russian River	Sulphur Creek
Upper Russian River	Ukiah
Middle Russian River	Warm Springs
Middle Russian River	Geyserville
Middle Russian River	Santa Rosa
Middle Russian River	Laguna
Middle Russian River	Mark West
Lower Russian River	Austin Creek
Lower Russian River	Guerneville

1.3.2 Total Maximum Daily Load (TMDL)

A total maximum daily load (TMDL) is a numerical calculation of the amount of a pollutant that a waterbody can assimilate and still meet water quality objectives. The TMDL equation is the sum of waste load allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background and must include a margin of safety. An allocation can be expressed as a concentration rather than a load. For pathogens, TMDLs are generally expressed as the concentration of a fecal indicator bacteria, which indicates the potential presence of illness-causing pathogens. This staff report includes all the information necessary to be approved as a TMDL under the Clean Water Act.

1.3.3 Action Plan

An Action Plan is adopted by the North Coast Water Board as an amendment to the Basin Plan. An Action Plan summarizes the findings of the TMDL analysis, indicating numeric targets, the TMDL calculation, and TMDL allocations, approves the TMDL, and establishes a program of implementation by which to attain water quality objectives, restore beneficial uses, and protect public health. An Action Plan may include a

prohibition, such as the Fecal Waste Discharge Prohibition established in this Action Plan.

An Action Plan amended into the Basin Plan is appropriate for the Russian River Watershed because control of existing direct and indirect discharges of fecal waste, monitoring of progress towards REC-1 protection, and attainment of water quality objectives will require multiple implementation actions. The California Administrative Procedures Act and the State's *Water Quality Control Policy for Addressing Impaired Waters: Regulatory Structure and Options* (Impaired Waters Policy) require the use of a Basin Plan amendment to tie together numerous actions by the North Coast Water Board to ensure that persons subject to regulations have notice and the opportunity to provide review and comment.

The purpose of the Action Plan is to:

1. Improve and protect the bacteriological quality of the surface waters in the Russian River Watershed so that public health is protected and water quality objectives are attained. The public health risk of most concern results from water contact recreation (REC-1) and incidental ingestion of water polluted by fecal waste, when and where such conditions exist or threaten to exist.
2. Set limits on the amount of fecal waste discharge to the surface waters of the Russian River Watershed from controllable sources⁴ that are necessary to protect water contact recreational beneficial uses (REC-1) by establishing the Fecal Waste Discharge Prohibition and the Russian River Pathogen TMDL.
3. Describe the program of implementation necessary to identify and control controllable discharges of fecal waste, reduce concentrations of fecal indicator bacteria, and reduce the potential for pathogen exposure in the Russian River Watershed to levels that protect public health and meet water quality objectives.
4. Describe the monitoring activities necessary to ensure that the program of implementation results in attainment of water quality objectives and protection of beneficial uses, or to support the revision of the program of implementation, as appropriate.

⁴ As examples, the controllable sources of concern to the Russian River Watershed include but are not limited to leaking septic systems, leaking sewer lines, leaking or undersized manure holding ponds, and direct disposal (or indirect disposal via storm water runoff) of human or domestic animal fecal waste into the Russian River and its tributaries.

This staff report includes all the information necessary to support the North Coast Water Board's consideration of the revised 2025 Action Plan as an amendment to the Basin Plan.

CHAPTER 2

WATERSHED SETTING

2.1 LOCATION

The Russian River Watershed is a large watershed in the southern portion of the North Coast Region. The North Coast Region is a relatively rural region; but, the Russian River Watershed houses one of its largest population centers. It spans two counties, Mendocino County in its northern reaches and Sonoma County to the south. The City of Santa Rosa is the most populous of the watershed's cities with nearly 172,000 people, followed in order of size by Rohnert Park, Windsor, Ukiah, and Healdsburg. The remaining towns and cities have fewer than 10,000 people. Nonetheless, the Russian River Watershed, like the region it sits in, is quite rural with considerable agriculture, timber and open space. As such, it provides a vibrant tourist trade, with wine tasting, restaurants, and outdoor activities, especially during the summer months. Recreational opportunities along the Russian River Watershed include, but are not limited to, swimming, wading, and kayaking/boating. Notable in the Russian River Watershed are several dams that control river flow from several of the river's tributaries and are important to efforts to restore habitat for threatened and endangered aquatic species. A large array of local, state, and federal agencies; private entities; and nonprofit organizations are fully engaged in multiple efforts to study and restore a functioning Russian River Watershed system.

The Russian River Watershed encompasses 1,484 square miles (949,982 acres) in Sonoma and Mendocino counties, California (Figure 2.1). Major municipalities within the watershed include Santa Rosa, Rohnert Park, Windsor, Healdsburg, Sebastopol, Cloverdale, and Ukiah. The watershed also includes numerous unincorporated communities such as, Forestville, Guerneville, Monte Rio, Hopland, and Calpella.

The Russian River Watershed has been divided into eleven (11) Hydrologic Subareas (HSA), which are shown in Figure 2.2 and listed in Table 2.1. The HSA delineation is an adequate basis for dividing the watershed for the purpose of general description.



Figure 2.1: Russian River Watershed Overview Map

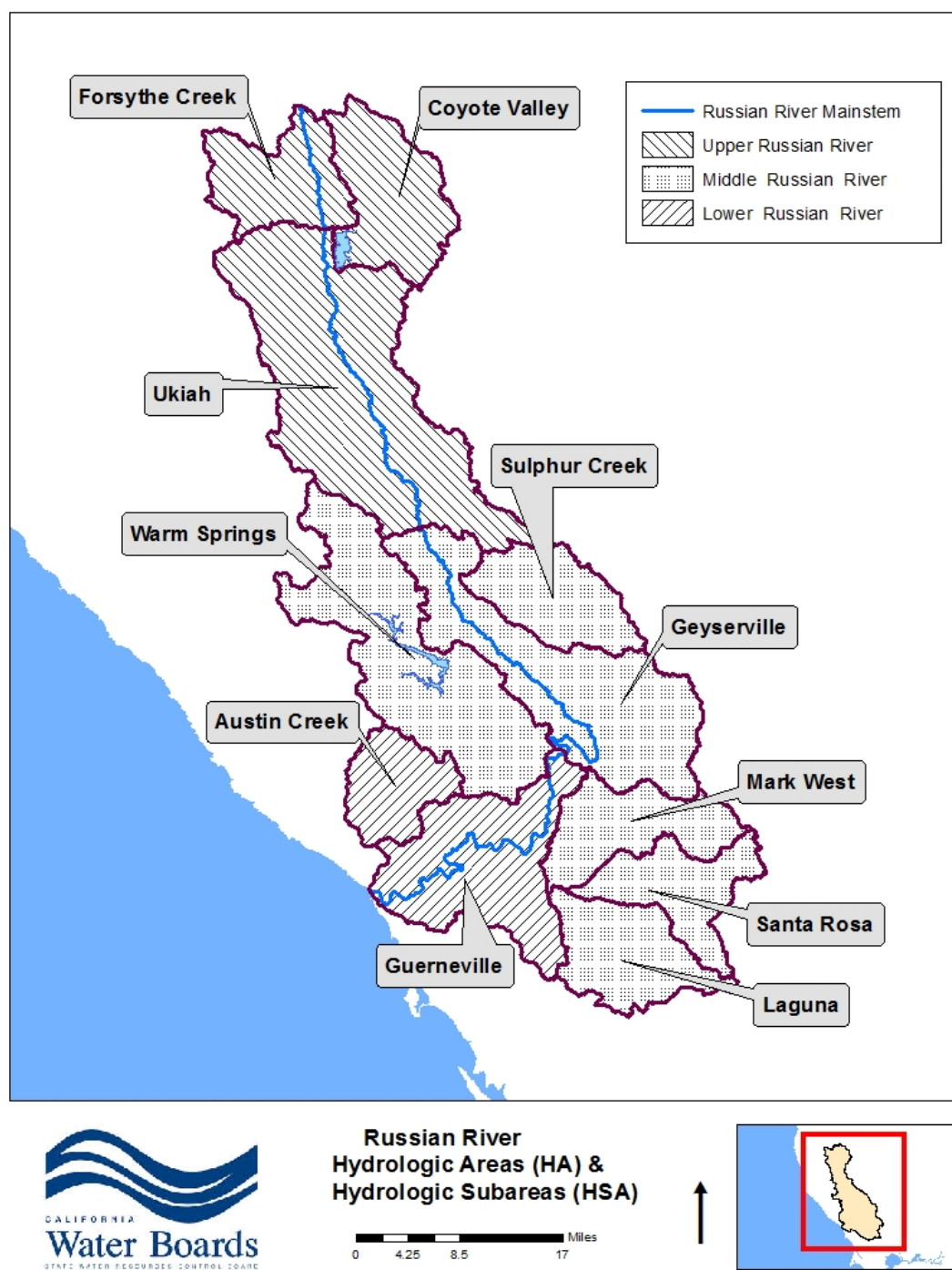


Figure 2.2: Hydrologic Subareas Of The Russian River Watershed

Table 2.1: Hydrologic Areas and Subareas of the Russian River

Hydrologic Area Name	Hydrologic Subarea Name	Acres	Relative Area (%)
Upper Russian River	Coyote Valley	67,011	7%
Upper Russian River	Forsythe Creek	53,965	6%
Upper Russian River	Ukiah	200,235	21%
Middle Russian River	Sulphur Creek	52,655	6%
Middle Russian River	Warm Springs	139,536	15%
Middle Russian River	Geyserville	133,007	14%
Middle Russian River	Laguna	56,644	6%
Middle Russian River	Santa Rosa	49,511	5%
Middle Russian River	Mark West	55,248	6%
Lower Russian River	Guerneville	102,303	11%
Lower Russian River	Austin Creek	39,867	4%
Russian River Watershed	Totals	949,982	100%

2.2 HYDROLOGY

The Russian River Watershed is hydrologically and geomorphologically diverse, containing 238 streams, 23 named springs, 14 natural lakes, 15 named reservoirs, all or portions of 10 groundwater basins, steep ridges, ephemeral streams, rolling hills, and wide alluvial valleys. The Russian River, in conjunction with Lake Mendocino and Lake Sonoma, serves as the primary water source for more than 500,000 residents in Mendocino, Sonoma and Marin counties, and for agricultural production in Mendocino and Sonoma counties. Lake Mendocino, located on the East Fork of the Russian River, has a capacity of 166,500 acre-feet and captures a drainage area of about 105 square miles. Lake Sonoma, located at the confluence of Warm Springs Creek and Dry Creek, about 14 miles northwest of the city of Healdsburg, has a capacity of 381,000 acre-feet

and captures a drainage area of about 130 square miles. Neither of these reservoirs were monitored for fecal indicator bacteria as part of this TMDL.

The Russian River Watershed includes all of the tributaries to the river and is affected by the interactions between the hillslopes, the channel, and its floodplain. Sediment produced in the headwaters of the Russian River Watershed is stored in the channel or in reservoirs, extracted as aggregate, or transported toward the Pacific Ocean. The main channel of the Russian River flows through a series of wide alluvial valleys separated by relatively narrow bedrock constrictions. These bedrock constrictions act as geologic controls such that each alluvial valley is relatively independent with respect to adjustments in slope, width and depth (Florsheim and Goodwin 1995).

The 110-mile mainstem channel of the Russian River originates in the Redwood Valley of central Mendocino County about 15 miles north of Ukiah. From its origin, the Russian River flows in a south to southeast direction to the Wohler Bridge area, where it changes to a southwest direction, crosses the Coast Range, and empties into the Pacific Ocean near the town of Jenner 20 miles west of Santa Rosa. Elevations range from zero at the Pacific Ocean to 4,343 feet at Mount St. Helena in the Mayacamas Mountains. Eleven hydrologic subareas containing fifty-seven valleys comprise the watershed.

The Russian River originates upstream of the Ukiah Valley and passes through the alluvial valley until the valley constricts at the Hopland Gage. The river again passes through another alluvial valley that contains the Town of Hopland before again being constricted in the Frog Woman Rock region. Downstream of Ukiah and Hopland, in the Alexander Valley reach, the river enters a mountainous area east of Healdsburg known as the Fitch Mountain Constriction where it is confined by steep bedrock banks. The section of the river in the Healdsburg Valley downstream to Wohler Bridge, where another bedrock constriction occurs, is known as the middle reach. The middle reach contains several permanent in-stream structures (Sonoma Water). The Water Agency, as local sponsor, controls and coordinates water supply releases from Lake Mendocino and Lake Sonoma in accordance with its water rights permits and the requirements of the State Water Resources Control Board's Decision 1610. Decision 1610 establishes minimum instream flow requirements for the mainstem Russian River and Dry Creek. Sonoma Water makes releases to meet downstream demands from agricultural, commercial, and residential individual water uses and other public water systems and to maintain minimum instream flow requirements for beneficial uses, including recreation and fish habitat.

The Potter Valley Project, owned and operated by Pacific Gas and Electric (PG&E), is a hydroelectric project that historically provided an interbasin water transfer from the Eel River to the East Fork of the Russian River. The Potter Valley Project is currently in the process of being decommissioned by PG&E as they have decided not to relicense the

project. The company is currently working on a surrender application and decommissioning plan to be submitted to the Federal Energy Regulatory Commission (FERC). The future of the project is unknown at this time.

2.3 LAND USES

Based on Landsat satellite imagery (Fry et al. 2006), primary land uses in the Russian River Watershed include urban, rural, agricultural, and undeveloped lands as shown in Table 2.2 and Figure 2.3. Most of the land in the watershed is privately owned (89.78%), with federal (5.41%), state (2.59%), local (2.15%), and tribal lands (0.08%) making up the remaining ownership. Land cover is primarily open space with fifty-one percent of the watershed having less than one housing unit per 160 acres (WCW 2007). Almost 300,000 people live in incorporated cities and towns of the Russian River Watershed (Table 2.3).

Urban, rural, and agricultural lands each host their own unique problems with respect to pathogens and fecal waste discharge. Chapter 6 elaborates on these sources in detail.

Table 2.2: Land Cover in the Russian River Watershed

Land Cover Category	Acres	Percent of Watershed Area
Shrub/Scrub	260,269	27.4%
Evergreen Forest	231,347	24.4%
Grassland/Herbaceous	163,358	17.2%
Mixed Forest	104,836	11.0%
Developed, Open Space	57,173	6.0%
Cultivated Crops	55,813	5.9%
Deciduous Forest	23,096	2.4%
Developed, Low Intensity	22,233	2.3%
Developed, Medium Intensity	16,312	1.7%
Open Water	7,130	0.8%
Woody Wetlands	2,564	0.3%
Developed, High Intensity	1,948	0.2%

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Land Cover Category	Acres	Percent of Watershed Area
Pasture/Hay	1,719	0.2%
Barren Land	1,469	0.2%
Herbaceous Wetlands	343	<0.1%
Total	949,611	100%

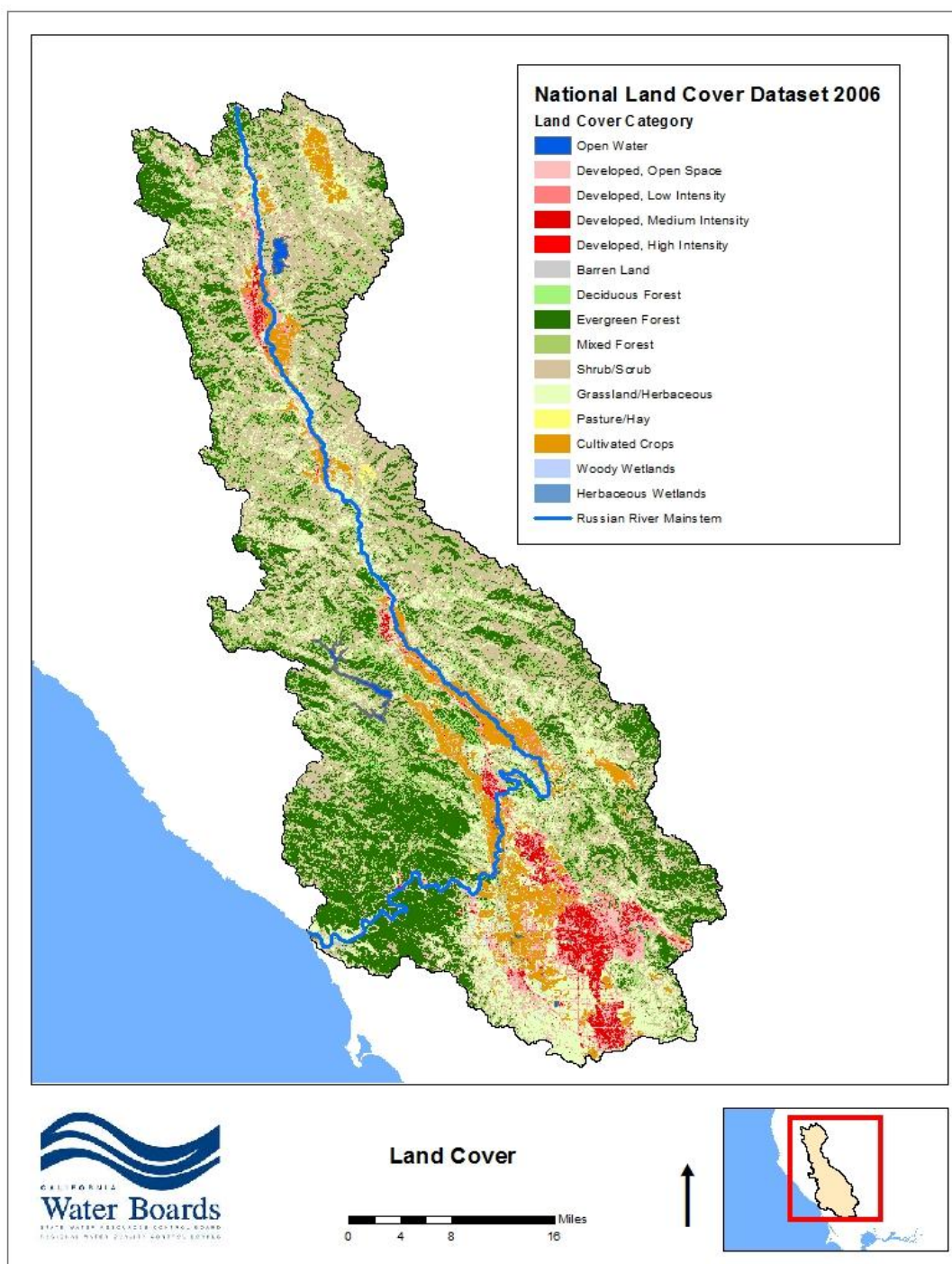


Figure 2.3: Land Cover In The Russian River Watershed

Table 2.3: Population of Cities in the Russian River Watershed

City or Town	Population¹	Percent of Municipal Population
Cloverdale	8,801	3%
Cotati	7,455	3%
Healdsburg	11,827	4%
Rohnert Park	42,622	14%
Santa Rosa	175,155	59%
Sebastopol	7,678	3%
Ukiah	15,882	5%
Windsor	27,555	9%
Total City Population	296,975	100%

¹ Per U.S. Census Bureau 2016

2.4 RECREATIONAL USES

The Russian River and tributary creeks are enjoyed by many swimmers, waders, canoers, kayakers, fishers, and enthusiasts that partake in water contact and non-contact water recreation. The Russian River is one of the most intensively used rivers for recreation in the North Coast Region. On holiday weekends in the summer, beach visitors along the river number in the thousands. Several of the most popular beaches are listed in Table 2.4 and shown in Figure 2.4. The greatest number of popular swimming beaches are located in the Guerneville HSA, in the lower part of the Russian River Watershed.

Table 2.4: Popular Swimming Beaches along the Russian River

Hydrologic Area Name	Hydrologic Subarea Name	Recreational Beach Name	Location
Upper Russian River	Coyote Valley	Mill Creek Park	Potter Valley
Upper Russian River	Forsythe Creek	Mariposa Swimming Hole	Redwood Valley
Upper Russian River	Ukiah	Vichy Springs Park	Ukiah

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Hydrologic Area Name	Hydrologic Subarea Name	Recreational Beach Name	Location
Upper Russian River	Ukiah	Mill Creek Park	Ukiah
Middle Russian River	Geyserville	Cloverdale River Park	Cloverdale
Middle Russian River	Geyserville	Wildhaven Sonoma Glamping	Healdsburg
Middle Russian River	Geyserville	Camp Rose Beach	Healdsburg
Lower Russian River	Guerneville	Veterans Memorial Beach	Healdsburg
Lower Russian River	Guerneville	Riverfront Park	Windsor
Lower Russian River	Guerneville	Mirabel Park Campground	Forestville
Lower Russian River	Guerneville	Steelhead Beach	Forestville
Lower Russian River	Guerneville	River Access Beach	Forestville
Lower Russian River	Guerneville	Sunset Beach	Forestville
Lower Russian River	Guerneville	Johnson's Beach	Guerneville
Lower Russian River	Guerneville	Monte Rio Beach	Monte Rio
Lower Russian River	Guerneville	Patterson Beach	Monte Rio
Lower Russian River	Guerneville	Casini Ranch Campground (West)	Duncans Mills
Lower Russian River	Guerneville	Casini Ranch Campground (East)	Duncans Mills



Figure 2.4: Popular Swimming Beaches On The Russian River

2.5 CLIMATE

The Russian River Watershed has a Mediterranean climate with hot, dry summers and wet winters. Average precipitation varies across the watershed with generally wetter conditions in the north and west. Summer temperatures can reach over 100° F in inland valleys for weeks at a time, with coastal conditions cool and moist. Drought and severe storms occur periodically but mostly unpredictably; El Niño/ La Niña Southern Oscillation climatic conditions can exacerbate climatic extremes.

Precipitation in the Russian River Watershed is distinctly seasonal; about 80 percent of the total occurs during five months, November through March. The bulk of the precipitation occurs during moderately intense general storms of several days' duration. Snow falls in modest amounts at altitudes above 2,000 feet, but it seldom remains on the ground for more than a few days. Mean annual precipitation varies from about 30 inches in the flat valley lands north of Santa Rosa to more than 80 inches in parts of the mountains. Summers are dry, with total rainfall from June through August averaging less than 0.5 inch (Zhang and Johnson 2010).

Table 2.5: Average Annual Precipitation

Hydrologic Area Name	Hydrologic Subarea Name	Mean Precipitation (inches/year)
Upper Russian River	Coyote Valley	41.1
Upper Russian River	Forsythe Creek	46.0
Upper Russian River	Ukiah	43.1
Middle Russian River	Sulphur Creek	51.4
Middle Russian River	Warm Springs	48.6
Middle Russian River	Geyserville	41.6
Middle Russian River	Laguna	31.3
Middle Russian River	Santa Rosa	38.5
Middle Russian River	Mark West	39.0
Lower Russian River	Guerneville	45.1
Lower Russian River	Austin Creek	65.5
Russian River Watershed	Mean	44.2

The spatial distribution of mean annual rainfall in the Russian River Watershed is shown in Figure 2.5. These precipitation zones were derived statewide by the California Department of Forestry and Fire Protection for the period 1900-1960. Table 2.5 presents the area weighted precipitation for each Hydrologic Subarea in the Russian River.

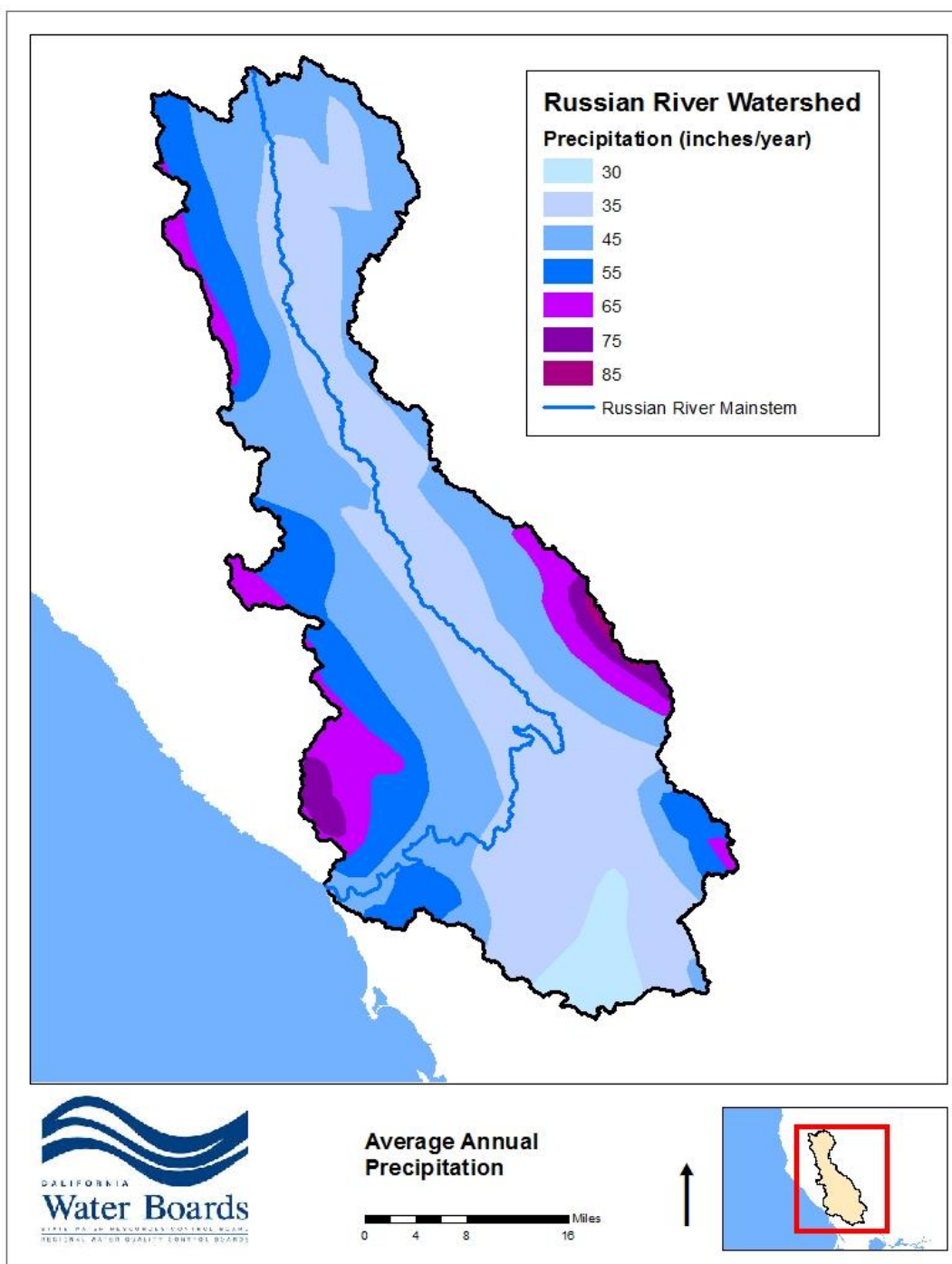


Figure 2.5: Average Annual Precipitation Patterns In The Russian River Watershed

2.6 GEOLOGY AND SOILS

The Russian River Watershed is underlain predominantly by the Franciscan Assemblage, which is a highly erodible mélange that formed during the Jurassic-Cretaceous age. The Franciscan Assemblage forms the bulk of the coast range; the sediment consists of muddy sandstones and cherts jumbled together and layered with basalt lava flow. This lithology is very unstable with landslides common throughout the mountainous regions of the basin. Many of the streams within the basin, including the upper mainstem Russian River, follow the northwest to southeast orientation of geologic faults. The Rodgers Creek Fault enters Sonoma County at San Pablo Bay and extends northward through the City of Santa Rosa, where it meets up with the Healdsburg Fault, which continues northward passing east of the Town of Windsor. The Mayacama Fault lies to the east of the Healdsburg Fault and continues northward, passing east of the City of Cloverdale.

The Russian River flows through a series of broad alluvial valleys and narrow bedrock constrictions. For a more in-depth understanding of watershed form and function, a conceptual model of the hydrology, surface and groundwater interactions, and stream ecology of Russian River Watershed has been completed by an Independent Science Review Panel since the first drafting of this report and is available online.⁵ Historic photographs show that the historic river channel once meandered across a broad natural floodplain and that the elevation of the active channel was once close to the elevation of the floodplain. Traces of the channel remained on the irregular floodplain as a series of "sloughs" or side channels. Subsequent land use changes in the Russian River Basin have leveled the floodplain, filled the side channels, and constrained the river channel into a narrow and straighter course (Florsheim and Goodwin 1995).

The Russian River Watershed contains a large number of different soils types (NRCS 2013). Identification of hydrologic soil groups is based on comparison of the characteristics of soil profiles, which include hydraulic conductivity, texture, bulk density, structure, strength, clay mineralogy, and organic matter content. Four hydrologic soil groups are categorized in Table 2.6 and shown on Figure 2.6 (NRCS 2007). Hydrologic soil characteristics influence the delivery of bacteria to surface waters. Soils with a greater potential to runoff also have a greater potential to deliver bacteria with the soil particles. Impervious lands, such as urban paved areas, deliver storm water and associated bacteria directly to the river and its tributaries.

⁵ [Russian River Independent Science Review Webpage](http://www.russianriverisrp.org/index.html)
(<http://www.russianriverisrp.org/index.html>)

Table 2.6: Hydrologic Soil Characteristics of the Russian River Watershed

Hydrologic Soil Group	Runoff Potential	Acres	Relative Watershed Area (%)
A	Low when thoroughly wet. Water is transmitted freely through the soil.	1,756	0.2%
B	Moderately low when thoroughly wet. Water transmission through the soil is unimpeded.	477,416	50%
C	Moderately high when thoroughly wet. Water transmission through the soil is somewhat restricted.	218,774	23%
D	High when thoroughly wet. Water movement through the soil is restricted or very restricted.	251,664	27%
	Total	949,611	100%

The Russian River Watershed is a very important watershed in the North Coast Region. Dependent on the water supplies provided by the Russian River, it contains one of the largest population centers in the region. The river provides broad recreational value, attracting a large tourist population. The Russian River Watershed supports multiple thriving land uses, which produce a variety of anthropogenic influences, stemming both from urban and rural living. The Mediterranean climate causes most of the precipitation in the Russian River Watershed to fall during the winter season. This, coupled with the steep slopes of the watershed, results in significant storm water runoff during the wet season. The broad valleys foster significant agricultural production within the river corridor.

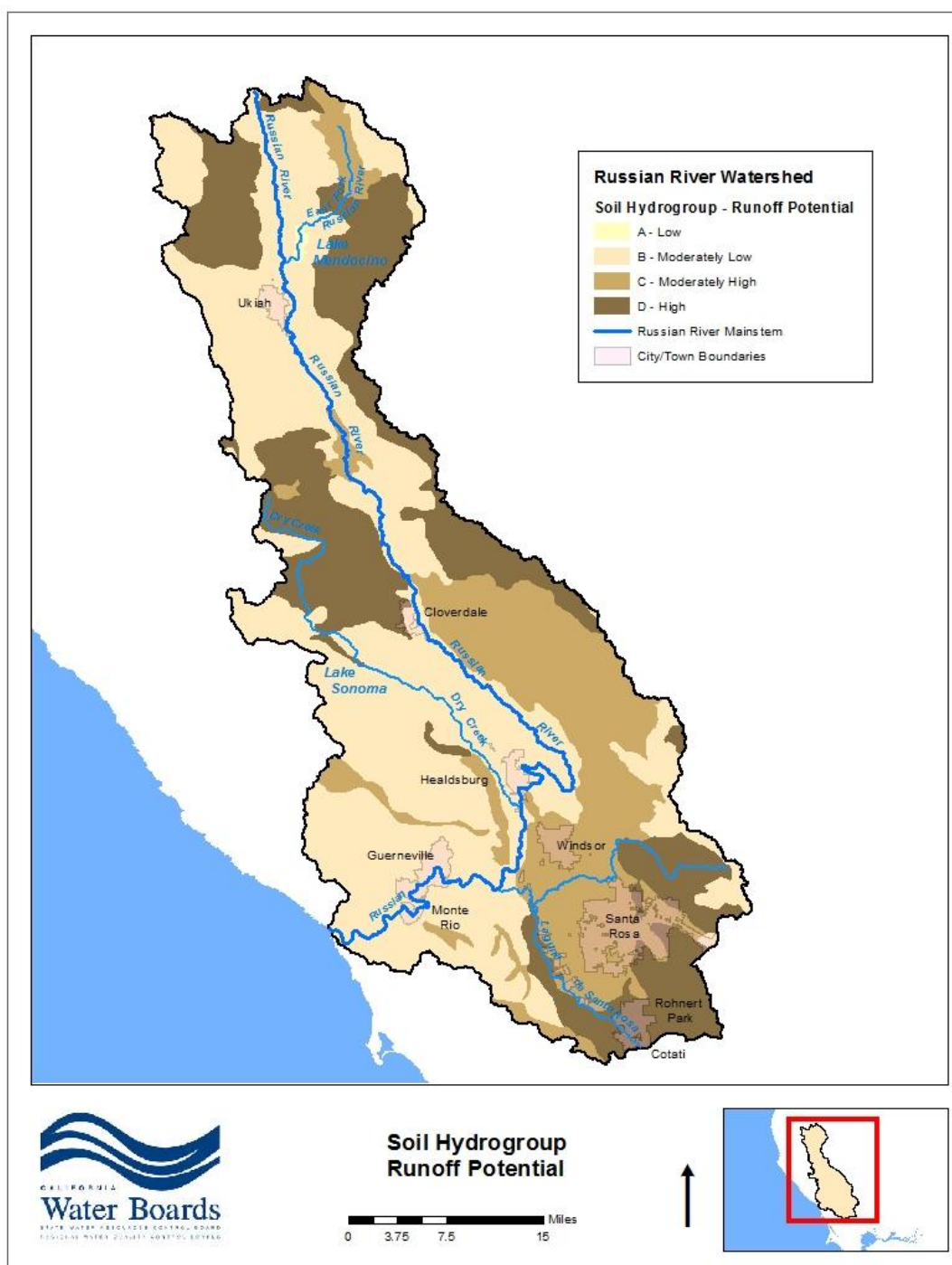


Figure 2.6: Hydrologic Soil Characteristics Of The Russian River Watershed

2.7 SUMMARY

The watershed setting is important to understanding the potential sources of pathogens in the Russian River Watershed, the conditions that result in fecal waste discharge, and the effect on water quality, water contact recreation, and public health. In short, the Russian River Watershed has densely populated urban centers, which rely on municipal services such as sewage collection, centralized wastewater treatment, and storm water collection systems. The collection and treatment facilities require adequate maintenance and repair, if they are to consistently transport, treat and dispose of fecal waste properly. The Russian River Watershed also has considerable rural development, where residents generally rely on onsite wastewater treatment systems (OWTS) to treat and dispose of fecal waste. Many reaches of the Russian River and its tributaries are within steep canyons with little soil to support adequate OWTS or were developed long before modern OWTS regulations were in place. As such, there are likely to be numerous old, failing, or inadequately sited OWTS in need of replacement or upgrade. Further, the Russian River Watershed is home to multiple kinds of agriculture, including small and large animal operations such as horse farms, goat farms and dairies, each with the potential for fecal waste discharge. The watershed experiences a long summer drought, with precipitation occurring primarily from October through April, which is important with respect to storm water runoff as a carrier of fecal waste. It is also a very popular tourist destination, particularly in the summer months, which is important with respect to the potential for pathogen exposure.

CHAPTER 3

BACTERIA STANDARDS AND OTHER INDICATORS OF PATHOGEN POLLUTION

The Russian River Pathogen TMDL uses a number of different analytical approaches to assess water quality conditions in the Russian River Watershed and the potential for human exposure to illness-causing pathogens. The science associated with assessment of pathogens has evolved over time, with the development of new methods, metrics, and criteria. The purpose of the chapter is to describe the standards and indicators used in the Russian River Pathogen TMDL.

3.1 WATER QUALITY STANDARDS FOR BACTERIA

Water quality standards are established in the Basin Plan. Water quality standards consist of three basic elements: beneficial uses, the water quality objectives minimally required to protect the beneficial uses, and an antidegradation policy. Resolution No. 68-16 was adopted by the State Water Board to protect the state's high quality waters and is incorporated into the Basin Plan as the antidegradation policy.

3.1.1 Beneficial Uses

The beneficial use at issue in this TMDL is water contact recreation. Water contact recreation (REC-1) is defined in the Basin Plan as “the uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white-water activities, fishing, or use of natural hot springs.” All of the beneficial uses designated in the Russian River Watershed are identified in **Error! Reference source not found.** through Table 3.3. Beneficial uses designated in a downstream waterbody are generally applicable upstream.

Table 3.1: Beneficial Uses Designated for Protection in Surface Waters of the Russian River Watershed, Part 1

HYDROLOGIC SUB AREAS (HSA) within the HYDROLOGIC AREA (HA) Upper Russian River	Coyote Valley	Forsythe Creek	Ukiah
Beneficial Uses			
Municipal and Domestic Supply (MUN)	X	X	X
Agricultural Supply (AGR)	X	X	X

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

HYDROLOGIC SUB AREAS (HSA) within the HYDROLOGIC AREA (HA) Upper Russian River	Coyote Valley	Forsythe Creek	Ukiah
Beneficial Uses			
Industrial Service Supply (IND)	X	X	X
Industrial Process Supply (PRO)	X	X	X
Groundwater Recharge (GWR)	X	X	X
Freshwater Replenishment (FRSH)	X		X
Navigation (NAV)	X	X	X
Hydropower Generation (POW)	X	X	X
Water Contact Recreation (REC-1)	X	X	X
Non-Contact Water Recreation (REC-2)	X	X	X
Commercial and Sport Fishing (COMM)	X	X	X
Warm Freshwater Habitat (WARM)	X	X	X
Cold Freshwater Habitat (COLD)	X	X	X
Wildlife Habitat (WILD)	X	X	X
Rare, Threatened, or Endangered Species (RARE)	X	X	X
Migration of Aquatic Organisms (MIGR)	X	X	X
Spawning, Reproduction, and/or Early Development (SPWN)	X	X	X
Shellfish Harvesting (SHELL)			X
Estuarine Habitat (EST)			

HYDROLOGIC SUB AREAS (HSA) within the HYDROLOGIC AREA (HA) Upper Russian River	Coyote Valley	Forsythe Creek	Ukiah
Beneficial Uses			
Aquaculture (AQUA)	X	X	X

**Table 3.2: Beneficial Uses Designated for Protection in Surface Waters of the
Russian River Watershed, Part 2**

HYDROLOGIC SUB AREAS (HSA) within the HYDROLOGIC AREA (HA) Middle Russian River	Sulphur Creek	Warm Springs	Geyserville	Laguna	Santa Rosa	Mark West
Beneficial Uses						
Municipal and Domestic Supply (MUN)	X	X	X	X	X	X
Agricultural Supply (AGR)	X	X	X	X	X	X
Industrial Service Supply (IND)	X	X	X	X	X	X
Industrial Process Supply (PRO)	X	X	X	X	X	X
Groundwater Recharge (GWR)	X	X	X	X	X	X
Freshwater Replenishment (FRSH)		X	X	X		X
Navigation (NAV)	X	X	X	X	X	X
Hydropower Generation (POW)	X	X	X	X	X	X
Water Contact Recreation (REC-1)	X	X	X	X	X	X

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

HYDROLOGIC SUB AREAS (HSA) within the HYDROLOGIC AREA (HA) Middle Russian River	Sulphur Creek	Warm Springs	Geyserville	Laguna	Santa Rosa	Mark West
Beneficial Uses						
Non-Contact Water Recreation (REC-2)	X	X	X	X	X	X
Commercial and Sport Fishing (COMM)	X	X	X	X	X	X
Warm Freshwater Habitat (WARM)	X	X	X	X	X	X
Cold Freshwater Habitat (COLD)	X	X	X	X	X	X
Wildlife Habitat (WILD)	X	X	X	X	X	X
Rare, Threatened, or Endangered Species (RARE)	X	X	X	X	X	X
Migration of Aquatic Organisms (MIGR)	X	X	X	X	X	X
Spawning, Reproduction, and/or Early Development (SPWN)	X	X	X	X	X	X
Shellfish Harvesting (SHELL)			X	X	X	X
Estuarine Habitat (EST)						
Aquaculture (AQUA)	X	X	X	X	X	X

Table 3.3: Beneficial Uses Designated for Protection in Surface Waters of the Russian River Watershed, Part 3

HYDROLOGIC SUB AREAS (HSA) within the HYDROLOGIC AREA (HA) Lower Russian River	Guerneville	Austin Creek
Beneficial Uses		
Municipal and Domestic Supply (MUN)	X	X
Agricultural Supply (AGR)	X	X
Industrial Service Supply (IND)	X	X
Industrial Process Supply (PRO)	X	X
Groundwater Recharge (GWR)	X	X
Freshwater Replenishment (FRSH)	X	
Navigation (NAV)	X	X
Hydropower Generation (POW)	X	X
Water Contact Recreation (REC-1)	X	X
Non-Contact Water Recreation (REC-2)	X	X
Commercial and Sport Fishing (COMM)	X	X
Warm Freshwater Habitat (WARM)	X	X
Cold Freshwater Habitat (COLD)	X	X
Wildlife Habitat (WILD)	X	X
Rare, Threatened, or Endangered Species (RARE)	X	X
Migration of Aquatic Organisms (MIGR)	X	X

HYDROLOGIC SUB AREAS (HSA) within the HYDROLOGIC AREA (HA) Lower Russian River	Guerneville	Austin Creek
Beneficial Uses		
Spawning, Reproduction, and/or Early Development (SPWN)	X	X
Shellfish Harvesting (SHELL)	X	
Estuarine Habitat (EST)	X	
Aquaculture (AQUA)	X	X

The Basin Plan delineates waterbodies, including the Russian River, utilizing Hydrologic Subareas (HSA's) and designates the beneficial uses associated with those HSA's.

3.1.2 Water Quality Objectives

The water quality objective for bacteria contained in the Basin Plan reads as follows.

Regional Bacteria Water Quality Objective

The bacteriological quality of waters of the North Coast Region shall not be degraded beyond natural background levels. In no case shall coliform concentrations in waters of the North Coast Region exceed the following:

In waters designated for contact recreation (REC-1), the median fecal coliform concentration based on a minimum of not less than five samples for any 30-day period shall not exceed 50/100 mL, nor shall more than ten percent of total samples during any 30-day period exceed 400/100 mL (State Department of Health Services).

At all areas where shellfish may be harvested for human consumption (SHELL), the fecal coliform concentration throughout the water column shall not exceed 43/100 ml for a 5-tube decimal dilution test or 49/100 ml when a three-tube decimal dilution test is

used (National Shellfish Sanitation Program, Manual of Operation).

Only the second part of the bacteria objective is the subject of the Russian River Pathogen TMDL. It is important to note that the objective was adopted by the North Coast Water Board in 1975 when fecal coliform was a common measure of bacterial contamination. In 1984, the U.S. EPA promulgated national criteria for the protection of recreation, which are based on *E. coli* and enterococci bacteria. In 2012, U.S. EPA released revised national criteria for the protection of recreation, also based on *E. coli* and enterococci bacteria. The State Water Board adopted statewide bacteria objectives in August of 2018, which are based on U.S. EPA's 2012 national criteria. The statewide bacteria objective supersedes REC-1 standards contained in Basin Plans. The statewide bacteria objective adopted by the State Water Board can be found on the State Water Board website.⁶ The adopted language includes protection of REC-1 in freshwaters based on the national criteria for *E. coli* using 32 gastrointestinal illnesses per 1,000 recreators as the threshold and in saline waters based on the national criteria for enterococci also using 32 gastrointestinal illnesses per 1,000 recreators as the threshold. (See further discussion below).

As such, the Russian River Pathogen TMDL is based on the statewide *E. coli* objective for freshwater and enterococci objective for saline water adopted in August 2018. Wasteload allocations and load allocations are also based on the statewide *E. coli* and enterococci objectives. (See further discussion in Chapter 7). The statewide *E. coli* objectives for the protection of REC-1 is reproduced in Table 3.4.

Table 3.4: Statewide Bacteria Objectives for the Protection of REC-1

Applicable Waters	Objective Elements	GM (cfu/100 mL)	STV (cfu/100 mL)
All the waters where salinity is equal to or less than 1 ppt 95 percent or more of the time	<i>E. coli</i>	100	320
All the waters where salinity is greater than 1 ppt more than 5 percent of the time	Enterococci	30	110

⁶ [State Water Boards Bacterial Objectives Webpage](http://www.waterboards.ca.gov/bacterialobjectives)
(<http://www.waterboards.ca.gov/bacterialobjectives>)

The waterbody GM shall not be greater than the applicable GM magnitude in any six-week interval, calculated weekly. The applicable STV shall not be exceeded by more than 10 percent of the samples collected in a CALENDAR MONTH, calculated in a static manner.

Statewide Bacteria Objectives for the Protection of REC-1 Represents Estimated Illness Rate (NGI): 32 per 1,000 water contact recreators

NGI = National Epidemiological and Environmental Assessment of Recreational Water gastrointestinal illness rate

GM = geometric mean

STV = statistical threshold value

cfu = colony forming units

mL = milliliters

ppth = parts per thousand

3.1.3 Antidegradation Policy

The federal antidegradation policy described in 40 C.F.R. section 131.12 and state Antidegradation Policy contained in State Water Board Resolution No. 68-16 obligate the North Coast Water Board to protect the quality of waters, and to make appropriate findings when any lowering of water quality is authorized. Under the state Antidegradation Policy, which incorporates the requirements of the federal policy, waters that exceed minimum water quality objectives are described as high-quality waters. In those locations and during those times of year when the quality of water in the Russian River Watershed can be described with respect to pathogens as high quality, the North Coast Water Board must maintain that high quality unless certain findings are made. Chapter 13 of the staff report more fully describes the North Coast Water Board's antidegradation analysis for the Russian River Pathogen TMDL.

3.2 OTHER INDICATORS OF PATHOGEN POLLUTION

Though the Russian River Pathogen TMDL is based on *E. coli* as the bacteria objective for protection of REC-1 in freshwater and enterococci for saline waters, there are numerous other analytical methods useful to the assessment of fecal waste discharge and pathogen exposure. This section describes some of the other metrics staff have used to assess pollution in the Russian River Watershed.

Pathogens most commonly identified and associated with waterborne diseases can be grouped into three general categories: bacteria, protozoans, and viruses (Table 3.5). Bacteria are microscopic unicellular organisms that are ubiquitous in nature, including the intestinal tract of animals. Many types of harmless bacteria colonize the human intestinal tract and are routinely shed in feces. However, pathogenic (disease-causing) bacteria are present in the feces of infected humans and animals and can contaminate surface water and groundwater as a result of inadequate waste treatment or disposal methods.

Protozoans are unicellular organisms that are present primarily in the aquatic environment. Of the 35,000 known species of protozoans, almost 30 percent are pathogenic. Pathogenic protozoans can occur in humans and animals where they multiply in the intestinal tract of the infected individual or animal and are later excreted in feces as cysts. Viruses are obligate intracellular parasites, incapable of replication outside of a specific host organism. Viruses that are of a public health concern are viruses that replicate in the intestinal tract of humans, and are referred to as human enteric viruses (U.S. EPA 2001).

Table 3.5: Pathogenic Bacteria, Protozoan, and Virus of Concern to Water Quality

Pathogen Type	Disease	Effects
Bacteria		
<i>Escherichia coli</i>	Gastroenteritis	Vomiting, diarrhea
<i>Salmonella typhi</i>	Typhoid fever	High fever, diarrhea, ulceration of the small intestine
<i>Salmonella</i>	Salmonellosis	Diarrhea, dehydration
<i>Shigella</i>	Shigellosis	Bacillary dysentery
<i>Vibrio cholera</i>	Cholera	Extremely heavy diarrhea, dehydration
<i>Yersinia enterocolitica</i>	Yersiniosis	Diarrhea
Protozoan		
<i>Balantidium coli</i>	Balantidiasis	Diarrhea, dysentery
<i>Cryptosporidium</i>	Cryptosporidiosis	Diarrhea, death in susceptible populations
<i>Entamoeba histolytica</i>	Amebiasis (amoebic dysentery)	Prolonged diarrhea with bleeding, abscesses of the liver and small intestine
<i>Giardia lamblia</i>	Giardiasis	Mild to severe diarrhea, nausea, indigestion
Virus		

Pathogen Type	Disease	Effects
Adenovirus	Respiratory disease, gastroenteritis	Various effects
Enterovirus	Gastroenteritis, heart anomalies, meningitis	Various effects
Hepatitis A	Infectious hepatitis	Jaundice, fever
Reovirus	Gastroenteritis	Vomiting, diarrhea
Rotavirus	Gastroenteritis	Vomiting, diarrhea
Calicivirus	Gastroenteritis	Vomiting, diarrhea
Astrovirus	Gastroenteritis	Vomiting, diarrhea

Adapted from Metcalf & Eddy 1991 and Fout 2000; as cited in U.S. EPA 2001

3.2.1 Fecal Indicator Bacteria (FIB)

Several groups of intestinal bacteria are used as indicators that a waterbody has been contaminated with fecal waste and that pathogens are present. Most strains of fecal indicator bacteria (FIB) do not directly pose a health risk to swimmers and those recreating in the water; but, indicator bacteria often co-occur with human pathogens and are easier to measure than the actual pathogens that may pose the risk of illness. Not only is it impractical to directly measure the wide range of fecal-borne pathogens (bacteria, viruses, and protozoans), but the methods to detect human pathogens are characteristically expensive and inefficient, or may not be available. The following are descriptions of various methods of using indicators to determine fecal waste contamination in a waterbody.

3.2.1.1 Fecal Coliform

Fecal coliform bacteria are a subgroup of total coliform bacteria found mainly in the intestinal tracts of warm-blooded animals, and thus, are considered a more specific indicator of fecal waste pollution than the total coliform group. Fecal coliform bacteria concentration criteria were initially recommended by U.S. EPA (1976) for assessing support of recreational use. However, since 1976, several key epidemiological studies were conducted to evaluate the criteria for effectiveness at protecting public health related to water contact recreation (Cabelli et al. 1982; Cabelli et al. 1983; Dufour 1983; Favero 1985; Seyfried et al. 1985a, Seyfried et al. 1985b). These studies concluded that the 1976

U.S. EPA recommended fecal coliform bacteria criteria were not protective of public health from incidental ingestion associated with swimming recreation. As a result, the U.S. EPA changed the criteria recommendation in 1986 to use the fecal indicator bacteria *E. coli* and enterococci bacteria. The State Water Board has since adopted objectives based on the U.S. EPA's recommendations that now supersede any fecal coliform objectives. This TMDL no longer relies upon fecal coliform bacteria data for assessment of impairment or pollution.

3.2.1.2 E. Coli Bacteria and Enterococci Bacteria

E. coli is a species of fecal coliform bacteria that is found in the fecal material of humans and other animals. U.S. EPA (2012) compiled numerous epidemiological studies and concluded that *E. coli* bacteria are a good indicator of human health risk from water contact in recreational freshwaters. National criteria are established for both the geometric mean and the statistical threshold value (STV). To assess compliance with the standard, the geometric mean criterion is compared to the logarithmic average of the bacteria concentration distribution. In addition, the STV criterion is compared to the 90th percentile of the bacteria concentration distribution. The State Water Board's bacteria objective for freshwater is based on *E. coli* and is consistent with the national criteria. This TMDL identifies monitoring stations and subwatersheds within which exceedance of the statewide objective for *E. coli* in freshwaters occur.

Enterococci is a genera of fecal indicator bacteria that is also found in the fecal material of humans and other animals. U.S. EPA (2012) compiled numerous epidemiological studies and concluded that enterococci bacteria are a good indicator of human health risk from water contact in recreational marine and freshwaters. National criteria are established for both the geometric mean and the statistical threshold value (STV). The geometric mean criterion is compared to the logarithmic average of the bacteria concentration distribution. In addition, the STV criterion is compared to the 90th percentile of the bacteria concentration distribution. The State Water Board adopted objectives for enterococci, which are consistent with the national criteria, but applicable to saline waters, only. The statewide objective for enterococci apply to waters with a salinity threshold of 1 part per thousand more than 5 percent during the calendar year. However, the scientific peer reviewers for the Russian River Pathogen TMDL recommended the use of enterococci bacteria in freshwater, too as an indicator of potential exposure to fecal-borne pathogens in the Russian River Watershed. This TMDL identifies monitoring stations and subwatersheds within which exceedance of the statewide objective occur for enterococci in waters with a salinity threshold that exceeds 1 ppt more than 5 percent of time in a calendar year. This TMDL also identifies monitoring stations and subwatersheds within which the national criteria for enterococci in freshwaters are exceeded. This approach is consistent the statewide bacteria objectives, the national bacteria criteria, and the results of the scientific peer review process.

U.S. EPA published *E. coli* and enterococci bacteria criteria for two different levels of illness risk. The first level of risk (36 estimated illnesses per 1,000 recreators) is the same risk level applied with the previous recreational criteria (i.e., U.S. EPA 1986). The 1986 U.S. EPA criteria correspond to the level of risk associated with an estimated illness rate of the number of highly credible gastrointestinal illnesses (HCGI) per 1,000 primary contact recreators. The information developed for the 2012 U.S. EPA criteria uses a more comprehensive definition of GI illness, referred to as NEEAR-GI (NGI), which includes diarrhea without the requirement of a fever. Because NGI is broader than HCGI, more illness cases were reported and associated with recreation using the NGI definition of illness, at the same level of water quality observed using the previous illness definition (i.e., HCGI). The U.S. EPA (2012) also recommends criteria that correspond to an illness rate of 32 NGI per 1,000 primary contact recreators to “encourage an incremental improvement in water quality.” The statewide bacteria objectives are based on 32 NGI per 1,000 primary contact recreators, as is this TMDL.

3.2.1.3 *Bacteroides* Bacteria

Bacteroides bacteria are another group of fecal indicator bacteria that are used to measure fecal waste in water. *Bacteroides* is the genus name of the bacteria from the phylum Bacteroidetes and order Bacteroidales. *Bacteroides* bacteria are anaerobic (i.e., they do not live or grow in the presence of oxygen) and make up a substantial portion of the gastrointestinal flora of mammals (Wexler 2007). However, some species of *Bacteroides* bacteria can come from non-enteric sources (Niemi et al. 2012).

Due to their anaerobic-nature, *Bacteroides* bacteria have a low potential for survival and regrowth in the environment. In addition, water temperature has been shown to affect the persistence of *Bacteroides* in surface water. For water temperatures typically observed in the Russian River during the summer period (20-25°C or 68-77°F), *Bacteroides* bacteria survive one to two days. In cooler temperatures, *Bacteroides* bacteria likely survive for a week or more. Because of this short life span, *Bacteroides* bacteria concentrations are often used to indicate recent introduction of fecal waste to surface waters.

Bacteroides bacteria are especially useful as a tool to identify fecal waste from specific animal sources. The percentage of the *Bacteroides* bacteria population that originates from specific animal hosts can be determined using real-time quantitative polymerase chain reaction (qPCR) methods, which amplify specific DNA sequences of the 16S rRNA gene marker (Molina 2007). *Bacteroides* bacteria assay primers have been developed for most domestic animal hosts including cattle, swine, chicken, dog, and horse (Griffith et al. 2013). Commercial laboratories are available that conduct these animal host analyses. Some animal host assays are non-quantitative and produce only presence/absence results. Water samples analyzed for the Russian River Pathogen TMDL project were analyzed for both human-specific and bovine-specific *Bacteroides* bacteria.

According to the few epidemiological studies currently available for human *Bacteroides*, there is link between the bacteria and illness rates. Wade et al. (2010) estimated the probability of gastrointestinal illness due to increasing concentrations of *Bacteroides* bacteria, and found that a geometric mean of 60 gene copies/100 mL corresponded to about 30 gastrointestinal illnesses per 1,000 swimmers. Ashbolt et al. (2010) compared human-specific *Bacteroides* bacteria concentration to *Norovirus* concentrations. From these estimates, a concentration of 860 gene copies/100 mL corresponded to about 30 gastrointestinal illnesses per 1,000 swimmers. Soller et al. (2010a) identified *Norovirus* as the pathogen most responsible for a majority of gastrointestinal illness. Bohem et al. (2015) found a linear relationship between the risk of GI illness associated with swimming and concentrations of human *Bacteroides* bacteria concentration.

For the purposes of this TMDL, *Bacteroides* data were used as a triad of information with *E. coli* and enterococci from which to assess the potential presence of illness causing pathogens. The detection of human or bovine-sourced *Bacteroides* was taken as an indication of the potential of recent discharge of fecal waste. Elevated *Bacteroides* concentrations was taken as an indication of the potential for significant recent discharge of fecal waste. In no case was a pollution determination made based on *Bacteroides* findings, alone.

3.2.1.4 DNA Marker Sensitivity and Specificity

Bernhard and Field (2000a) first identified species composition differences in *Bacteroides* bacteria populations by screening 16S rDNA from human and cow feces. Conventional host-specific PCR assays were then developed to detect these genetic markers in environmental samples (Bernhard and Field 2000b). Further technical advancements have allowed for the relative quantification of animal host-specific genetic markers. There have been more than a dozen human-specific genetic markers developed over the last decade (Griffith et al. 2013). Studies have evaluated these genetic markers for sensitivity (does the marker detect human material when it is present in the sample) and specificity (does the marker cross-react with other animal sources).

Shilling et al. (2009) recommended use of the HuBac genetic marker of human-specific *Bacteroides* bacteria and the BoBac marker for bovine-specific *Bacteroides* bacteria for concentration measurements to support the Russian River Pathogen TMDL. Layton et al. (2006) found the HuBac genetic marker assay had 100% sensitivity, but it also had a 32% false-positive rate with potential for cross-sensitivity with swine feces. Shanks et al. (2010a) found the HuBac marker showed cross-sensitivity with feces from other animal hosts, most prominently with cats, dogs, and chickens. This leads staff to conclude that the HuBac marker was highly likely to correctly detect human waste material in samples from the watershed, but could have also counted other animal fecal waste in the total concentration value.

In regards to bovine host markers, Layton et al. (2006) found the BoBac genetic marker assay was specific for bovine fecal samples with 100% sensitivity and 0% cross-sensitivity with the other animal hosts evaluated. Shanks et al. (2010b) found that the BoBac genetic marker showed cross-sensitivity with feces from many other animal hosts, most prominently with sheep and pig feces. The bovine-specific genetic markers, CowM2 and CowM3, both showed 100% specificity with no detection of other animal host fecal wastes.

The use of the HF183 and HumM2 markers is recommended for future human-specific *Bacteroides* analyses and CowM2 and Rum2Bac markers for bovine-specific analyses, until such time that better technology becomes available. These recommendations are based on the research and review by Griffith et al. (2013) of studies on human-specific and bovine-specific genetic markers. Griffith et al. concluded that the HF183 and HumM2 markers should be used for measuring human fecal waste in environmental samples because they provide the best combination of sensitivity and specificity. Griffith et al. also suggests that bovine-specific assays use both the CowM2 and the Rum2Bac genetic markers if non-cow ruminants are present in the watershed.

3.2.2 Direct Measurement of Pathogens

Pathogenic bacteria, protozoans, and viruses are occasionally measured directly without relying on indicator bacteria species, and the ability to do so is increasing with continuing advances in DNA technology. No direct measurements of viruses were made in support of this TMDL project. But, direct measurements of specific bacteria and protozoans were available, as described below.

3.2.2.1 Bacteria Community

Analytical measurement technology has advanced to a point where entire bacterial communities are quantified instead of just specific fecal indicator bacteria groups or species. High-throughput DNA sequence analysis can potentially identify all sources of microbial contaminants in a single test by measuring the total diversity of microbial communities. The PhyloChip™ (Second Genome, San Bruno CA) is a phylogenetic DNA microarray that has 16S rRNA gene probes that can quantify 59,316 different bacterial taxa in a single water sample. Analyzing the comprehensive suite of bacteria in a sample can help identify specific disease-causing bacteria species, as well as the major sources of fecal waste pollution from which such disease-causing bacteria may be emanating (Hazen et al. 2010).

Analysis of the bacteria with the PhyloChip™ reveals strong differences in community composition among fecal wastes from human, birds, pinnipeds, and livestock. Differences in the diversity among fecal wastes reveal hundreds of unique taxa that are specific to human, bird, and livestock feces (Dubinsky et al. 2012). Actinobacteria, Bacilli, and many Gammaproteobacteria taxa discriminate birds from mammalian sources. Families within

the Clostridia and Bacteroidetes taxa discriminate between humans, livestock, and pinniped animal sources. Comprehensive interrogation of microbial communities for these diverse identifier taxa can assist in fecal waste source identification. Phylogenetic microarrays are an effective tool for rapidly measuring the full assortment of microbial taxa that discriminate sources of fecal contamination in surface waters. Similarly, phylogenetic microarrays are an effective tool for identifying the presence of specific potential human pathogens.

For the purpose of this TMDL, PhyloChip™ data was used in a manner like that of *Bacteroides* data. That is, PhyloChip™ data indicating the significant⁷ presence of human or bovine fecal waste was used as a line of evidence with which to interpret *E. coli* and enterococci findings. No pollution determinations were made on the basis of PhyloChip™ data, alone.

3.2.2.2 Cryptosporidium and Giardia Protozoa

Protozoans are unicellular organisms that are present primarily in the aquatic environment. Of the 35,000 known species of protozoans, almost 30 percent are pathogenic. Pathogenic protozoans can occur in humans and animals where they multiply in the intestinal tract of the infected individual or animal and are later excreted in feces as cysts. Protozoan cysts do not reproduce in the environment, but are capable of surviving dormant in the soil and surface water for extended periods of time, which makes them a prominent public health concern.

Two waterborne protozoans of major public health concern are *Giardia lamblia* and *Cryptosporidium parvum*. The *Giardia* organism inhabits the digestive tract of a wide variety of domestic and wild animal species, as well as humans. Once shed in feces, *Giardia* cysts are frequently found in rivers and lakes. Infection by *Giardia* can result in giardiasis in humans, which is characterized by gastroenteritis, particularly among the young and elderly. *Giardia* is considered nonpathogenic in cattle because it is usually found in animals that have normal feces and no sign of disease. However, among the human population, giardiasis affects approximately 200 million people worldwide and is one of the most prevalent waterborne diseases in the United States. *Cryptosporidium* species are a group of parasitic protozoa that are recognized as pathogens of domesticated livestock, poultry, and wildlife and are readily transmitted to humans. *Cryptosporidium* oocysts are about 4-6 µm in diameter, slightly larger than bacteria, and relatively unaffected by conventional methods of wastewater disinfection, such as

⁷ A 20% gene match or higher was used as the threshold to determine whether human or grazer-sourced pathogens were potentially significant at a given site (Dubinsky and Anderson, 2014).

chlorination. Infection by *Cryptosporidium* can cause cryptosporidiosis, whose symptoms include loss of appetite, nausea, and abdominal pain followed by acute or persistent diarrhea. Although *Cryptosporidium* infections are usually of short duration and self-limiting in individuals with an intact immune system, there is no specific treatment available and the infection can be life threatening in patients with profound impairment of immune function.

For the purpose of this TMDL, the direct measurement of protozoa was included in the Staff Report for general interest. No pollution determinations were made using direct measurement of protozoa, alone.

3.3 SUMMARY

The fecal coliform bacteria objective for REC-1 protection currently described in the Basin Plan is replaced by the statewide bacteria objective for *E. coli* in freshwater and enterococci in saline water. This TMDL is based on the statewide bacteria objectives. Since publication of the 2019 Staff Report and Action Plan, assessment results have been updated, when compared to previous versions, to eliminate consideration of fecal coliform data.

There are numerous other metrics with which to assess the potential for human exposure to illness-causing pathogens, including other fecal indicator bacteria, as well as direct measures of specific pathogens.

The North Coast Water Board's scientific peer reviewers strongly recommended the use of enterococci bacteria as a good indicator of human health exposure to pathogens in freshwaters. To conform to the results of the legally mandated scientific peer review process, national criteria for enterococci in freshwaters were also used to assess pollution.

The results of the TMDL Studies designed to support this TMDL are summarized in Chapter 6, Source Analysis. The results of the subwatershed-based Fecal Indicator Bacteria (FIB) and Microbial Source Tracking (MST) data analyses are summarized in Chapter 4, Evidence of Pollution.

Enterococci in freshwater was assessed but only in combination with other evidence that considered by itself would constitute evidence of pollution and the potential for human exposure to illness-causing pathogens.

CHAPTER 4

EVIDENCE OF POLLUTION

4.1 OVERVIEW

The development of a TMDL includes monitoring studies, analyses and assessments to help determine the geographic extent of the noted pollution and the sources of the pollution that need additional management and control. The Action Plan is designed to address both exceedances of water quality objectives for bacteria (e.g., as required of a TMDL under federal law) and evidence of pollution as demonstrated using other relevant and reliable metrics (e.g., under the authority of state law). As described in Chapter 3, using multiple lines of evidence to assess fecal waste pollution, beneficial use impacts, and the potential for exposure to illness-causing pathogens is reasonable and appropriate given the nature of pathogens and the evolving field of pathogen measurement and assessment. Individual metrics for the measurement of pathogens respond to environmental factors in different ways, indicating the efficacy of using multiple lines of evidence to ensure full public health protection. All the lines of evidence of fecal waste pollution are taken as a whole when describing an appropriate Program of Implementation to be implemented under state law.

The 2024 Section 303(d) List of Impaired Waters was partially approved by U.S. EPA on December 13, 2024, and does not include any changes to fecal indicator bacteria listings in the Russian River Watershed, reflecting those originally made in 2012. There are seven (7) waterbody-pollutant pairs, some encompassing multiple waterbody segments, in the Russian River Watershed identified in the 2024 Section 303(d) List as impaired for fecal indicator bacteria due to the failure to fully attain the Basin Plan bacteria water quality objective. This chapter and Chapter 6 together provide 1) data that shows exceedances of bacteria water quality objectives across the Russian River Watershed, 2) lines of evidence of widespread pathogen pollution using other pathogen indicators (e.g., *Bacteroides*, PhyloChip™, etc.), and 3) evidence of land characteristics across the whole watershed (e.g., developed sewer lands, developed non-sewer lands, lands with a high density of OWTs, etc.) that are associated with exceedances of water quality objectives. The TMDL Action Plan describes a program of implementation that addresses the pollution and impairment present in the whole watershed based on this evidence.

For the purposes of this TMDL, North Coast Water Board staff have conducted multiple monitoring studies to assess the geographic extent of fecal waste discharge in the Russian River Watershed and the potential for human exposure to pathogens. The results of the TMDL Studies (e.g., Land Cover Study, OWTs Study, and Recreation Study) are presented in Chapter 6 of this Staff Report. A primary conclusion from the TMDL Studies is that sewer and unsewer developed areas, areas with a high density of OWTs, and agricultural areas are associated with the delivery of fecal waste

material to waters of the Russian River in concentrations that risk pathogen exposure to humans and exceed water quality objectives. These land cover categories are distributed throughout the entire Russian River Watershed.

This chapter summarizes the analyses of FIB data, identifying monitoring locations where data show exceedances of bacteria water quality objectives for recreational water beneficial use. Much of the water quality data analyzed and reported in this chapter were collected as part of the TMDL Studies designed to assess the potential for human exposure to pathogens in the Russian River and inform the TMDL Action Plan. The TMDL Studies were designed to assess associations of land-use characteristics with potential for exceedances of water quality objectives and other human health based thresholds. They were not collected for the purpose of characterizing water quality conditions across the watershed. As such and for the most part, the detection of fecal waste pollution as presented here is limited to those areas where data were collected, with significant gaps especially in the upper and middle watershed. The results of the TMDL Studies as reported in Chapter 6, augment the analyses in this chapter which show widespread human fecal waste signature throughout the watershed and these combined results provide evidence of pollution across the whole watershed. These multiple lines of evidence of fecal waste pollution and impacts to beneficial use allow for robust, conservative conclusions regarding the geographic extent and sources of fecal waste pollution, as is appropriate for public health protection and reflected in the TMDL Action Plan.

Staff analyzed all the data collected as part of this TMDL to compare against the statewide REC-1 bacteria objectives and federal recreational water quality criteria, which are both based on *E. coli* and enterococci. Other data such as *Bacteroides* and microbial source tracking provide additional lines of evidence. Waterbody assessment between statewide objectives and federal criteria have two primary differences: (1) indicator bacteria used and (2) the assessment time frame.

- (1) Statewide objectives require different indicator bacteria depending on the waterbody's salinity. Enterococci data are applicable only to saline waters, which are defined by a salinity greater than 1 part per trillion (ppt) more than 5 percent of the time. Otherwise, *E. coli* must be used in freshwater, defined as less than 1 ppt for 95 percent or more of time. Federal criteria allow enterococci assessment regardless of the waterbody's salinity; however, *E. coli* may only be used in freshwater bodies, like statewide objectives.
- (2) Statewide objectives require geometric means (GM) to be calculated in six-week intervals with each interval rolling one week forward. For example, bacteria data spanning eight weeks have three six-week intervals—the first interval is week one through week six; the second interval is week two through week seven; and the third interval is week three through week eight. Weeks are based on the epidemiological

week, which starts on Sundays and ends on Saturdays. For assessing the percent of samples exceeding the STV values, statewide objectives use static calendar months (January, February, etc.). Federal criteria use static 30-day intervals for both GM calculations and counting STV exceedances.

E. coli exceedances are only calculated for freshwater stations. Enterococci exceedances are calculated for all stations. Freshwater stations' exceedances use the federal enterococci criteria, and saline stations use the statewide enterococci objectives. To simplify calculations and harmonize with statewide criteria, staff use calendar months for federal criteria instead of 30-day intervals. The minimum bacteria sample size for calculating the GM for a time interval is five, and the minimum sample size for STV exceedances is one. Tables 4.2 through 4.5 omit stations that do not meet the sample size requirements.

In summary, the evidence indicates that surface waters throughout the Russian River Watershed experience fecal waste pollution, as demonstrated by water samples with measured pathogen indicator bacteria concentrations that exceed the statewide bacteria objectives to protect REC-1, the U.S. EPA (2012) bacteria criteria for protection of recreation, and as corroborated by *Bacteroides* bacteria data, DNA analyses, the TMDL Studies, and other analytical methods. Though it is recognized that the greatest public use of the Russian River occurs during the summer months, water contact recreation is a beneficial use of the Russian River Watershed throughout the year. Evidence of pollution is based on data collected in both the wet and dry season, with the following general findings:

1. Concentrations of *E. coli* bacteria measured in numerous recreational beaches and streams in the watershed indicate a potential risk of illness during water contact recreation. These data also demonstrate periodic exceedances of the statewide bacteria objective for the protection of REC-1.
2. Concentrations of enterococci bacteria measured in numerous recreational beaches and streams in the watershed indicate a potential risk of illness during water contact recreation. These data also demonstrate periodic exceedances of the statewide REC-1 objective for saline waters and national REC-1 criteria recommended by the U.S. EPA (2012) for freshwaters. One of the scientific reviewers of this project specifically supported use of the U.S. EPA 2012 enterococci bacteria criteria as an important line of evidence relative to public health protection in freshwaters.
3. Human-specific and bovine-specific *Bacteroides* bacteria are found in almost all sampling locations in the watershed. Detections of human and bovine *Bacteroides* bacteria in association with *E. coli* and/or enterococci bacteria confirm the likelihood that exceedances of the statewide *E. coli* and enterococci bacteria objectives or the U.S. EPA 2012 enterococci criteria are related to fecal waste pollution and not other

environmental causes.

4. Microbiological source identification using PhyloChip™ phylogenetic DNA microarray associate specific animal sources with elevated concentrations of fecal indicator bacteria. These data confirm the presence of fecal waste in the water column in several locations where samples were analyzed.
5. Bacteria species that are potential human pathogens are found at numerous locations in the watershed. These data confirm the potential for exposure to illness-causing pathogens via water contact.
6. The 2024 Section 303(d) List of Impaired Waters identifies several reaches of the mainstem Russian River and several tributaries as impaired for indicator bacteria.
7. Public health advisories warning of potential risk of illness from recreational water contact have been posted at mainstem Russian River beaches and as a permanent advisory along Santa Rosa Creek.
8. Land cover types, season, OWTS density, and recreation intensity are associated with exceedance of water quality objectives and impacts to beneficial uses, as identified in the TMDL Studies summarized in Chapter 6.

Sampling locations for *E. coli*, enterococci, and *Bacteroides* were established at multiple places throughout the watershed, as described in Table 4.1 and depicted in Figure 4.1. Not all parameters were measured at every location.

Table 4.1: Sample Locations for *E. coli*, enterococci, and *Bacteroides*

Hydrologic Area	Hydrologic Subarea	Station Code	Location
Lower Russian River	Guerneville	114DB0147	Dutch Bill Creek at Fir Road
Lower Russian River	Guerneville	114RR1898	Russian River at Forestville Access Beach
Lower Russian River	Guerneville	114RR1325	Russian River at Johnson's Beach
Lower Russian River	Guerneville	114RR0898	Russian River at Monte Rio Beach
Lower Russian River	Guerneville	114C12FSM	Unnamed Tributary at Foothill Drive
Lower Russian River	Guerneville	114C05MNS	Unnamed Tributary at Main Street
Lower Russian River	Guerneville	114C13LSA	Unnamed Tributary at Market Street

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Hydrologic Area	Hydrologic Subarea	Station Code	Location
Lower Russian River	Guerneville	114C03OMR	Unnamed Tributary at Old Monte Rio Road
Lower Russian River	Guerneville	114C02SPR	Unnamed Tributary at River Drive
Lower Russian River	Guerneville	114C01EDR	Unnamed Tributary at River Road near Duncan Road
Lower Russian River	Guerneville	114C06VRG	Unnamed Tributary at River Road near Rio Nido
Lower Russian River	Guerneville	114GV2455	Green Valley Creek at Martinelli Road
Lower Russian River	Guerneville	114RR2036	Russian River at Steelhead Beach
Lower Russian River	Guerneville	114DDRC59	Unnamed Tributary at Del Rio Court
Lower Russian River	Guerneville	114C04TRF	Unnamed Tributary at Trenton Road
Lower Russian River	Guerneville	114RR0066	Russian River at Jenner Boat Ramp
Lower Russian River	Guerneville	114AT0714	Atascadero Creek at Green Valley Road
Lower Russian River	Guerneville	114RR2370	Russian River at Riverfront Park
Lower Russian River	Guerneville	Hacienda_Bridge_SCWA	Russian River at Hacienda Bridge
Lower Russian River	Guerneville	114C07MRC	Unnamed Tributary at Moscow Road
Lower Russian River	Guerneville	114UL3960	Unnamed Tributary at Old Redwood Highway
Lower Russian River	Guerneville	114UM0355	Mays Creek at Neeley Road
Lower Russian River	Guerneville	Bridgehaven_SCWA	Russian River at Bridgehaven
Lower Russian River	Guerneville	Casini_Ranch_SCWA	Russian River at Casini Ranch
Lower Russian River	Guerneville	Duncans_Mills_SCWA	Russian River at Duncans Mills
Middle Russian River	Geyserville	114RR3119	Russian River at Camp Rose Beach
Middle Russian River	Geyserville	114RR2940	Russian River at Healdsburg Veterans Memorial Beach

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Hydrologic Area	Hydrologic Subarea	Station Code	Location
Middle Russian River	Geyserville	114DFMR68	Unnamed Tributary at Fitch Mountain Road
Middle Russian River	Geyserville	114C11RDH	Unnamed Tributary at Redwood Drive
Middle Russian River	Geyserville	114RR5652	Russian River at Crocker Road
Middle Russian River	Geyserville	114RR5748	Russian River at Cloverdale River Park
Middle Russian River	Geyserville	114RR4234	Russian River at Alexander Valley Road
Middle Russian River	Geyserville	114RR4751	Russian River at Highway 128
Middle Russian River	Geyserville	114C10AVR	Unnamed Tributary at Alexander Valley Road
Middle Russian River	Geyserville	114C08FRS	Unnamed Tributary at Fredson Road
Middle Russian River	Geyserville	Diggers_Bend SCWA	Russian River at Diggers Bend
Middle Russian River	Laguna	114LG3411	Laguna de Santa Rosa at Sebastopol Community Center
Middle Russian River	Laguna	114LG0916	Laguna de Santa Rosa at Guerneville Road
Middle Russian River	Laguna	114BL1999	Blucher Creek at Lone Pine Road
Middle Russian River	Laguna	114CO0655	Copeland Creek at Commerce Drive
Middle Russian River	Laguna	114CR3673	Crane Creek at Snyder Lane
Middle Russian River	Laguna	114GO0351	Gossage Creek at Gilmore Avenue
Middle Russian River	Laguna	114US1675	Unnamed Tributary at Sanford Road
Middle Russian River	Laguna	114UT3915	Unnamed Tributary at Turner and Daywalt Road
Middle Russian River	Mark West	114MW0930	Mark West Creek at Trenton-Healdsburg Road
Middle Russian River	Mark West	114UR3927	Unnamed Tributary at River Road
Middle Russian River	Mark West	114VB0410	Van Buren Creek at St. Helena Road

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Hydrologic Area	Hydrologic Subarea	Station Code	Location
Middle Russian River	Santa Rosa	114SR3260	Santa Rosa Creek at Railroad Street
Middle Russian River	Santa Rosa	114SR6158	Santa Rosa Creek at Los Alamos Road
Middle Russian River	Santa Rosa	114PI0729	Piner Creek at Fulton Road
Middle Russian River	Santa Rosa	114UW0048	Abramson Creek at Willowside Road Levy
Middle Russian River	Santa Rosa	C1-SRC-D	C1- Santa Rosa Creek down gradient of urban footprint
Middle Russian River	Santa Rosa	C2-SRC-U	C2- Santa Rosa Creek up gradient of urban footprint
Middle Russian River	Warm Springs	114C09WDC	Unnamed Tributary at West Dry Creek Road
Middle Russian River	Warm Springs	114FO3662	Foss Creek at Matheson Street
Middle Russian River	Warm Springs	114PA3647	Palmer Creek at Palmer Creek Road
Middle Russian River	Warm Springs	114UD0000	Unnamed Tributary at Lambert Bridge Road
Upper Russian River	Coyote Valley	114EF6320	Russian River, East Fork at East Road
Upper Russian River	Forsythe Creek	114RR9181	Russian River at East School Way
Upper Russian River	Ukiah	114RR6273	Russian River at Highway 101
Upper Russian River	Ukiah	114RR6968	Russian River at River Road near Hopland
Upper Russian River	Ukiah	114RR8709	Russian River at Lake Mendocino Drive
Upper Russian River	Ukiah	114RR8265	Russian River at Talmage Road
Upper Russian River	Ukiah	114RR8402	Russian River at Vichy Springs Road

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

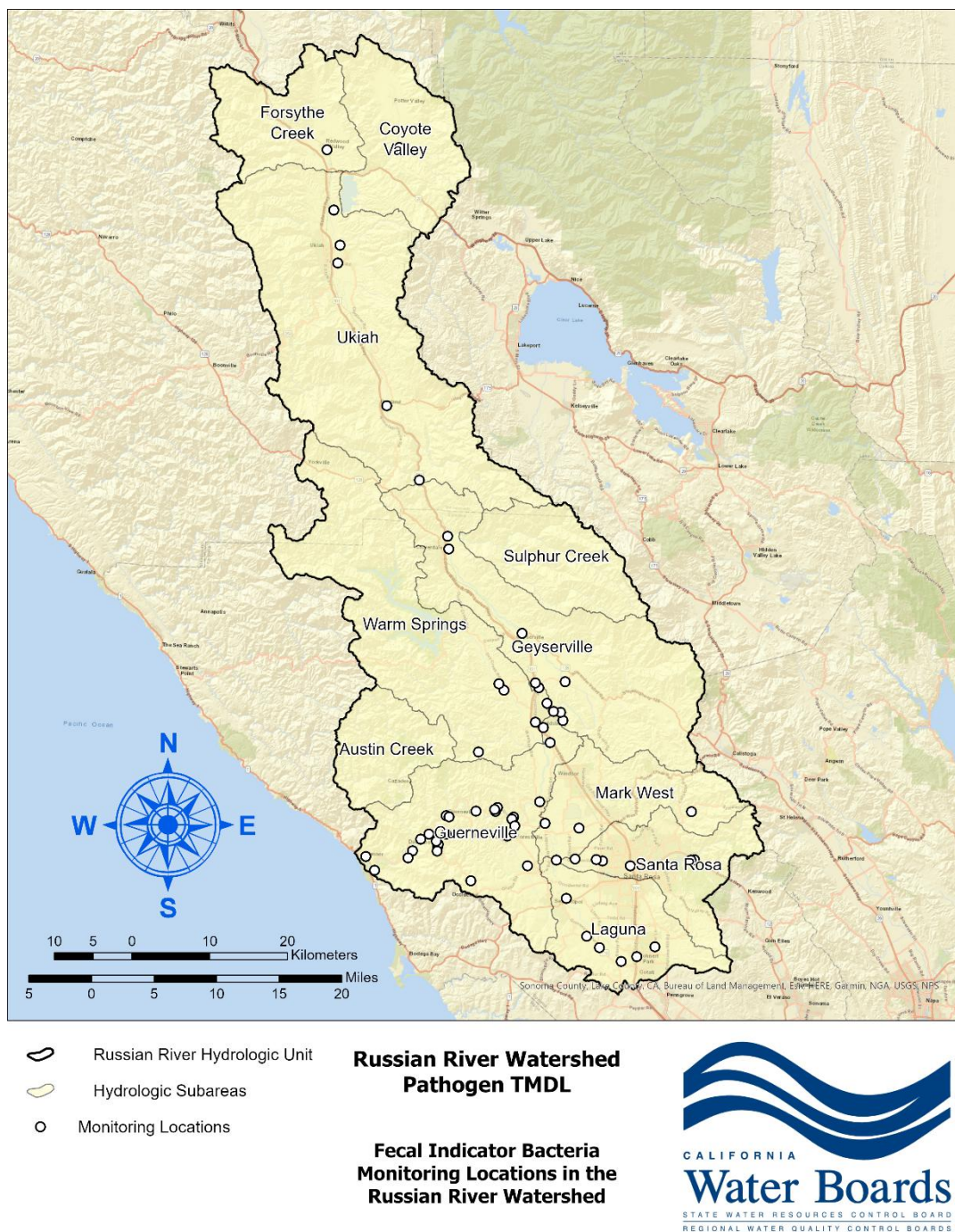


Figure 4.1 Fecal Indicator Bacteria Monitoring Locations

4.2 ASSESSMENT OF *E. COLI*/BACTERIA CONCENTRATIONS

E. coli bacteria data from the Russian River Watershed were compiled from three agencies: the North Coast Water Board, the Sonoma County Water Agency, and the University of California (UC) Davis Aquatic Ecosystems Analysis Laboratory. Sample locations are representative of the range of streams and rivers in the watershed. Water samples were collected at 64 locations from 2001 to 2017 for analysis of *E. coli* bacteria concentrations (NCRWQCB 2012, 2013a, 2013b).

Water samples were analyzed by IDEXX Colilert and were either undiluted or serially diluted 1:10, resulting in a minimum reporting limit of 1 or 10 MPN/100 mL and a maximum reporting limit of 2,419 or 24,196 MPN/100 mL. Sample measurements below and above analytical reporting limits are called censored data. When bacteria concentration results were beyond any of these limits, the reporting limit was substituted for censored data. The results of the assessment for *E. coli* bacteria concentrations are presented by Hydrologic Subarea and monitoring location in Table 4.2, Table 4.3, Figure 4.2, and Figure 4.3. Table 4.2 and Table 4.3 show, respectively, the number of STV and geometric mean exceedances of the State objective over the total number of sample periods or calculations.

Table 4.2: *E. coli* Bacteria Data – Comparison of Results to STV Water Quality Objectives

Hydrologic Subarea	Location	Calendar Months with Data	Months Exceeding STV ¹ Objectives
Guerneville	Atascadero Creek at Green Valley Road	6	4
Laguna	Blucher Creek at Lone Pine Road	4	3
Guerneville	Unnamed Tributary at River Road near Duncan Road	3	1
Guerneville	Unnamed Tributary at River Drive	3	1
Guerneville	Unnamed Tributary at Old Monte Rio Road	3	3
Guerneville	Unnamed Tributary at Trenton Road	4	4
Guerneville	Unnamed Tributary at Main Street	4	0

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Hydrologic Subarea	Location	Calendar Months with Data	Months Exceeding STV¹ Objectives
Guerneville	Unnamed Tributary at River Road near Rio Nido	3	2
Guerneville	Unnamed Tributary at Moscow Road	1	1
Geyserville	Unnamed Tributary at Fredson Road	4	4
Warm Springs	Unnamed Tributary at West Dry Creek Road	4	3
Geyserville	Unnamed Tributary at Alexander Valley Road	4	0
Geyserville	Unnamed Tributary at Redwood Drive	4	4
Guerneville	Unnamed Tributary at Foothill Drive	1	1
Guerneville	Unnamed Tributary at Market Street	3	0
Laguna	Copeland Creek at Commerce Drive	4	2
Laguna	Crane Creek at Snyder Lane	4	2
Guerneville	Dutch Bill Creek at Fir Road	8	1
Guerneville	Unnamed Tributary at Del Rio Court	3	2
Geyserville	Unnamed Tributary at Fitch Mountain Road	4	1
Coyote Valley	Russian River, East Fork at East Road	1	1
Warm Springs	Foss Creek at Matheson Street	12	10
Laguna	Gossage Creek at Gilmore Avenue	4	2
Guerneville	Green Valley Creek at Martinelli Road	13	7
Laguna	Laguna de Santa Rosa at Guerneville Road	5	3

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Hydrologic Subarea	Location	Calendar Months with Data	Months Exceeding STV¹ Objectives
Laguna	Laguna de Santa Rosa at Sebastopol Community Center	13	9
Mark West	Mark West Creek at Trenton-Healdsburg Road	3	0
Warm Springs	Palmer Creek at Palmer Creek Road	5	1
Santa Rosa	Piner Creek at Fulton Road	6	4
Guerneville	Russian River at Monte Rio Beach	52	4
Guerneville	Russian River at Johnson's Beach	50	2
Guerneville	Russian River at Forestville Access Beach	29	1
Guerneville	Russian River at Steelhead Beach	47	1
Guerneville	Russian River at Riverfront Park	6	0
Geyserville	Russian River at Healdsburg Veterans Memorial Beach	50	2
Geyserville	Russian River at Camp Rose Beach	50	1
Geyserville	Russian River at Alexander Valley Road	20	1
Geyserville	Russian River at Highway 128	14	2
Geyserville	Russian River at Crocker Road	3	0
Geyserville	Russian River at Cloverdale River Park	17	0
Ukiah	Russian River at Highway 101	20	1
Ukiah	Russian River at River Road near Hopland	7	0
Ukiah	Russian River at Talmage Road	1	0
Ukiah	Russian River at Vichy Springs Road	1	0

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Hydrologic Subarea	Location	Calendar Months with Data	Months Exceeding STV¹ Objectives
Ukiah	Russian River at Lake Mendocino Drive	1	0
Forsythe Creek	Russian River at East School Way	1	0
Santa Rosa	Santa Rosa Creek at Railroad Street	36	32
Santa Rosa	Santa Rosa Creek at Los Alamos Road	13	7
Warm Springs	Unnamed Tributary at Lambert Bridge Road	4	2
Guerneville	Unnamed Tributary at Old Redwood Highway	4	3
Guerneville	Mays Creek at Neeley Road	3	1
Mark West	Unnamed Tributary at River Road	4	1
Laguna	Unnamed Tributary at Sanford Road	4	3
Laguna	Unnamed Tributary at Turner and Daywalt Road	4	4
Santa Rosa	Abramson Creek at Willowside Road Levy	4	3
Mark West	Van Buren Creek at St. Helena Road	4	1
Santa Rosa	C1- Santa Rosa Creek down gradient of urban footprint	49	16
Santa Rosa	C2- Santa Rosa Creek up gradient of urban footprint	48	8
Geyserville	Russian River at Diggers Bend	6	0
Guerneville	Russian River at Hacienda Bridge	6	0

¹ The numbers shown are the count of calendar months where the proportion of water quality samples exceeding 320 cfu/100 mL is greater than 10 percent

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

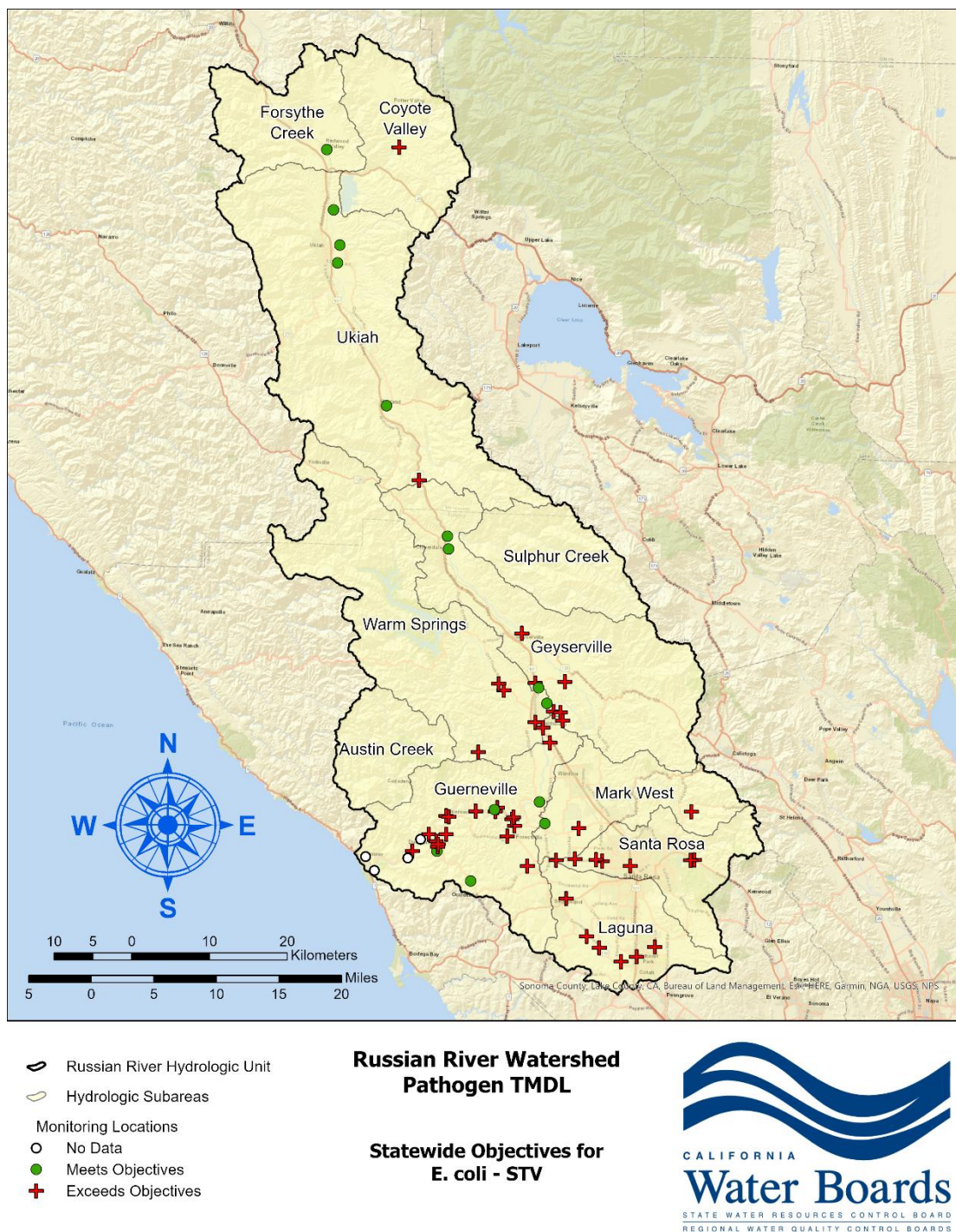


Figure 4.2 Exceedance of STV Bacteria Objectives for E. Coli

Table 4.3: E. coli Bacteria Data – Comparison of Results to Geometric Mean Water Quality Objectives

Hydrologic Subarea	Location	Number of 6-Week Geometric Means	Geometric Means Exceeding Objectives¹
Guerneville	Atascadero Creek at Green Valley Road	2	2
Guerneville	Dutch Bill Creek at Fir Road	18	0
Warm Springs	Foss Creek at Matheson Street	2	2
Guerneville	Green Valley Creek at Martinelli Road	17	6
Laguna	Laguna de Santa Rosa at Guerneville Road	2	2
Laguna	Laguna de Santa Rosa at Sebastopol Community Center	19	9
Mark West	Mark West Creek at Trenton-Healdsburg Road	6	4
Guerneville	Russian River at Monte Rio Beach	140	1
Guerneville	Russian River at Johnson's Beach	133	0
Guerneville	Russian River at Forestville Access Beach	78	0
Guerneville	Russian River at Steelhead Beach	123	0
Guerneville	Russian River at Riverfront Park	18	0
Geyserville	Russian River at Healdsburg Veterans Memorial Beach	134	0
Geyserville	Russian River at Camp Rose Beach	133	0
Geyserville	Russian River at Alexander Valley Road	57	0
Geyserville	Russian River at Highway 128	34	0

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Hydrologic Subarea	Location	Number of 6-Week Geometric Means	Geometric Means Exceeding Objectives¹
Geyserville	Russian River at Crocker Road	13	0
Geyserville	Russian River at Cloverdale River Park	40	0
Ukiah	Russian River at Highway 101	52	0
Ukiah	Russian River at River Road near Hopland	18	0
Santa Rosa	Santa Rosa Creek at Railroad Street	57	55
Santa Rosa	Santa Rosa Creek at Los Alamos Road	26	22
Geyserville	Russian River at Diggers Bend	17	0
Guerneville	Russian River at Hacienda Bridge	18	0

¹ The numbers shown are the count of geometric mean calculations that exceed 100 cfu/100 mL

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

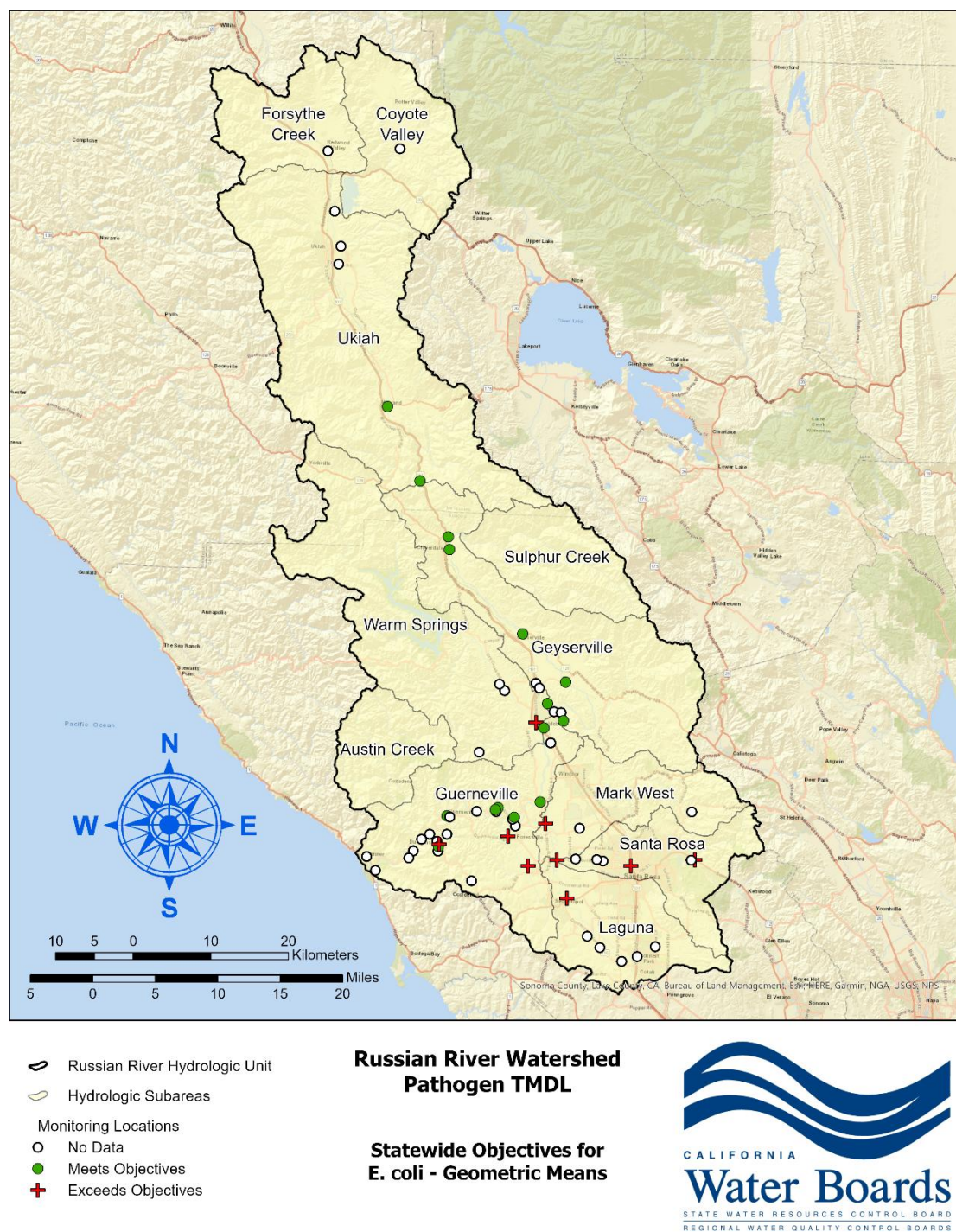


Figure 4.3: Exceedances of Geometric Mean Bacteria Objectives For E. Coli

4.3 ASSESSMENT OF ENTEROCOCCI BACTERIA CONCENTRATIONS

Enterococci bacteria data from the Russian River Watershed were compiled from three agencies: the North Coast Water Board, the Sonoma County Water Agency, and the University of California (UC) Davis Aquatic Ecosystems Analysis Laboratory. Sample locations are representative of the range of streams and rivers in the watershed. Water samples were collected at 29 locations from 2001 to 2013 for analysis of enterococci bacteria concentrations (NCRWQCB 2012, 2013a, 2013b).

Water samples were analyzed by IDEXX Enterolert and were either undiluted or serially diluted 1:10, resulting in a minimum reporting limit of 1 or 10 MPN/100 mL and a maximum reporting limit of 2,419 or 24,196 MPN/100 mL. Sample measurements below and above analytical reporting limits are called censored data. When bacteria concentration results were beyond any of these limits, the reporting limit was substituted for censored data. Enterococci data in saline stations were assessed using a rolling 6-week geometric mean in accordance with the statewide bacteria objective. Data collected at the Jenner Boat Ramp, Bridgehaven, and Duncan Mills locations within the Guerneville Hydrologic Subarea (i.e., the estuary) were treated this way. Enterococci data in freshwater stations were assessed using static calendar month geometric means in accordance with the U.S. EPA criteria. The U.S. EPA criteria for enterococci are set as a geometric mean (30 cfu/100 mL) or the statistical threshold value (110 cfu/100 mL) to ensure no more than 32 illnesses per 1000 recreators, as defined by U.S. EPA (2012). All STV exceedances were assessed based on static calendar months regardless of a station's salinity.

While the statewide bacteria objective for freshwater is based on *E. coli*, one of the scientific peer reviewers of this project recommended use of U.S. EPA (2012) enterococci bacteria criteria in freshwater because of the strength of the epidemiological relationships. Use of enterococci bacteria in freshwater as a line of evidence in this project affirms the importance of scientific peer review, strengthens the conclusions regarding fecal waste pollution, and is allowed under state law. The results of the assessment for enterococci bacteria concentrations are presented in Table 4.4, Table 4.5, Figure 4.4, and Figure 4.5.

Table 4.4: Enterococci Bacteria Data – Comparison of Results to STV Water Quality Objectives and Criteria

Hydrologic Subarea	Location	Calendar Months with Data	Months Exceeding STV¹ Objectives or Criteria
Guerneville	Russian River at Jenner Boat Ramp ²	19	6
Guerneville	Russian River at Bridgehaven ²	5	1
Guerneville	Russian River at Duncans Mills ²	5	0
Guerneville	Atascadero Creek at Green Valley Road	5	3
Laguna	Blucher Creek at Lone Pine Road	4	3
Guerneville	Unnamed Tributary at River Road near Duncan Road	3	3
Guerneville	Unnamed Tributary at River Drive	3	3
Guerneville	Unnamed Tributary at Old Monte Rio Road	3	3
Guerneville	Unnamed Tributary at Trenton Road	4	3
Guerneville	Unnamed Tributary at Main Street	3	1
Guerneville	Unnamed Tributary at River Road near Rio Nido	3	3
Guerneville	Unnamed Tributary at Moscow Road	1	0
Geyserville	Unnamed Tributary at Fredson Road	4	3

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Hydrologic Subarea	Location	Calendar Months with Data	Months Exceeding STV¹ Objectives or Criteria
Warm Springs	Unnamed Tributary at West Dry Creek Road	4	4
Geyserville	Unnamed Tributary at Alexander Valley Road	4	3
Geyserville	Unnamed Tributary at Redwood Drive	4	3
Guerneville	Unnamed Tributary at Foothill Drive	1	1
Guerneville	Unnamed Tributary at Market Street	3	2
Laguna	Copeland Creek at Commerce Drive	4	3
Laguna	Crane Creek at Snyder Lane	4	4
Guerneville	Dutch Bill Creek at Fir Road	8	2
Guerneville	Unnamed Tributary at Del Rio Court	3	3
Geyserville	Unnamed Tributary at Fitch Mountain Road	4	2
Coyote Valley	Russian River, East Fork at East Road	1	1
Warm Springs	Foss Creek at Matheson Street	10	8
Laguna	Gossage Creek at Gilmore Avenue	5	3
Guerneville	Green Valley Creek at Martinelli Road	13	10

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Hydrologic Subarea	Location	Calendar Months with Data	Months Exceeding STV¹ Objectives or Criteria
Laguna	Laguna de Santa Rosa at Guerneville Road	5	3
Laguna	Laguna de Santa Rosa at Sebastopol Community Center	13	10
Mark West	Mark West Creek at Trenton-Healdsburg Road	3	2
Warm Springs	Palmer Creek at Palmer Creek Road	5	2
Santa Rosa	Piner Creek at Fulton Road	4	2
Guerneville	Russian River at Monte Rio Beach	39	7
Guerneville	Russian River at Johnson's Beach	26	2
Guerneville	Russian River at Forestville Access Beach	29	2
Guerneville	Russian River at Steelhead Beach	36	2
Guerneville	Russian River at Riverfront Park	6	0
Geyserville	Russian River at Healdsburg Veterans Memorial Beach	37	1
Geyserville	Russian River at Camp Rose Beach	36	3
Geyserville	Russian River at Alexander Valley Road	20	5
Geyserville	Russian River at Highway 128	14	3

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Hydrologic Subarea	Location	Calendar Months with Data	Months Exceeding STV¹ Objectives or Criteria
Geyserville	Russian River at Crocker Road	3	2
Geyserville	Russian River at Cloverdale River Park	17	2
Ukiah	Russian River at Highway 101	20	5
Ukiah	Russian River at River Road near Hopland	7	0
Ukiah	Russian River at Talmage Road	1	0
Ukiah	Russian River at Vichy Springs Road	1	0
Ukiah	Russian River at Lake Mendocino Drive	1	1
Forsythe Creek	Russian River at East School Way	1	0
Santa Rosa	Santa Rosa Creek at Railroad Street	30	23
Santa Rosa	Santa Rosa Creek at Los Alamos Road	11	9
Warm Springs	Unnamed Tributary at Lambert Bridge Road	4	3
Guerneville	Unnamed Tributary at Old Redwood Highway	4	4
Guerneville	Mays Creek at Neeley Road	3	2
Mark West	Unnamed Tributary at River Road	4	2

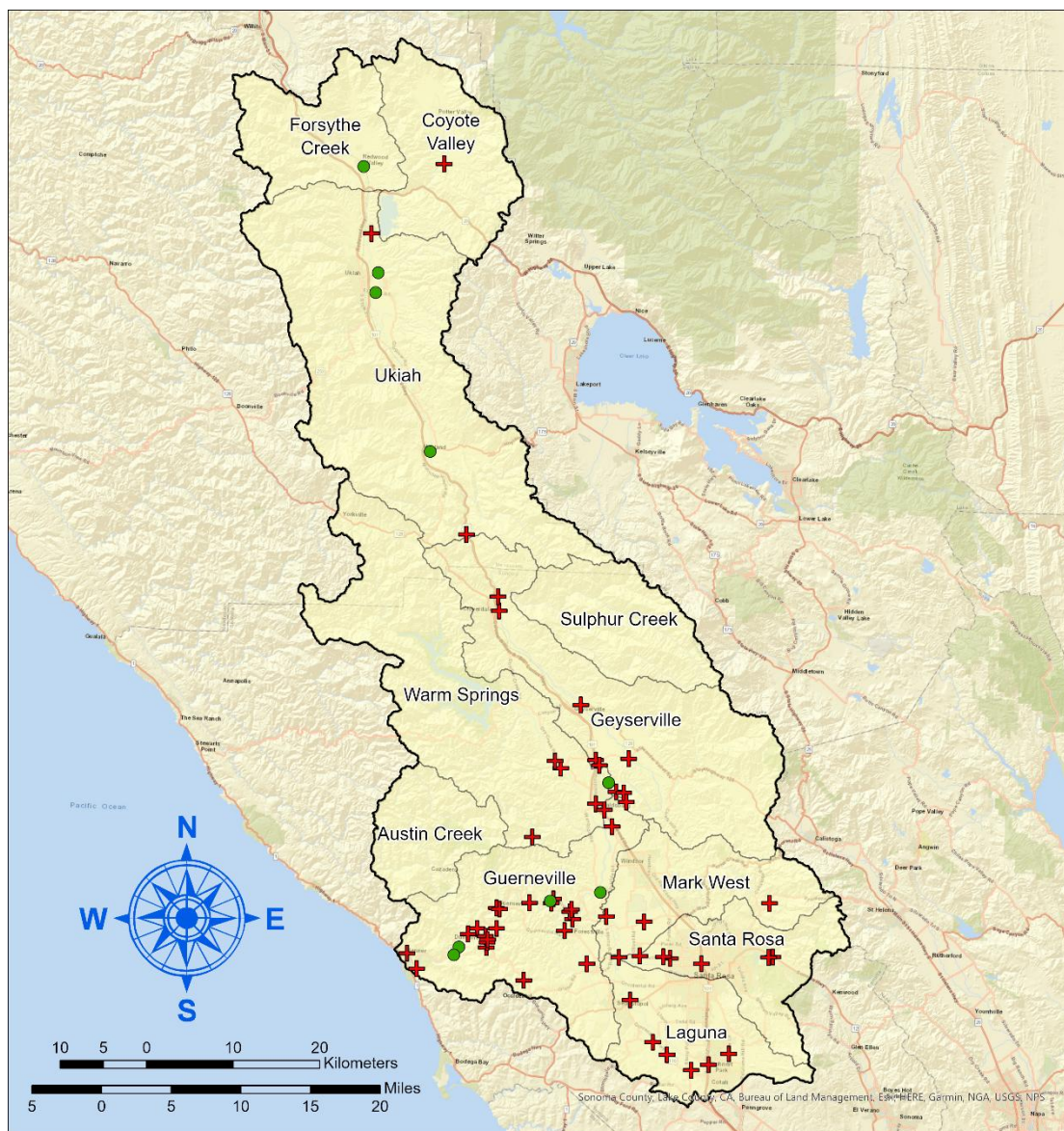
Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Hydrologic Subarea	Location	Calendar Months with Data	Months Exceeding STV¹ Objectives or Criteria
Laguna	Unnamed Tributary at Sanford Road	4	3
Laguna	Unnamed Tributary at Turner and Daywalt Road	4	3
Santa Rosa	Abramson Creek at Willowside Road Levy	4	2
Mark West	Van Buren Creek at St. Helena Road	4	1
Santa Rosa	C1- Santa Rosa Creek down gradient of urban footprint	11	7
Santa Rosa	C2- Santa Rosa Creek up gradient of urban footprint	2	1
Guerneville	Russian River at Casini Ranch	5	1
Geyserville	Russian River at Diggers Bend	6	0
Guerneville	Russian River at Hacienda Bridge	6	0

¹ The numbers shown are the count of calendar months where the proportion of water quality samples exceeding 110 cfu/100 mL is greater than 10 percent, based on the federal enterococci criteria for recreational use, except for the Jenner Boat Ramp, Bridgehaven, and Duncan Mills locations.

² The statewide bacteria objective includes a geomean and STV for enterococci, which applies to saline waters. Saline waters are those in which salinity exceeds 1 part per thousand more than 5% of the time during the calendar year. The Jenner Boat Ramp, Bridgehaven, and Duncan Mills locations meet this salinity threshold and follow the state enterococci STV objective, which is 110 cfu/100 mL.

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed



- Russian River Hydrologic Unit
- Hydrologic Subareas
- Monitoring Locations
 - No Data
 - Meets Objectives/Criteria
 - Exceeds Objectives/Criteria

**Russian River Watershed
Pathogen TMDL**

**Statewide Objectives and
Federal Criteria for
Enterococcus - STV**



**Figure 4.4: Exceedances of STV Bacteria Objectives and Criteria for
Enterococcus**

Table 4.5 Enterococci Bacteria Data – Comparison of Results to Geometric Mean Water Quality Objectives and Criteria

Hydrologic Subarea	Location	Number of Geometric Means Calculated	Geometric Means Exceeding Objectives or Criteria¹
Guerneville	Dutch Bill Creek at Fir Road	3	0
Guerneville	Green Valley Creek at Martinelli Road	2	1
Laguna	Laguna de Santa Rosa at Sebastopol Community Center	2	2
Geyserville	Russian River at Alexander Valley Road	9	4
Guerneville	Russian River at Bridgehaven ²	12	0
Geyserville	Russian River at Camp Rose Beach	13	5
Geyserville	Russian River at Cloverdale River Park	7	2
Geyserville	Russian River at Crocker Road	3	2
Geyserville	Russian River at Diggers Bend	1	1
Guerneville	Russian River at Duncans Mills ²	12	0
Guerneville	Russian River at Forestville Access Beach	13	0
Guerneville	Russian River at Hacienda Bridge	1	0
Geyserville	Russian River at Healdsburg Veterans Memorial Beach	14	0
Ukiah	Russian River at Highway 101	6	2
Geyserville	Russian River at Highway 128	5	1
Guerneville	Russian River at Jenner Boat Ramp ²	30	5

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Hydrologic Subarea	Location	Number of Geometric Means Calculated	Geometric Means Exceeding Objectives or Criteria¹
Guerneville	Russian River at Johnson's Beach	12	3
Guerneville	Russian River at Monte Rio Beach	15	3
Ukiah	Russian River at River Road near Hopland	1	1
Guerneville	Russian River at Riverfront Park	1	0
Guerneville	Russian River at Steelhead Beach	13	2
Santa Rosa	Santa Rosa Creek at Los Alamos Road	3	3
Santa Rosa	Santa Rosa Creek at Railroad Street	5	2

¹ Unless otherwise noted (see below), the numbers shown are the count of calendar months whose geometric means exceed 30 cfu/100 mL, based on the federal enterococci criteria for recreational use, except for the Jenner Boat Ramp, Bridgehaven, and Duncan Mills locations.

² The statewide bacteria objective includes a geomean and STV for enterococci, which applies to saline waters. Saline waters are those in which salinity exceeds 1 part per thousand more than 5% of the time during the calendar year. The Jenner Boat Ramp, Bridgehaven, and Duncan Mills locations meet this salinity threshold. For these stations, the third column contains the number of 6-week geometric mean calculations and the fourth column is equal to the number of geometric means exceeding 30 cfu/100 mL.

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

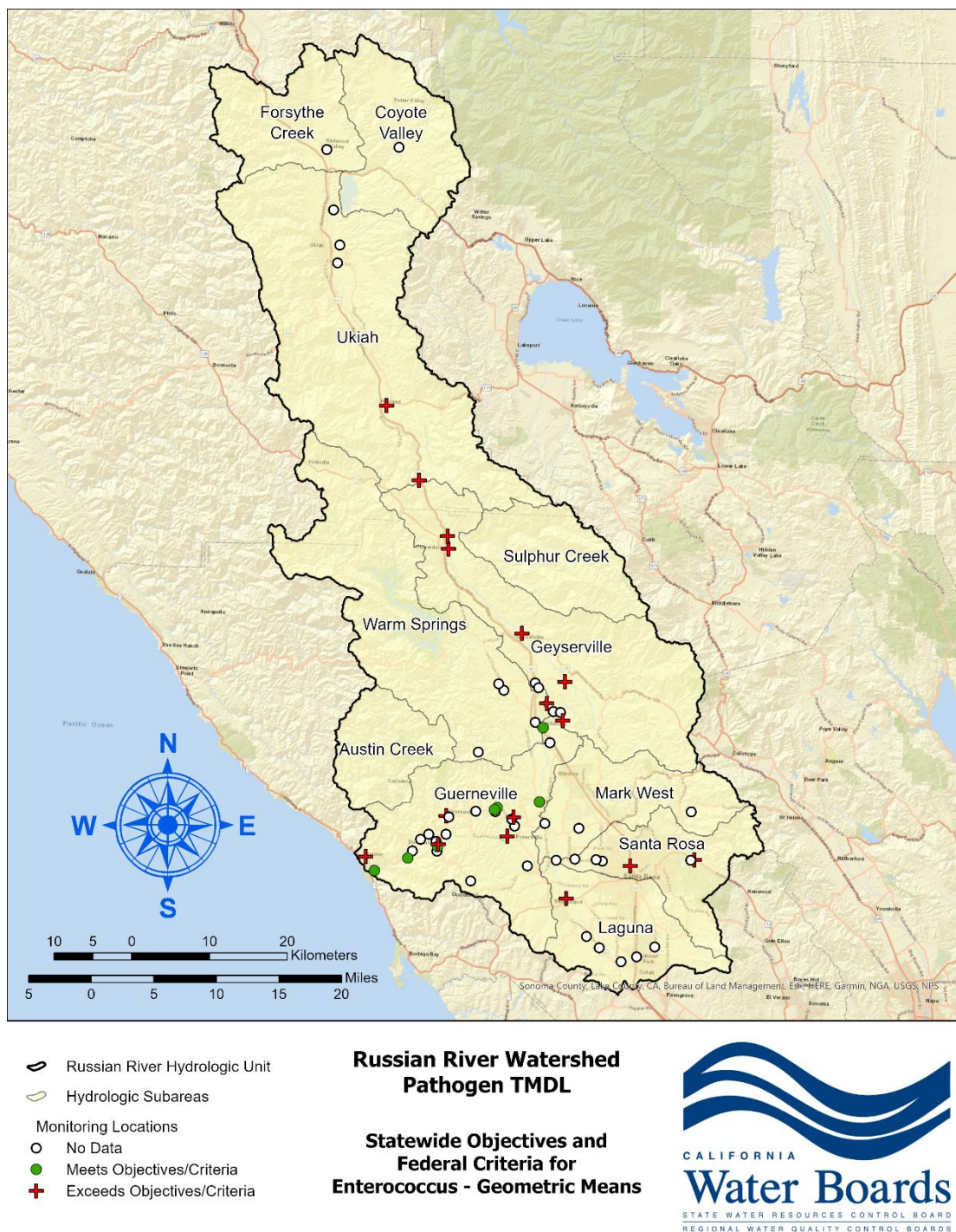


Figure 4.5: Exceedances of Geometric Mean Bacteria Objectives and Criteria for Enterococcus

4.4 ASSESSMENT OF *BACTEROIDES* BACTERIA CONCENTRATIONS

North Coast Water Board staff collected water samples for measurement of human-specific and bovine-specific *Bacteroides* bacteria at numerous locations in the Russian River Watershed from 2011 to 2013 (NCRWQCB 2012; NCRWQCB 2013a; NCRWQCB 2013b). Sample locations represent the range of streams and rivers in the watershed. Staff collected samples from waterbodies during both wet and dry periods and from a range of flows. Sample locations were in waterbodies that drain the wide range of land uses (from urban to undeveloped) and geomorphic features (from bedrock to alluvial landscapes) in the watershed.

Bacteroides bacteria are a suitable indicator of a waterbody's bacteriological quality since the bacteria come from the gastrointestinal systems of mammals, they degrade rapidly outside of the body, and technology is available to trace the bacteria back to specific types of animals, including humans and domestic animals. Human-specific and bovine-specific *Bacteroides* bacteria data were compared to the current laboratory reporting limit of 60 gene copies/100 mL for human-specific *Bacteroides* and 30 gene copies/100 mL for bovine-specific *Bacteroides*. Any measurements above the reporting limit indicate a likelihood that fecal waste material is present and the bacteriological quality of the water has been degraded. Human-specific *Bacteroides* were analyzed with the HuBac genetic marker and the Bovine-specific *Bacteroides* were analyzed with the BoBac genetic marker following U.S. EPA (2010) Method B.

The median concentrations of human-specific and bovine-specific *Bacteroides* measured at each location in the mainstem Russian River Watershed and tributaries are shown in Figure 4.6 and listed in Tables 4.6 and 4.7, respectively. Stations showing *Bacteroides* concentrations of >10,000 gene copies/100 mL indicate very strong evidence of water quality degradation. As a general recommendation, those Hydrologic Subareas with median *Bacteroides* concentrations >10,000 gene copies/100 mL should be considered for additional monitoring. High concentrations of human-specific *Bacteroides* bacteria indicate the presence of human fecal sources requiring control. High concentrations of bovine-specific *Bacteroides* bacteria indicate the presence of bovine fecal sources requiring control.

Assessment of the human-specific *Bacteroides* bacteria data shows that bacteria from human waste are widespread throughout the Russian River Watershed. Human-specific *Bacteroides* bacteria are present at levels that exceed the current laboratory reporting limit (60 gene copies/100 mL for human-specific *Bacteroides*) in all 18 mainstem locations, and in all but seven of the 20 tributary locations sampled by North Coast Water Board staff. Of the 149 samples collected in these 38 sites, 95% of the samples exceed the analytical reporting limit, meaning that 95% of the samples contain detectable levels of human-source *Bacteroides* bacteria. Table 4.6 and Figure 4.6 summarize these results.

Table 4.6 Human-specific Bacteroides in the Russian River

Hydrologic Subarea	Location	Median Concentration (gene copies per 100 mL)^{1,2}	Number of Bacteroides Measurements
Guerneville	Dutch Bill Creek at Fir Road	223	2
Guerneville	Green Valley Creek at Martinelli Road	17,016	2
Laguna	Laguna de Santa Rosa at Sebastopol Community Center	7,469	2
Geyserville	Russian River at Alexander Valley Road	6,809	5
Geyserville	Russian River at Camp Rose Beach	11,100	5
Geyserville	Russian River at Cloverdale River Park	1,087	2
Geyserville	Russian River at Crocker Road	573	3
Forsythe Creek	Russian River at East School Way	978	3
Guerneville	Russian River at Forestville Access Beach	57,553	2
Geyserville	Russian River at Healdsburg Veterans Memorial Beach	15,464	10
Ukiah	Russian River at Highway 101	2,731	2
Geyserville	Russian River at Highway 128	13,501	2
Guerneville	Russian River at Jenner Boat Ramp	4,837	2
Guerneville	Russian River at Johnson's Beach	1,677	10
Ukiah	Russian River at Lake Mendocino Drive	3,275	3
Guerneville	Russian River at Monte Rio Beach	8,897	18
Ukiah	Russian River at River Road near Hopland	1,898	3
Guerneville	Russian River at Steelhead Beach	48,484	2
Ukiah	Russian River at Talmage Road	9293	3
Ukiah	Russian River at Vichy Springs Road	11,803	3
Coyote Valley	Russian River, East Fork at East Road	5,949	3
Santa Rosa	Santa Rosa Creek at Los Alamos Road	2,727	2

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Hydrologic Subarea	Location	Median Concentration (gene copies per 100 mL) ^{1,2}	Number of Bacteroides Measurements
Santa Rosa	Santa Rosa Creek at Railroad Street	32,909	2
Geyserville	Unnamed Tributary at Alexander Valley Road	1,920	5
Guerneville	Unnamed Tributary at Del Rio Court	2,131	3
Geyserville	Unnamed Tributary at Fitch Mountain Road	238	5
Guerneville	Unnamed Tributary at Foothill Drive	371,000	1
Geyserville	Unnamed Tributary at Fredson Road	6,730	5
Guerneville	Unnamed Tributary at Main Street	557	5
Guerneville	Unnamed Tributary at Market Street	9,090	4
Guerneville	Unnamed Tributary at Moscow Road	<60 ²	1
Guerneville	Unnamed Tributary at Old Monte Rio Road	25,100	4
Geyserville	Unnamed Tributary at Redwood Drive	2,310	5
Guerneville	Unnamed Tributary at River Drive	6,365	4
Guerneville	Unnamed Tributary at River Road near Duncan Road	217	3
Guerneville	Unnamed Tributary at River Road near Rio Nido	1,600	3
Guerneville	Unnamed Tributary at Trenton Road	50,600	5
Warm Springs	Unnamed Tributary at West Dry Creek Road	4,040	5

¹ Stations with median concentration greater than 10,000 gene copies/100 mL of human-specific Bacteroides are in bold font. These stations show very strong evidence of the presence of human fecal waste in surface waters. Human-specific Bacteroides were analyzed with the HuBac genetic marker following U.S. EPA (2010) Method B

² The method detection limit (MDL) for human-specific Bacteroides is 60 gene copies/100 mL. In stations with multiple measurements where at least one but not all those measurements are below the MDL (i.e., a non-detect), the non-detect value is assumed to be half the MDL (i.e., 30 gene copies/100 mL) when calculating the median. For stations whose measurements are all non-detects, the median results are reported as <60 gene copies/100 mL.

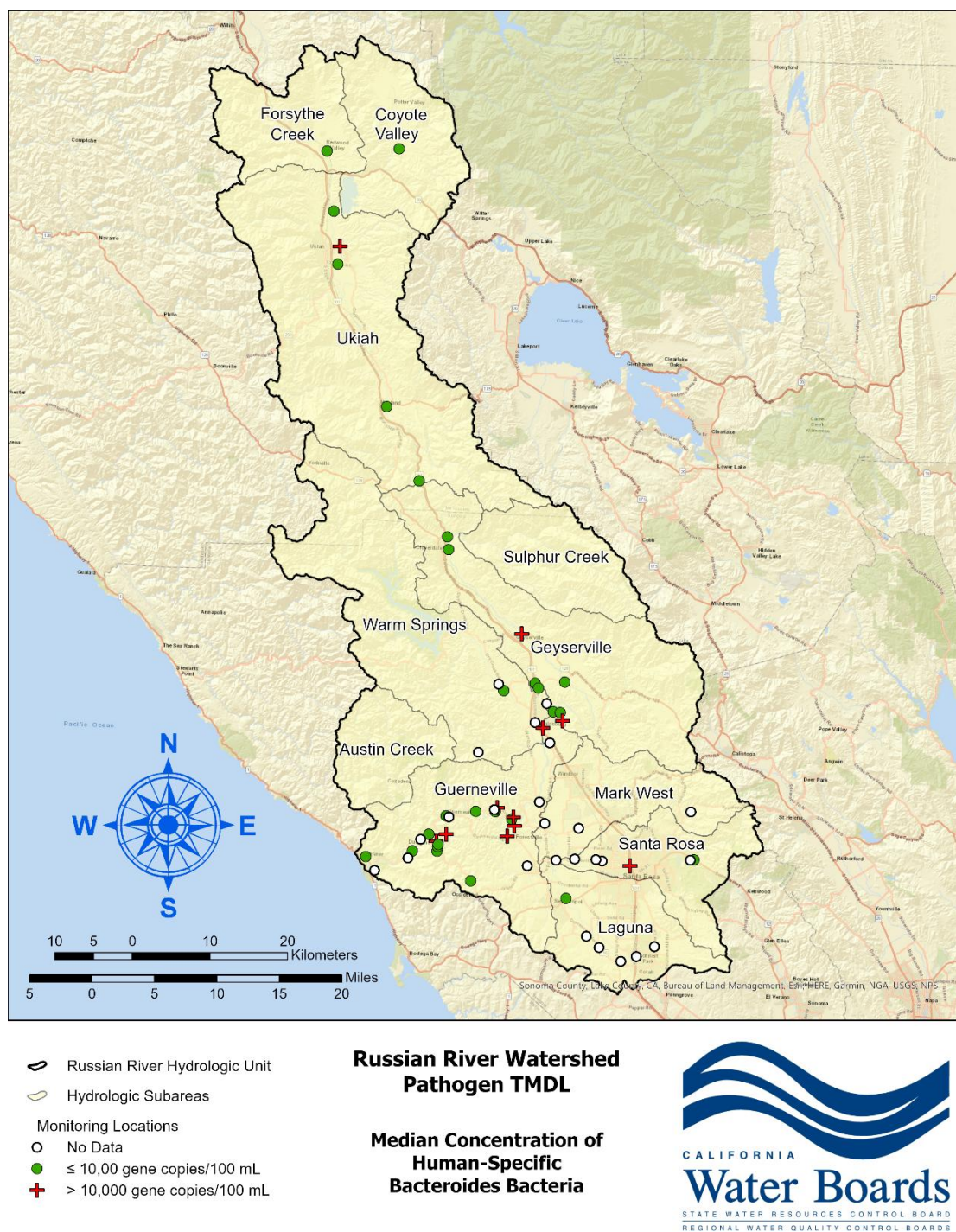


Figure 4.6: Median Concentration of Human-Specific Bacteroides

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

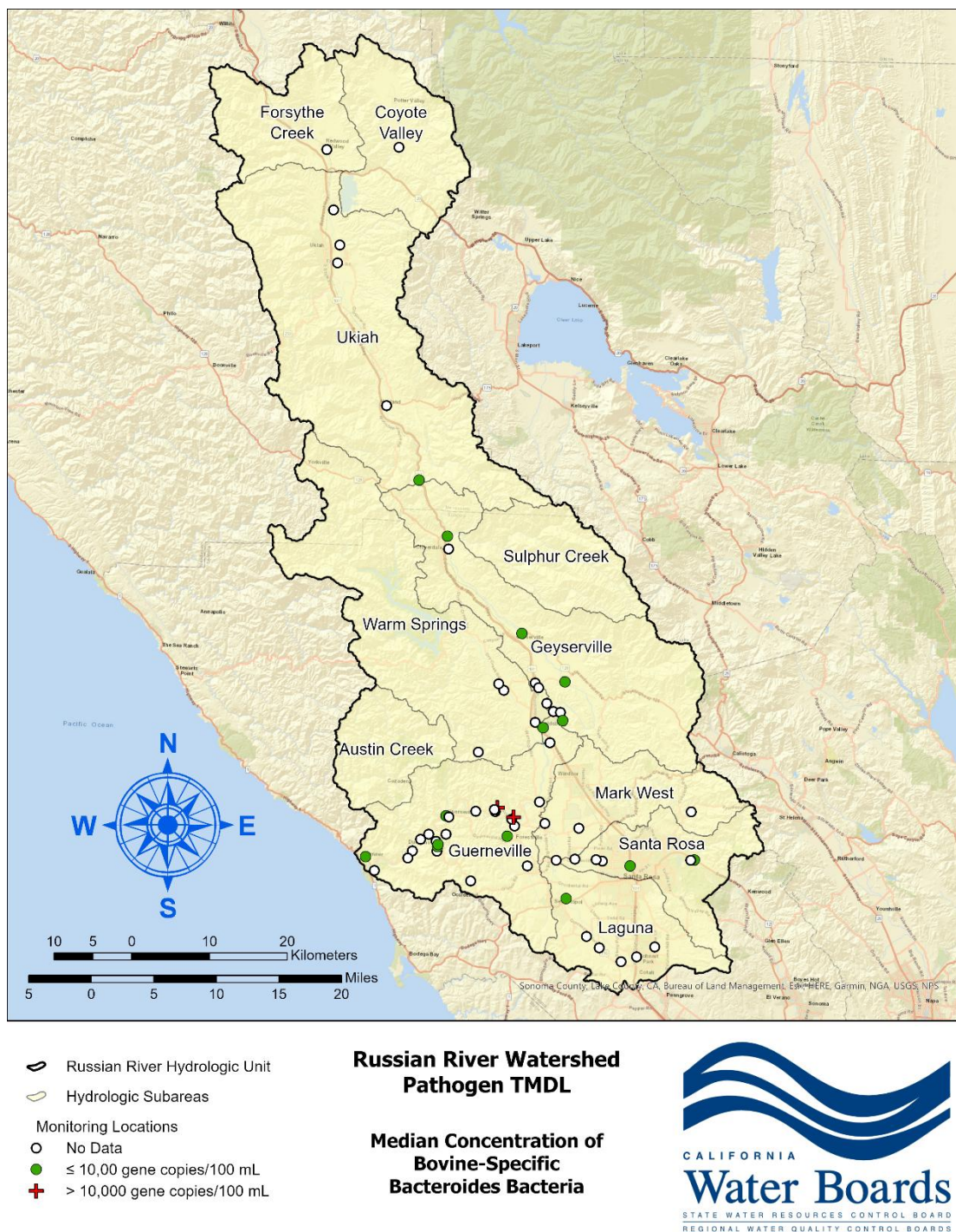


Figure 4.7: Median Concentration of Bovine-Specific Bacteroides

For bovine-specific *Bacteroides* bacteria, quantifiable levels were found in all but one of the 11 mainstem locations, and in all but two of the 5 tributary locations sampled for the assessment of *Bacteroides* bacteria. Of the 48 samples collected, 88% of the samples also exceed the analytical reporting limit (30 gene copies/100mL for bovine-specific *Bacteroides*), meaning that 88% of the samples contain detectable levels of bovine source *Bacteroides* bacteria. Figure 4.7 and Table 4.7 summarize these data

Table 4.7 Bovine-specific *Bacteroides* in the Russian River

Hydrologic Subarea	Location	Median Concentration (gene copies /100 mL) ^{1,2}	Number of <i>Bacteroides</i> measurements
Guerneville	Dutch Bill Creek at Fir Road	<30 ²	2
Guerneville	Green Valley Creek at Martinelli Road	72	2
Laguna	Laguna de Santa Rosa at Sebastopol Community Center	264	2
Geyserville	Russian River at Alexander Valley Road	116	2
Geyserville	Russian River at Camp Rose Beach	286	2
Geyserville	Russian River at Cloverdale River Park	710	2
Guerneville	Russian River at Forestville Access Beach	14,710	2
Geyserville	Russian River at Healdsburg Veterans Memorial Beach	380	2
Ukiah	Russian River at Highway 101	5,412	2
Geyserville	Russian River at Highway 128	236	2
Guerneville	Russian River at Jenner Boat Ramp	2,682	2
Guerneville	Russian River at Johnson's Beach	65	10
Guerneville	Russian River at Monte Rio Beach	761	10
Guerneville	Russian River at Steelhead Beach	23,684	2
Santa Rosa	Santa Rosa Creek at Los Alamos Road	181	2
Santa Rosa	Santa Rosa Creek at Railroad Street	7,765	2

¹ Stations with median concentration greater than 10,000 gene copies/100 mL of bovine-specific *Bacteroides* are in bold font. These stations show very strong evidence

of the presence of human fecal waste in surface waters. Human-specific *Bacteroides* were analyzed with the HuBac genetic marker following U.S. EPA (2010) Method B

² The method detection limit (MDL) for bovine-specific *Bacteroides* is 30 gene copies/100 mL. In stations with multiple measurements where at least one but not all those measurements are below the MDL (i.e., a non-detect), the non-detect value is assumed to be half the MDL (i.e., 15 gene copies/100 mL) when calculating the median. For stations whose measurements are all non-detects, the results are reported as <30 gene copies/100 mL.

4.5 MICROBIOLOGICAL SOURCE IDENTIFICATION

North Coast Water Board staff conducted a monitoring study to attribute the animal sources of fecal waste to elevated fecal indicator bacteria concentrations in surface waters of the Russian River Watershed from 2011 to 2013 (NCRWQCB 2012, 2013a, 2013b, 2013c). The monitoring study included microbiological source identification in the watershed. Over one hundred samples were analyzed during this study by the Lawrence Berkeley National Laboratory using the PhyloChip™ phylogenetic DNA microarray to estimate the percentages of bacteria in water samples that matched DNA profiles for reference fecal waste sources. Figure 4.8 shows PhyloChip™ monitoring locations. The analysis methods and results (Dubinsky and Anderson 2014) are summarized in this section. Dubinsky and Andersen (2014) recommend a threshold of 20% DNA match as strong evidence of fecal waste; Dubinsky (personal communication, July 8, 2019) identifies 10% DNA match as moderate evidence of fecal waste. The results of the study: 1) identify key locations in the watershed with evidence of human or ruminant fecal waste signals and 2) the presence of specific pathogenic bacteria. The study also concludes that high FIB counts, as measured against instantaneous beach action values, were often due to environmental populations enhanced by nutrient and carbon enriched runoff. Instantaneous FIB concentrations were not well correlated with PhyloChip™ fecal waste signals.

4.5.1 Methods

The Lawrence Berkeley National Laboratory collected, composited, and cataloged specific DNA profiles of fecal waste from humans, grazing mammals, and birds. This library of DNA profiles included human waste samples from raw sewage, septic waste, and feces. The DNA profile for grazing mammals included samples of droppings from cows, horses, deer, and elk. The profile for birds included samples of droppings from gulls and pelicans. Water samples from the Russian River Watershed were then compared to the library of DNA profiles from known human, grazer, and bird wastes to determine the percentage of bacteria DNA gene sequences that matched the known profiles.

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

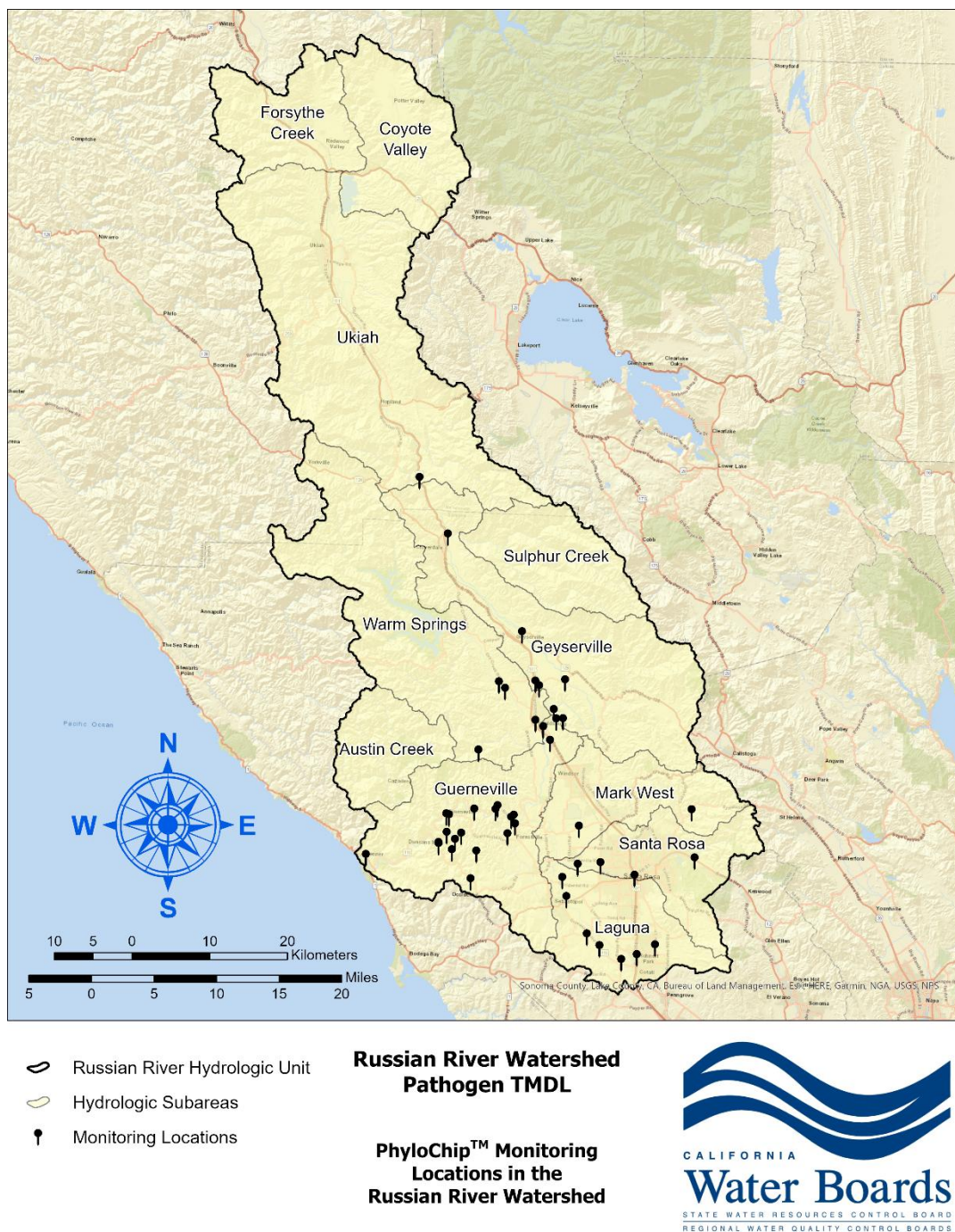


Figure 4.8: PhyloChip™ Monitoring Locations in the Russian River Watershed

North Coast Water Board staff collected multiple water samples from monitoring locations in the Russian River Watershed during both wet and dry seasons to analyze for *E. coli*, enterococci, and *Bacteroides* bacteria, as well as DNA profiles. Sets of all samples were analyzed for *E. coli*, enterococci, and *Bacteroides* bacteria. However, due to cost, not all water samples were immediately analyzed to assess for fecal DNA profile. Instead, a set of each water sample collected was frozen to be analyzed later using the phylogenetic DNA microarray. Frozen water samples were later thawed and analyzed using the phylogenetic DNA microarray when any of the other fecal bacteria measurements were shown to be elevated.

4.5.2 Results

Sample locations where the gene sequence percent match exceeds 10% and 20% represent locations with moderate and strong evidence, respectively, of a source of fecal waste requiring control (personal communication, Eric Dubinsky, July 8, 2019). Please note that only 7 of the 11 Hydrologic Subareas were measured using the PhyloChip™ DNA microarray technique. Of these 7 Hydrologic Subareas, 5 contained locations where the human gene sequence percent match exceeded 10% (i.e., Guerneville, Laguna, Mark West, Warm Springs) and 3 contained locations exceeding 20% (i.e., Guerneville, Laguna, and Santa Rosa). The same Hydrologic Subareas have locations where the grazer gene sequence match exceeded 10% and 20%, respectively. None of the Hydrologic Subareas measured showed bird gene sequences at or exceeding the 20% threshold, though Guerneville, Laguna, Santa Rosa, and Warm Springs Hydrologic Subareas showed bird gene sequences at or all exceeding the 10% threshold. Tables 4.8, 4.9, and 4.10 show the results of the gene sequence match results for human, grazer, and birds, respectively.

Table 4.8 Bacteria DNA sequences – Human Fecal Waste

Hydrologic Subarea	Station Name	Max of Gene Sequence Percent Match¹	Median of Gene Sequence Percent Match¹	Number of Gene Sequence Measurements
Guerneville	Camp Meeker AOC	7	5	2
Guerneville	Cassini LD-HR	1	1	1
Guerneville	Dutch Bill Creek	4	2	2
Guerneville	Forestville Access Beach	4	2	2
Guerneville	Forestville HD-HR	9	5	4
Guerneville	Forestville HD-LR1	54	41	3
Guerneville	Forestville HD-LR2	5	5	2

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Hydrologic Subarea	Station Name	Max of Gene Sequence Percent Match ¹	Median of Gene Sequence Percent Match ¹	Number of Gene Sequence Measurements
Guerneville	Green Valley Creek	1	1	2
Guerneville	Healdsburg HD-HR	5	3	2
Guerneville	Jenner Boat Ramp	16	9	2
Guerneville	Johnson's Beach	54	27	2
Guerneville	Johnson's Beach (Rec)	50	1	5
Guerneville	Limerick Creek	52	29	2
Guerneville	Mays Creek	16	11	2
Guerneville	Memorial Beach	1	1	2
Guerneville	Monte Rio AOC	88	88	1
Guerneville	Monte Rio Beach	59	29	2
Guerneville	Monte Rio Beach (Rec)	1	0	5
Guerneville	Monte Rio HD-HR	1	1	3
Guerneville	Monte Rio HD-LR	1	1	2
Guerneville	Northwood HD-LR	4	4	1
Guerneville	Rio Nido LD-HR	8	4	2
Guerneville	Steelhead Beach	2	1	2
Geyserville	Alex Valley Campground	2	1	2
Geyserville	Camp Rose	1	1	2
Geyserville	Cloverdale River Park	0	0	2
Geyserville	Geyserville Hwy Bridge	1	1	2
Geyserville	Healdsburg AOC	10	8	2
Geyserville	Healdsburg LD-LR1	4	3	2
Geyserville	Healdsburg LD-LR3	1	1	2
Laguna	Blucher Creek	11	6	2
Laguna	Copeland Creek	23	12	2
Laguna	Crane Creek	21	12	2
Laguna	Gossage Creek	14	7	2
Laguna	Irwin Creek	9	4	2
Laguna	Laguna de Santa Rosa	0	0	2

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Hydrologic Subarea	Station Name	Max of Gene Sequence Percent Match ¹	Median of Gene Sequence Percent Match ¹	Number of Gene Sequence Measurements
Laguna	Turner Creek	10	9	2
Mark West	Woolsey Creek	12	6	2
Mark West	van Buren Creek	5	3	2
Santa Rosa	Abramson Creek	16	12	2
Santa Rosa	Piner Creek	31	17	2
Santa Rosa	Santa Rosa Ck-Los Alamos	4	3	2
Santa Rosa	Santa Rosa Ck-Railroad	1	1	2
Warm Springs	Foss Creek	15	9	2
Warm Springs	Healdsburg LD-LR2	1	1	1
Warm Springs	Lambert Creek	6	5	2
Warm Springs	Palmer Creek	5	4	2
Ukiah	Commisky Station Road	0	0	2

¹ Stations where the percent gene sequence match of a sample to a known source of fecal waste exceeds 10% or 20% are highlighted in bold font. These are stations and hydrologic subareas with good evidence that human fecal waste has been discharged in amounts requiring further monitoring and/or control.

Table 4.9: Bacteria DNA sequences – Grazer Fecal Waste

Hydrologic Subarea	Station Name	Max of Gene Sequence Percent Match¹	Median of Gene Sequence Percent Match¹	Number of Gene Sequence Measurements
Guerneville	Camp Meeker AOC	2	1	2
Guerneville	Cassini LD-HR	2	2	1
Guerneville	Dutch Bill Creek	6	4	2
Guerneville	Forestville Access Beach	19	10	2
Guerneville	Forestville HD-HR	2	1	4
Guerneville	Forestville HD-LR1	14	7	3
Guerneville	Forestville HD-LR2	3	2	2
Guerneville	Green Valley Creek	5	3	2
Guerneville	Healdsburg HD-HR	3	2	2
Guerneville	Jenner Boat Ramp	4	3	2
Guerneville	Johnson's Beach	16	9	2
Guerneville	Johnson's Beach (Rec)	18	3	5
Guerneville	Limerick Creek	19	15	2
Guerneville	Mays Creek	11	8	2
Guerneville	Memorial Beach	1	1	2
Guerneville	Monte Rio AOC	23	23	1
Guerneville	Monte Rio Beach	20	11	2
Guerneville	Monte Rio Beach (Rec)	3	1	5
Guerneville	Monte Rio HD-HR	1	1	3
Guerneville	Monte Rio HD-LR	3	2	2
Guerneville	Northwood HD-LR	1	1	1
Guerneville	Rio Nido LD-HR	3	2	2
Guerneville	Steelhead Beach	11	6	2
Geyserville	Alex Valley Campground	2	2	2
Geyserville	Camp Rose	2	1	2
Geyserville	Cloverdale River Park	1	1	2
Geyserville	Geyserville Hwy Bridge	2	1	2

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Hydrologic Subarea	Station Name	Max of Gene Sequence Percent Match ¹	Median of Gene Sequence Percent Match ¹	Number of Gene Sequence Measurements
Geyserville	Healdsburg AOC	6	6	2
Geyserville	Healdsburg LD-LR1	14	8	2
Geyserville	Healdsburg LD-LR3	3	2	2
Laguna	Blucher Creek	32	17	2
Laguna	Copeland Creek	33	17	2
Laguna	Crane Creek	33	20	2
Laguna	Gossage Creek	29	15	2
Laguna	Irwin Creek	16	9	2
Laguna	Laguna de Santa Rosa	2	1	2
Laguna	Turner Creek	33	24	2
Mark West	Woolsey Creek	18	10	2
Mark West	van Buren Creek	4	2	2
Santa Rosa	Abramson Creek	36	22	2
Santa Rosa	Piner Creek	12	7	2
Santa Rosa	Santa Rosa Ck-Los Alamos	5	3	2
Santa Rosa	Santa Rosa Ck-Railroad	3	2	2
Warm Springs	Foss Creek	3	2	2
Warm Springs	Healdsburg LD-LR2	3	3	1
Warm Springs	Lambert Creek	6	5	2
Warm Springs	Palmer Creek	8	8	2
Ukiah	Commisky Station Road	2	1	2

¹ Stations where the percent gene sequence match of a sample to a known source of fecal waste exceeds 10% or 20% are highlighted in bold font. These are stations and hydrologic subareas with good evidence that human fecal waste has been discharged in amounts requiring further monitoring and/or control.

Table 4.10 Bacteria DNA sequences – Bird Fecal Waste

Hydrologic Subarea	Station Name	Max of Gene Sequence Percent Match¹	Median of Gene Sequence Percent Match¹	Number of Gene Sequence Measurements
Guerneville	Camp Meeker AOC	7	6	2
Guerneville	Cassini LD-HR	3	3	1
Guerneville	Dutch Bill Creek	9	8	2
Guerneville	Forestville Access Beach	6	4	2
Guerneville	Forestville HD-HR	4	3	4
Guerneville	Forestville HD-LR1	8	4	3
Guerneville	Forestville HD-LR2	6	5	2
Guerneville	Green Valley Creek	8	5	2
Guerneville	Healdsburg HD-HR	3	3	2
Guerneville	Jenner Boat Ramp	3	3	2
Guerneville	Johnson's Beach	4	3	2
Guerneville	Johnson's Beach (Rec)	5	3	5
Guerneville	Limerick Creek	10	9	2
Guerneville	Mays Creek	6	5	2
Guerneville	Memorial Beach	4	3	2
Guerneville	Monte Rio AOC	10	10	1
Guerneville	Monte Rio Beach	7	4	2
Guerneville	Monte Rio Beach (Rec)	2	2	5
Guerneville	Monte Rio HD-HR	9	7	3
Guerneville	Monte Rio HD-LR	4	4	2
Guerneville	Northwood HD-LR	3	3	1
Guerneville	Rio Nido LD-HR	8	6	2
Guerneville	Steelhead Beach	4	3	2
Geyserville	Alex Valley Campground	3	2	2
Geyserville	Camp Rose	2	2	2
Geyserville	Cloverdale River Park	2	2	2
Geyserville	Geyserville Hwy Bridge	2	2	2

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Hydrologic Subarea	Station Name	Max of Gene Sequence Percent Match ¹	Median of Gene Sequence Percent Match ¹	Number of Gene Sequence Measurements
Geyserville	Healdsburg AOC	8	6	2
Geyserville	Healdsburg LD-LR1	7	7	2
Geyserville	Healdsburg LD-LR3	5	5	2
Laguna	Blucher Creek	5	4	2
Laguna	Copeland Creek	8	5	2
Laguna	Crane Creek	10	8	2
Laguna	Gossage Creek	7	6	2
Laguna	Irwin Creek	5	4	2
Laguna	Laguna de Santa Rosa	6	4	2
Laguna	Turner Creek	9	8	2
Mark West	Woolsey Creek	10	6	2
Mark West	van Buren Creek	6	5	2
Santa Rosa	Abramson Creek	13	10	2
Santa Rosa	Piner Creek	18	12	2
Santa Rosa	Santa Rosa Ck-Los Alamos	6	4	2
Santa Rosa	Santa Rosa Ck-Railroad	4	4	2
Warm Springs	Foss Creek	5	4	2
Warm Springs	Healdsburg LD-LR2	5	5	1
Warm Springs	Lambert Creek	11	7	2
Warm Springs	Palmer Creek	11	7	2
Ukiah	Commisky Station Road	3	2	2

¹ Stations where the percent gene sequence match of a sample to a known source of fecal waste exceeds 10% or 20% are highlighted in bold font. These are stations and hydrologic subareas with good evidence that human fecal waste has been discharged in amounts requiring further monitoring and/or control.

4.6 ASSESSMENT OF PATHOGENIC SPECIES

Pathogenic bacteria and protozoans are occasionally measured directly without relying on indicator bacteria species, and the ability to do so is increasing with continuing advances in DNA technology. This section describes detections of pathogenic organisms and provides additional evidence of fecal waste pollution.

4.6.1 Pathogenic Bacteria Detections

North Coast Water Board staff collected water samples from 2011 to 2013 (NCRWQCB 2012, 2013a, 2013b). This monitoring focused on microbiological source identification in the middle and lower Russian River Watershed. As described above, over one hundred samples were analyzed by the Lawrence Berkeley National Laboratory using the PhyloChip™ phylogenetic DNA microarray, which evaluates 16S rRNA gene sequences to identify different bacteria taxa. Taxa were identified, but not quantified. The analysis results (Dubinsky and Anderson 2014) are summarized in this section and in a memo to the file record (Butkus 2014a).

Over 10,000 different bacteria taxa were identified in the samples from the Russian River Watershed. Most of the taxa detected are in the Actinobacteria phylum, Flavobacteria order, and Proteobacteria phylum of bacteria, which are naturally abundant in freshwater and soil, and do not likely originate from human or animal fecal waste sources. However, a substantial number of taxa in the Bacteroidia class, Clostridia class, Bacilli class, and Verrucomicrobia phylum of bacteria were also found in the samples. These taxa likely originate from fecal waste sources and individual pathogenic species are found within these taxa groups.

The human health risk associated with the presence of pathogenic bacteria is unknown since detection of a pathogenic species does not necessarily indicate that illness will occur. Some pathogenic bacteria are only pathogenic under certain circumstances, such as contact with an open wound. Additionally, there can be more than one strain of a particular bacterium species, and not all strains are pathogenic. The results of the PhyloChip™ analysis, as presented in Table 4.11, show a list of bacteria species found in the Russian River Watershed that have the potential to be human pathogens and cause illness.

Table 4.11 Potential Human Pathogens Detected in the Russian River Watershed

Pathogenic Bacteria Species	Health Impact	Number of Locations with Detected Species Mainstem	Number of Locations with Detected Species Tributaries	Percent of Samples with Detected Bacteria
<i>Proteus mirabili</i>	Urinary Tract Infections	1	10	11%
<i>Salmonella enterica</i>	Gastroenteritis	1	9	10%
<i>Serratia marcescens</i>	Infections, Pneumonia, Meningitis	3	27	41%
<i>Shigella flexneri</i>	Gastroenteritis	0	15	16%
<i>Staphylococcus epidermidis</i>	Infections	3	13	22%
<i>Staphylococcus haemolyticus</i>	Infections	2	0	2%
<i>Yersinia sp.</i>	Plague	4	7	15%

4.6.2 Cryptosporidium and Giardia Detections

The Sonoma County Water Agency (SCWA) conducted monitoring for *Cryptosporidium* and *Giardia* oocysts in the Russian River near Wohler Bridge from 2004 through 2006 as part of their Sanitary Survey as shown in Table 4.12 (Palencia & Archibald 2013). The SCWA found three *Giardia* cysts and five *Cryptosporidium* oocysts out of 660 L of water from 48 samples. *Giardia lamblia* and *Cryptosporidium parvum* are pathogens that can cause gastrointestinal illness. The low number of *Cryptosporidium* oocysts detected meant no additional treatment is needed for the drinking water collected from the Russian River near Wohler Road (71 FR 775).

Table 4.12 Cryptosporidium and Giardia Detections in the Russian river near Wohler Bridge

Collection Date	<i>Cryptosporidium</i> (oocysts/L)	<i>Giardia</i> (cysts/L)
3/9/2004	0.1	-
5/18/2004	-	0.1
12/26/2004	0.2	-
3/2/2005	0.1	0.1
3/23/2005	0.1	-
8/8/2005	0.1	0.1
1/10/2006	-	0.1

(data from Palencia and Archibald, 2013)

4.7 PUBLIC HEALTH ADVISORIES

Local agencies use information on fecal indicator bacteria concentrations to post streams with public health advisories that warn against swimming and water recreation. The City of Santa Rosa posts a permanent advisory for swimming in Santa Rosa Creek at Prince Memorial Greenway. This advisory is based on fecal indicator bacteria concentrations measured in the stream near the Railroad Street Bridge. The Sonoma County Department of Health Services posted public health advisories a total of 145 days at popular Russian River swimming beaches in the period of 2001 through 2011. Postings were based on exceedances of beach action values for total coliform, *E. coli*, or enterococci. Table 4.13 lists the number of days with posted advisories in the period of 2013 to 2018, when only those exceedances of beach action values for total coliform and *E. coli* were used.

E. coli bacteria concentration data used by the City of Santa Rosa and the County of Sonoma for posting advisories were assessed and utilized in the development of the TMDL, and the results are described in this chapter.

**Table 4.13: Russian River Beach Advisories Issued by the Sonoma County
Department of Health Services from 2013-2018**

Year	Cloverdale River Park Geyserville Hydrologic Subarea (# of posted days)	Veterans Memorial Beach Geyserville Hydrologic Subarea (# of posted days)	Johnsons Beach Guerneville Hydrologic Subarea (# of posted days)	Monte Rio Beach Guerneville Hydrologic Subarea (# of posted days)
2013	1	4	1	7
2014	3	0	0	0
2015	11	0	1	6
2016	0	0	0	0
2017	0	0	0	4
2018	0	0	0	0
TOTAL	15	4	2	17

4.8 SUMMARY

The statewide bacteria objectives and federal criteria for the protection of REC-1 are based on fecal indicator bacteria (i.e., *E. coli* and enterococci) that are typically associated with fecal waste discharge and epidemiologically-derived risk of gastrointestinal illness. The scientific peer review process illuminated the value of enterococci over *E. coli* as a fecal indicator bacteria due to the strength of the related epidemiology. The statewide bacteria objective adoption process illuminated the value of *E. coli* over enterococci based on the potential for enterococci results to be influenced by environmental factors. Based on the PhyloChip™ study, both *E. coli* and enterococci sometimes appear to pick up shifts in environmental bacterial populations, perhaps due to enriched carbon or nitrogen runoff. Thus both have the potential to be influenced by environmental factors. In addition to TMDL studies (see Chapter 6), this TMDL also identifies those Hydrologic Subareas and locations where the geomean and statistical

threshold value calculations of *E. coli* and enterococci data exceed water quality objectives and criteria. Similarly, it gives weight to direct evidence of beneficial use impacts (e.g., public health advisories on public swimming beaches). By considering other lines of evidence, such as provided by *Bacteroides* monitoring data and PhyloChip™ phylogenetic DNA microarray results, the evidence shows fecal waste pollution is present in the Russian River Watershed. Finally, direct measurement of pathogenic species expands the range of public health concerns from gastrointestinal illness as associated with exceedance of *E. coli* and enterococci to include exposure to bacteria responsible for such illnesses as urinary tract infections, dermal infections, pneumonia, meningitis, and the plague. Table 4.14 summarizes the findings from all the lines of evidence. Chapter 6 includes summary of the findings of the TMDL Studies, which constitute additional lines of evidence.

Table 4.14: Water Sampling and Public Health Advisories Summary

Hydrologic Area	Hydrologic Subarea	<i>E. coli</i> ¹	Public Health Advisory ²	Enterococcus	Human Bacteroides ³	Bovine Bacteroides ³	Human DNA ⁴	Grazer DNA ⁴
Upper Russian River	Coyote Valley	●	-	x	x	-	-	-
Upper Russian River	Forsythe Creek	x	-	x	x	-	-	-
Upper Russian River	Sulphur Creek	-	-	-	-	-	-	-
Upper Russian River	Ukiah	x	-	●	●	x	x	x
Middle Russian River	Warm Springs	●	-	●	x	-	●	x
Middle Russian River	Geyserville	●	●	●	x	x	●	●

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Hydrologic Area	Hydrologic Subarea	<i>E. coli</i> ¹	Public Health Advisory ²	Enterococcus	Human <i>Bacteroides</i> ³	Bovine <i>Bacteroides</i> ³	Human DNA ⁴	Grazer DNA ⁴
Middle Russian River	Santa Rosa	●	-	●	●	x	●	●
Middle Russian River	Laguna	●	-	●	x	x	●	●
Middle Russian River	Mark West	●	-	●	●	-	●	●
Lower Russian River	Austin Creek	-	-	-	-	-	-	-
Lower Russian River	Guerneville	●	●	●	●	●	●	●

¹ The parameters collected in each Hydrologic Subarea (HSA) are indicated with an “x” in the relevant parameter column. HSAs indicated with a “-” indicate that no sample was collected for the assessment of a particular parameter. HSAs with parameters represented as “●” are locations where data collected exceeds either the statewide bacteria objective *E. coli* in freshwater or enterococci in saline waters, federal criteria for enterococci in freshwater, or the REC-1 beneficial use is impacted due to public health advisories associated with recreational beaches. *Bacteroides* and PhyloChip™ data that exceed the respective assessment thresholds are also represented by a “●” symbol.

² Any public health advisory posted between 2012 and 2019 for a recreational beach in the Russian River Watershed represents an impact to the recreational beneficial use and is represented as “●”.

³ *Bacteroides* bacteria data indicate the presence of relatively fresh fecal waste from the gut of its host (e.g., human, bovine). A threshold of 10,000 gene copies/100 mL was used as very strong evidence of the presence of host fecal waste. These data were used for informational purposes, only.

⁴ PhyloChip™ data indicate the percent of a sample that matches known gene sequences of specific source animals. A threshold of 10% and 20% gene sequence match with a known fecal waste source (e.g., human, grazer) was used as evidence of the presence of host fecal waste. These data were used for informational purposes,

only.

As summarized in Table 4.14, the analyses of instream data from both mainstem and tributary locations across the watershed show evidence of fecal waste pollution. Chapter 6 describes the results of the TMDL Studies (source assessment) conducted for this TMDL project, including an assessment of land cover types and their respective association with *E. coli*, enterococci, and *Bacteroides* bacteria. The TMDL Studies also include assessment of the relationship of OWTS to potential for exceedance of criteria, as well as the relationship of recreation to the potential for exceedance of criteria. The *Bacteroides* bacteria concentration data and PhyloChip™ DNA microarray data point to both human and bovine sources of fecal waste as significant in much of the Russian River watershed. The TMDL Studies and other lines of evidence such as widespread *Bacteroides* detections support a Program of Implementation that applies to the entire watershed.

CHAPTER 5

NUMERIC TARGETS

5.1 OVERVIEW

It is sometimes necessary as part of a TMDL to establish indicators and numeric targets by which to measure progress towards attainment of the water quality objectives applicable to the TMDL. The water quality objectives at issue in this pathogen TMDL are the statewide fecal indicator bacteria objectives based on *E. coli* in freshwater and enterococci in saline waters. For each of these fecal indicator bacteria, the statewide objectives establish a rolling 6-week geometric mean limitation and a monthly statistical threshold value, as described in Chapter 3 and summarized here. Direct measurement of the statewide bacteria objectives themselves is an adequate means of tracking progress towards attainment of the limitations. There are no numeric targets other than the statewide bacteria objectives proposed for this pathogen TMDL.

5.2 PROPOSED NUMERIC TARGETS

Table 5.1 outlines the proposed numeric targets for *E. coli* and enterococci bacteria, identical to the statewide bacteria objectives.

Table 5.1: Statewide Bacteria Objectives for the Protection of REC-1

Applicable Waters	Objective Elements	GM (cfu/100 mL)	STV (cfu/100 mL)
All the waters where salinity is equal to or less than 1 ppt 95 percent or more of the time	<i>E. coli</i>	100	320
All the waters where salinity is greater than 1 ppt more than 5 percent of the time	Enterococci	30	110

The waterbody GM shall not be greater than the applicable GM magnitude in any six-week interval, calculated weekly. The applicable STV shall not be exceeded by more than 10 percent of the samples collected in a CALENDAR MONTH, calculated in a static manner.

Estimated Illness Rate (NGI): 32 per 1,000 water contact recreators

NGI = National Epidemiological and Environmental Assessment of Recreational Water gastrointestinal illness rate

GM = geometric mean

STV = statistical threshold value

cfu = colony forming units

mL = milliliters

ppth = parts per thousand

5.3 SUMMARY

Attainment of the statewide bacteria objectives for the protection of REC-1 is best determined by measurement of the fecal indicator bacteria for which statewide objectives have been established. In the Russian River Watershed, the REC-1 beneficial use is designated as a year-round use and applies to all waters.

CHAPTER 6

SOURCE ANALYSIS

6.1 OVERVIEW

A TMDL source analysis typically identifies the amount, timing, and point of origin of pollutants of concern, measured or estimated as loads or loading rates (e.g., pounds/acre or tons/mi²/year). The pollutant loading is then translated into load and waste load allocations, which together with a margin of safety represent the total maximum daily loading that will meet objectives.

This typical approach is somewhat modified when the pollutant of concern is bacteria. A modification is necessary for many reasons. 1) The water quality issue of concern with respect to fecal indicator bacteria is a public health concern related to the risk of exposure to pathogens. 2) The risk of exposure to pathogens is estimated by the presence of fecal indicator bacteria. 3) A given concentration of specific fecal indicator bacteria is associated with a number of illnesses per 1,000 recreators that is acceptable as defined by policy. 4) The presence of fecal indicator bacteria is an indication of fecal waste discharge. 5) Any discharge of human and/or domestic animal fecal waste increases the risk of pathogen exposure to recreators. 6) As a matter of general public health protection, there is no allowable load of fecal waste discharge that is without any risk. 7) An obvious public health principle is to eliminate the discharge of fecal waste to waterbodies that support recreation and other human contact.

Given that any load of fecal waste discharge can pose a risk to human health, pathogen TMDLs generally take another approach. Pathogen TMDLs generally apply fecal indicator bacteria *concentrations* as the load and waste load allocations. Through the use of concentrations, policy makers assert the allowable number of illnesses per 1,000 recreators that constitute an acceptable public health risk. With respect to the development of a program of implementation, this approach serves to narrow the needs of a source analysis. Unlike mass-based load and wasteload allocations, where the mass of pollutant from each source adds up to the total allocation, concentration-based allocations do not add up to equal the TMDL. Rather, in order to achieve the concentration-based TMDL, each permitted source of waste discharge must meet the concentration-based allocation. Unpermitted discharges must control their waste onsite. Under this approach, a source analysis simply needs to identify the categories of sources of fecal waste discharge, the places on the landscape where they exist, and the places where there is a high risk of fecal waste discharge such that its control is a high priority.

This chapter evaluates all potential sources of fecal waste discharge and identifies the major sources of fecal waste contributing to elevated concentrations of fecal indicator bacteria found in the surface waters of the Russian River Watershed. Three TMDL Studies were implemented to assess the relationship between the landuse characteristics and exceedance of objectives and thresholds. The results of those

studies are included here. The Land Cover Study results are summarized in Section 6.2. The Onsite Wastewater Treatment System (OWTS) Study results are summarized in Section 6.4.7. The Recreational Study results are summarized in Section 6.5.1. Where there are geographic delineations made in this chapter, they are based on Hydrologic Subarea (HSA).

The source analysis is composed of two parts:

1. An assessment of elevated fecal indicator bacteria concentrations associated with different land cover categories.
2. An inventory of the types of point source and nonpoint source facilities and activities that discharge or have the potential to discharge fecal waste to surface waters.

The land cover assessment serves two purposes. 1) It helps to extend the evidence of pollution findings in Chapter 4 to the whole watershed by associating FIB sampling results with land cover categories that exist across the whole watershed. 2) By establishing the land cover categories that are associated with evidence of pollution, it helps to confirm whether or not the inventory of potential sources is reasonably complete. The inventory of point and nonpoint source facilities and activities with the potential to discharge fecal waste represent all the known potential sources of fecal waste in the watershed. Section 6.6 Source Analysis Conclusions provides a summary of the sources requiring further control, which are associated with land cover types showing evidence of pollution. The program of implementation is designed to ensure additional assessment of individual facilities and activities, where the development of a new source control program may be necessary or existing programs may need updating.

6.2 SOURCES BY LAND COVER TYPE

Fecal indicator bacteria results described in Chapter 4 showed exceedance of statewide bacteria objectives for both *E. coli* in freshwater and enterococci in saline water during both wet and dry weather periods. North Coast Water Board staff conducted studies to investigate the relationship between land cover types and fecal indicator bacteria in the surface waters of the Russian River Watershed. North Coast Water Board staff assessed the relative contributions, magnitude, and variability of fecal indicator bacteria in the Russian River Watershed based on different land cover types during both dry and wet weather periods. Methods and sample concentration results are documented in a monitoring report by North Coast Water Board staff (NCRWQCB 2012). An assessment of the data, including a statistical analysis, is documented in technical memorandums (Butkus 2013a, Butkus 2014c). This section of the staff report summarizes the findings.

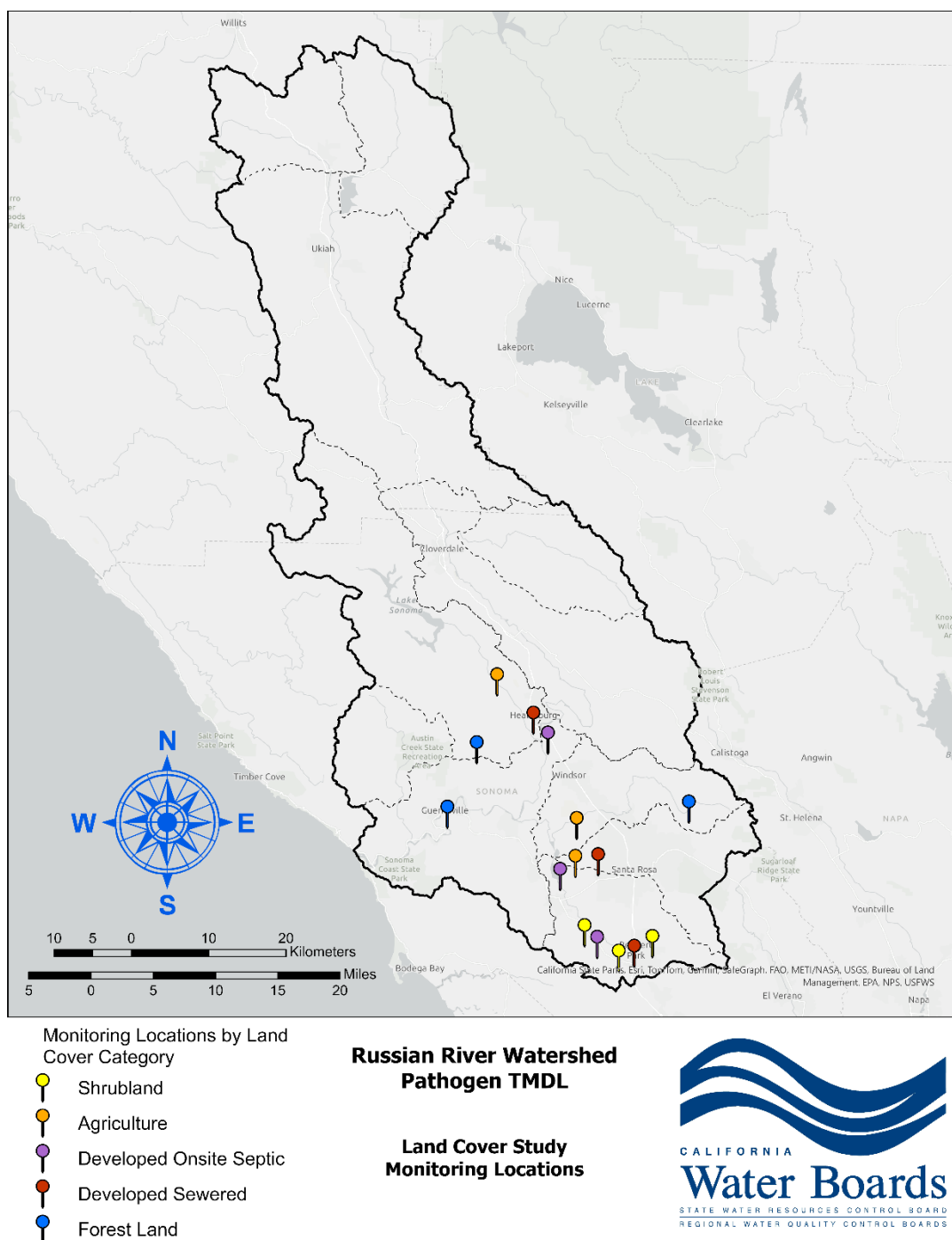


Figure 6.1: Monitoring Locations for the Land Cover Study (NCRWQCB 2012, Butkus 2013a, Butkus 2014c)

6.2.1 Methods

North Coast Water Board staff collected water samples from streams within the study area that drain subwatersheds primarily composed of one type of land use only, as a way of isolating the influence of different land uses on fecal indicator bacteria concentrations⁸. Five land cover categories were selected. These land cover categories were based on the National Land Cover Dataset (Fry et al. 2011) and Urban Service Areas (PRMD 2010). The land cover categories were defined through remote sensing by Anderson et al. (1976), and are summarized as follows:

- **Forest Land** – Areas with a 10 percent or more tree-crown areal density (crown closure percentage).
- **Shrubland** – Areas where the potential natural vegetation is predominantly grasses, grass-like plants, forbs, or shrubs. Anderson et al. (1976) previously defined this land cover as “Rangeland.” These areas do not include animal pastures or dry croplands.
- **Agriculture** – Areas were defined by visual indications of agricultural activity through distinctive geometric field or road patterns and the traces produced by livestock or mechanized equipment.
- **Developed Sewered** - Urban and residential areas identified by Fry et al. (2011) where much of the land is covered by structures including cities, towns, villages, strip developments along highways, transportation, power, and communications facilities. Residential land uses range from low density (where houses are on lots of more than an acre) to high density, multiple-unit structures. The boundaries of the Urban Service Areas (PRMD 2010) were used to identify those urban and residential areas that are sewered to receive domestic wastewater treatment.
- **Developed Non-Sewered** – Residential land uses identified by Fry et al. (2011) where the houses are outside of the boundaries of the Urban Service Areas (PRMD, 2010) and assumed to use individual onsite wastewater treatment systems (OWTS), cesspools, or direct discharges for disposal of domestic waste.

⁸ All the sampling locations drained watersheds with 50% or more of their area in one type of land cover category, except for sampling locations representing the developed non-sewered category. There was a relatively low percentage of land in this category as developed non-sewered areas are interspersed with other categories, especially agricultural lands.

For each of the five land cover categories, six water samples were collected at three different locations during both wet and dry periods. Samples were analyzed for *E. coli*, enterococci, human-specific *Bacteroides*, and bovine-specific *Bacteroides* bacteria. Visual comparison and statistical hypothesis tests were made between different data groupings. More information on the assessment methods is available in Butkus (2013a).

The assessment of data was conducted prior to the adoption in August 2018 of statewide bacteria objectives for *E. coli* and enterococci. As such, the *E. coli* and enterococci data evaluated as part of the Land Cover Study were assessed using the national criteria for these indicators, choosing the criteria representing 32 gastrointestinal illnesses per 1,000 recreators. Importantly, the exceedance of the geometric mean criteria was calculated in a static manner, rather than a rolling manner as is now required by the new statewide objectives. The results of the Land Cover Study as first published in Butkus (2013a) and summarized in the 2015 draft Staff Report and again in the 2017 draft Staff Report have not been altered. Staff assert that the differences between the two methods of calculation though real are insignificant with respect to the purpose of the study. The numeric thresholds for both the national criteria reported here and the statewide bacteria objectives are identical.

Contemporaneous with the FIB monitoring data, PhyloChip™ phylogenetic DNA microarray data was also collected.

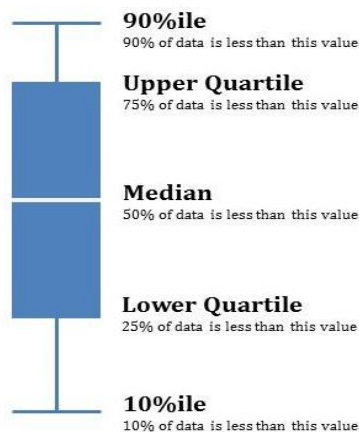


Figure 6.2 Data Example: Reading A Box And Whisker Plot

6.2.2 Results

The results of the land cover analysis are presented in box-and-whisker plots in Figures 6.2 through 6.6. A separate box and whisker plot is produced for each land cover type, each sampling season, and for each FIB. Figure 6.2 provides a visual explanation of how to read a box and whisker plot.

One of the key findings of the land cover assessment is that there is evidence of fecal waste discharge from all of the land cover categories evaluated. This is consistent with the findings reported in Chapter 4. Also consistent with the findings in Chapter 4, the concentrations of FIB measured in surface waters is higher during the wet season than during the dry season. While all land cover categories are associated with FIB, the concentrations measured in association with the Forestland cover type are significantly less than those measured in association with the other land cover types. Importantly, elevated public health risks, as measured by *E. coli* bacteria, appear to be most strongly associated with unsewered developed areas and shrubland⁹ during both the dry and wet seasons. This finding points to onsite wastewater treatment systems (OWTS) as a potential year-round source of human fecal waste. Similarly, *E. coli* data is strongly associated with sewer and unsewered developed areas during the wet season, suggesting that there are connections between sources of human fecal waste and storm water collection systems.

A stable isotope analysis, which measures oxygen and nitrogen in the water sample, was also conducted on samples from different land use categories to help identify the source of the water associated with the bacteria in samples. The results show that most of the nitrate measured in the samples was from soil, which was likely carried into the water column through rainfall-induced erosion. The results also show that several of the samples collected during wet weather in both sewer and unsewered (OWTS) developed areas were likely derived from domestic wastewater, which suggests that storm events may be transporting untreated domestic wastewater from sanitary sewer overflows and exfiltration, failing sanitary sewer pipelines and sewer laterals, and failing septic systems into streams. Sampling under this study was conducted in such a manner as to prevent capture of permitted surface water discharges from municipal wastewater treatment facilities, by collecting samples upstream of treated effluent discharge locations.

Summary of Findings of the Land Cover Assessment (Butkus 2013):

- All land cover types are associated with exceedance of *E. coli* and enterococci criteria and detections of *Bacteroides* bacteria.
- *E. coli*, enterococci, and *Bacteroides* bacteria concentrations in wet periods have statistically-significant higher concentrations than dry periods, indicating that fecal waste discharge is strongly influenced by storm water runoff patterns.
- Runoff from forest lands has statistically-significant lower concentrations of fecal indicator bacteria than runoff in all other assessed land cover categories. This suggests that inventorying potential sources of fecal waste from forestlands is relatively unimportant to the goal of reducing human fecal waste discharge.

⁹ Shrubland does not include animal pastures or dry cropland. But, it likely includes rural residential sites.

- Runoff from shrublands, agricultural areas, and forested areas have statistically-significant lower *E. coli* and enterococci concentrations than runoff from developed areas (both sewered and non-sewered areas). This suggests that inventorying potential sources of fecal waste in developed areas is relatively important to the goal of reducing human fecal waste discharge.
- *Bacteroides* bacteria concentrations are statistically the same for wet and dry period runoff draining from developed sewered areas, developed areas with OWTS, agricultural areas and shrublands. This suggests that fecal indicator bacteria may recognize the human signature associated with managed land cover types.

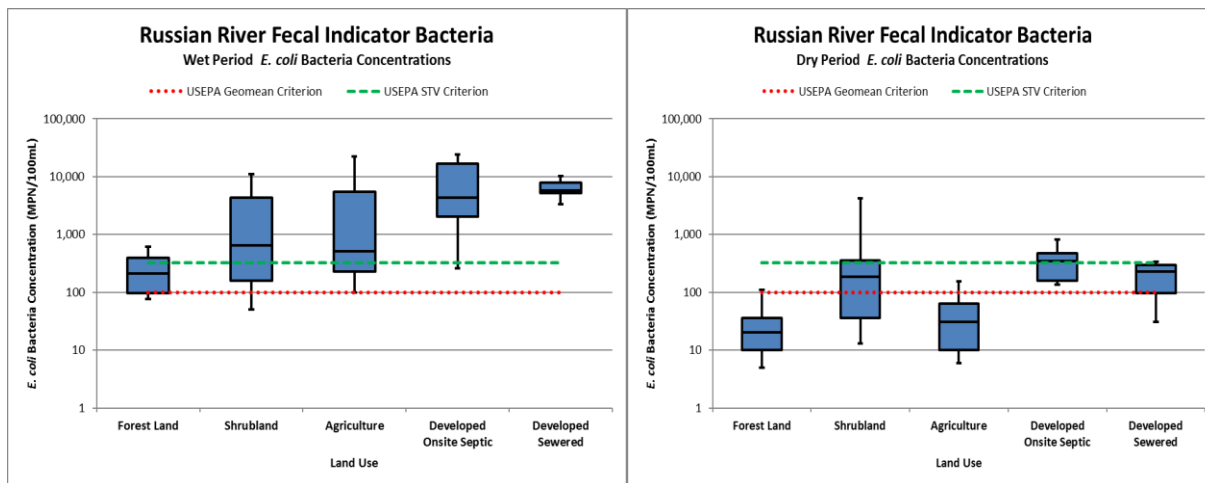


Figure 6.3: E. Coli Bacteria Concentrations Measured In The Russian River Watershed By Land Cover Category.

E. coli, enterococci, and *Bacteroides* bacteria concentrations are statistically the same for developed sewered areas and developed areas with OWTS. This suggests that certain common features such as leaking septic system/sewer lines may be pervasive.

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

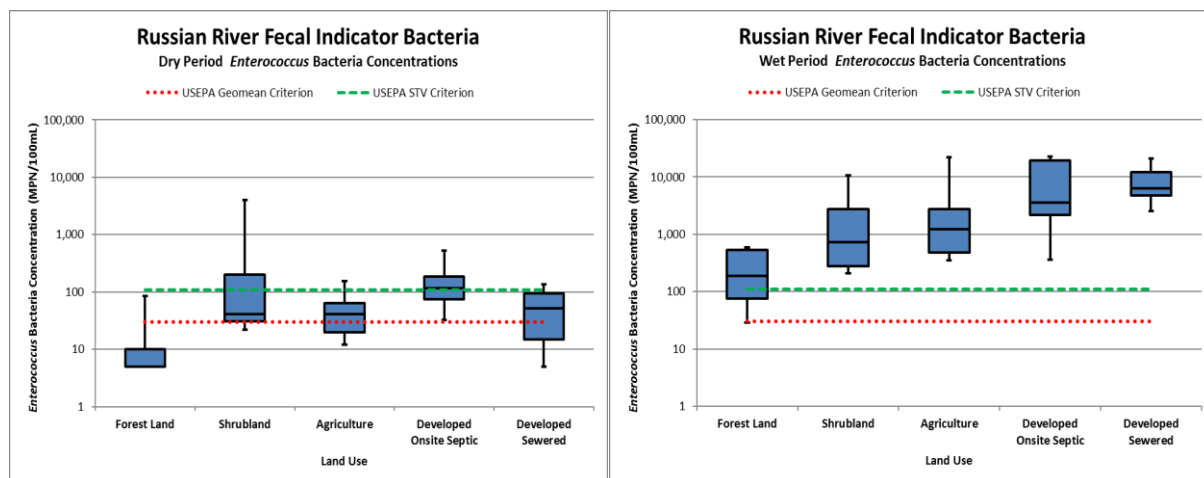


Figure 6.4: Enterococci Bacteria Concentrations Measured In The Russian River Watershed By Land Cover Category.

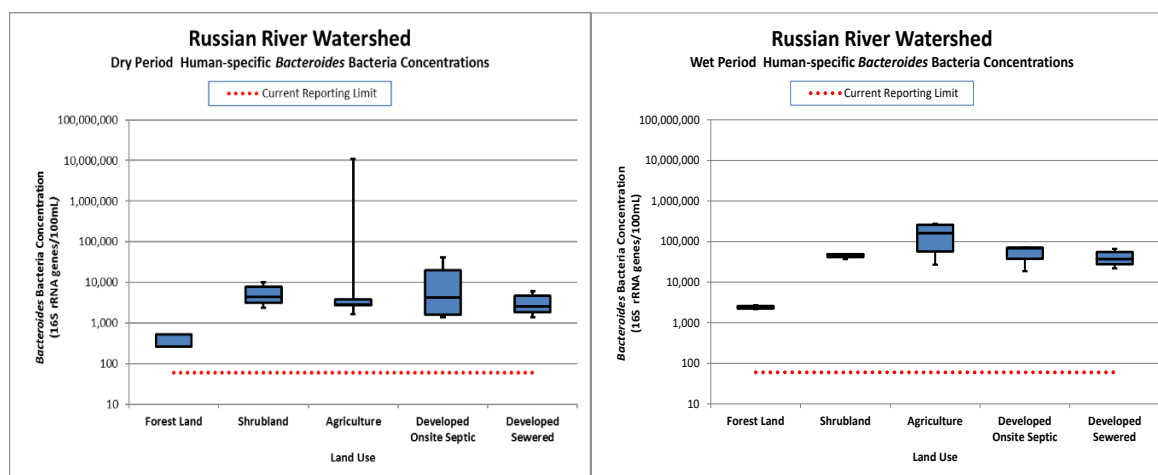


Figure 6.5: Human-Specific Bacteroides Bacteria Concentrations Measured In The Russian River Watershed By Land Cover Category.

Human-specific *Bacteroides* were analyzed with the HuBac genetic marker following U.S. EPA (2010) Method B.

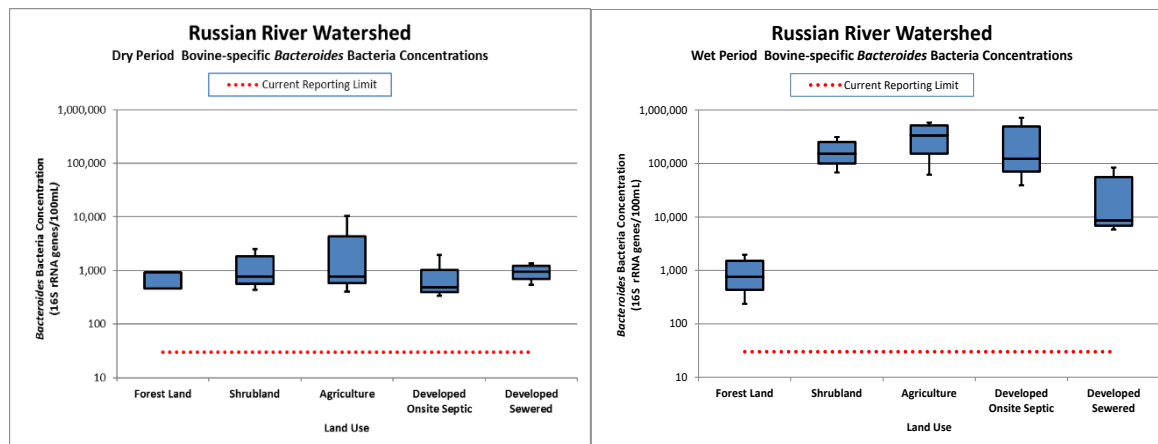


Figure 6.6: Bovine-Specific *Bacteroides* Bacteria Concentrations Measured In The Russian River Watershed By Land Cover Category.

Bovine-specific *Bacteroides* were analyzed with the BoBac genetic marker following U.S. EPA (2010) Method B.

6.2.3 Conclusions

These data indicate that all land cover types are associated with evidence of human and bovine fecal waste discharge. They also indicate that the inventory of potential sources of fecal waste must thoroughly consider all potential sources in developed areas, both sewered and unsewered. It is the developed areas where fecal waste appears to be reaching surface waters of the Russian River Watershed during all times of the year, though in significantly higher concentrations during the wet season. It is also in the developed areas where the predominant fecal waste signature is from human sources, representing a higher potential for elevating exposure to illness-causing pathogens to those who recreate in the Russian River.

Storm water runoff appears to be a major pathway by which fecal waste enters surface waters of the Russian. Sources of fecal waste that have the potential to enter storm water collection systems will be important to inventory and evaluate. Similarly, sources of fecal waste in agricultural areas and shrublands, which have the potential to runoff the landscape during storms, are also important to inventory and evaluate. Conversely, inventorying fecal waste sources on forestlands is relatively unimportant to the overall goals.

6.3 POINT SOURCE FACILITIES AND ACTIVITIES

This section describes potential point sources of pathogens in the Russian River Watershed. Clean Water Act section 402 addresses direct discharges of waste into navigable waters. "Point source", as defined in the Clean Water Act, means any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock,

concentrated animal feeding operation, or vessel or other floating craft. This term does not include agricultural storm water discharges and return flows from irrigated agriculture. (33 U.S.C. §1362). Point source discharges to waters of the United States are regulated under the federal National Pollutant Discharge Elimination System (NPDES) program, through NPDES permits. Point source discharges to waters of the state are regulated in accordance with the Porter-Cologne Water Quality Control Act through waste discharge requirements (WDRs) that also serve as NPDES permits.

The point sources described in this section were identified by querying the California Integrated Water Quality System (CIWQS) database for existing facilities regulated by a NPDES permit.

6.3.1 Wastewater Discharges to Surface Waters

Wastewater discharges to surface waters in the Russian River Watershed occur from both direct permitted discharges of treated effluent and from unpermitted spills and leaks. The following sections identify potential sources in the watershed.

6.3.1.1 Municipal Wastewater Discharges To Surface Waters

The watershed contains nine municipal wastewater treatment facilities authorized under NPDES permits to discharge treated domestic wastewater into surface waters. Table 6.1 summarizes these facilities (per information obtained from CIWQS in Nov. 2013) and describes their level of treatment. Figure 6.7 shows the locations of these facilities in the watershed. All facilities in the watershed treat to secondary or tertiary levels. Secondary treatment refers to physical, chemical, and biological unit processes used to meet federal standards in 40 C.F.R. §133.102 for biochemical oxygen demand (BOD), total suspended solids (TSS), and pH. Tertiary treatment is generally defined as treatment beyond secondary levels to achieve a higher level of BOD or TSS removal or to remove constituents of concern such as nutrients or toxic compounds.

To achieve water quality objectives, protect beneficial uses, protect public health, and prevent nuisance, surface water discharges within the Russian River are prohibited from May 15 through September 30. During the remainder of the year, discharges are limited to one percent of the flow volume in the receiving water unless specifically exempted in the NPDES permit. For authorized discharges of wastewater to the Russian River and its tributaries during October 1 through May 14, the Basin Plan requires that discharges of municipal waste “*shall be of advanced treated wastewater in accordance with effluent limitations contained in NPDES permits for each affected discharger, and shall meet a median coliform level of 2.2 MPN/100 mL.*” The North Coast Water Board has defined advanced wastewater treatment in individual permits as treated effluent meeting, in part, disinfection standards, including total coliform thresholds, consistent with tertiary treated recycled water requirements set forth in title 22 of the California Code of Regulations.

Disinfection standards in existing municipal NPDES permits consist of effluent limitations for total coliform bacteria and other process requirements to ensure adequate

effluent disinfection. For surface water discharges, municipal NPDES permits are prescribed uniform effluent limitations for total coliform bacteria that require:

- The 7-day median concentration not exceed an MPN of 2.2 per 100 mL;
- The number of coliform bacteria not exceed an MPN of 23 per 100 mL in more than one sample in any 30-day period; and
- No single sample exceed an MPN of 240 total coliform bacteria per 100 mL.

In addition to effluent limitations for total coliform bacteria, existing municipal NPDES permits also require compliance with disinfection process requirements depending on the permitted facility's method of disinfection. For wastewater treatment facilities that employ an ultraviolet (UV) disinfection process, permittees are required to ensure a minimum UV dose, maintain a minimum UV transmittance, and perform appropriate operation and maintenance activities specified by Division of Drinking Water of the State Water Resources Control Board.

For wastewater treatment facilities that utilize chlorine as a means of disinfection, permittees must demonstrate a continuous chlorine residual after treatment or provide a minimum CT (the product of total chlorine residual and modal contact time) value of not less than 450 mg-min/L at all times. North Coast Water Board staff used discharger-specific effluent monitoring data from self-monitoring reports to assess total coliform bacteria concentrations in the effluent from these facilities. Table 6.1 shows that disinfection methods are highly effective at meeting effluent limitations for total coliform bacteria. Consequently, direct discharges to surface water of treated municipal wastewater that meet effluent limitations for bacteria and discharge specifications for disinfection are not considered a significant source of bacteria. See Section 6.3.1.2 for discussion of the potential for bacterial contamination from discharges from holding ponds.

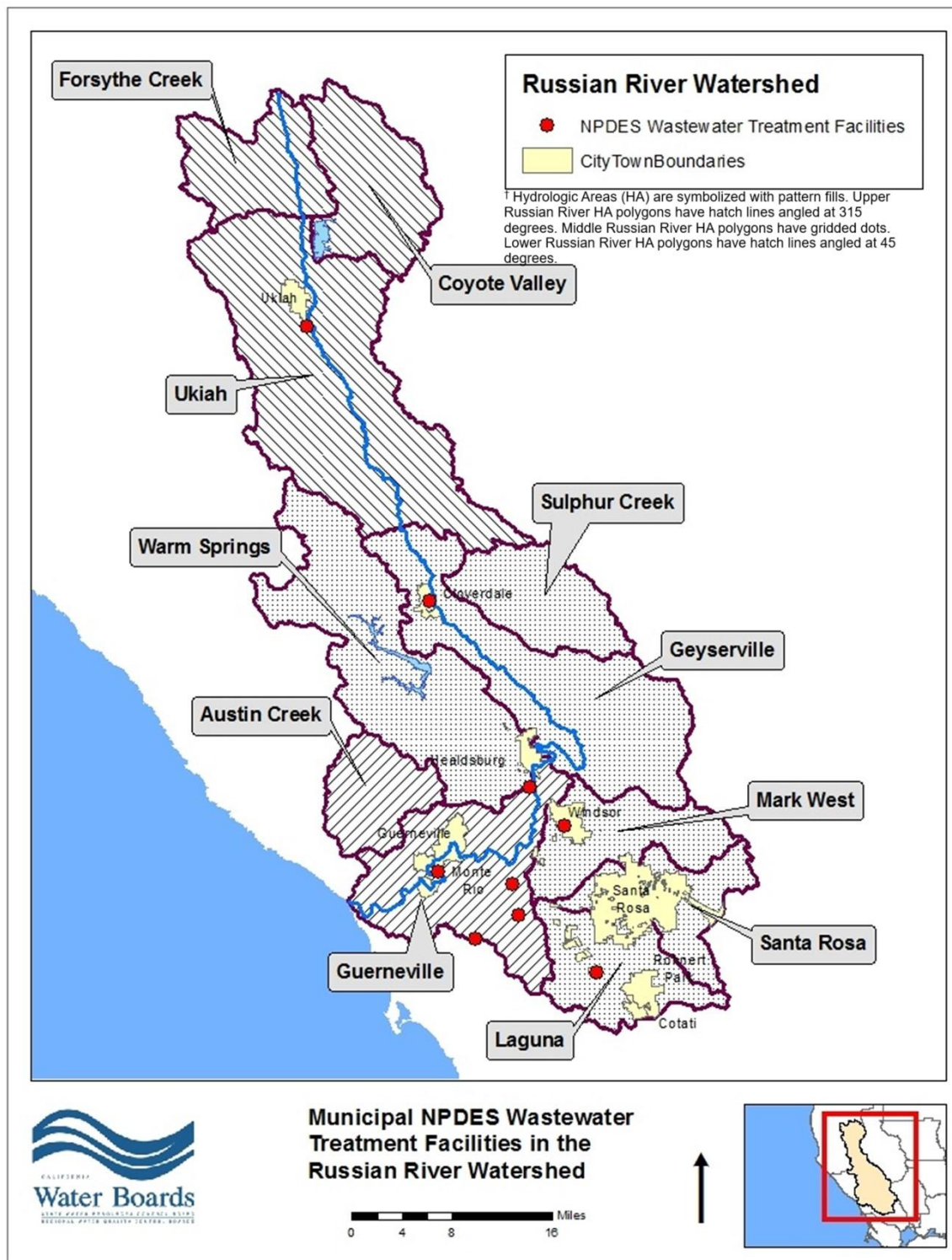


Figure 6.7: Municipal NPDES Wastewater Treatment Facilities in The Russian River Watershed

6.3.1.2 Recycled Water Holding Ponds

The beneficial reuse of treated wastewater, which is also known as recycled water, is common in the Russian River Watershed as a means to conserve scarce potable water supply and to comply with stringent discharge requirements imposed in NPDES permits in the watershed, including the Basin Plan's prohibition against summertime discharges of waste to the Russian River and its tributaries. For these and other reasons, storage ponds for many wastewater treatment facilities serve a dual purpose: 1) to temporarily store recycled water in large holding ponds for later distribution to recycled water users or 2) to temporarily store treated wastewater until conditions are suitable and permitted for discharge to surface waters. It is the experience of North Coast Water Board staff that discharges from holding ponds to surface waters outside of the prescribed discharge season or as a result of rain-induced pond overflows are rare, and are not considered a significant source of fecal bacteria in the Russian River Watershed.

Although advanced wastewater treatment systems in the Russian River Watershed are operated to produce recycled water that is essentially pathogen-free and suitable for water recycling, compliance with effluent limitations for bacteria has been historically measured at municipal treatment plants at a point immediately after completion of the disinfection process. The point at which disinfection is complete, for example, at the end of a chlorine contact chamber, may be separated from the surface water discharge by both distance and time. As a result, this same recycled water, when stored in open-air holding ponds, may become contaminated as a result of regrowth of bacteria or through contribution of fecal waste from wildlife, particularly birds that frequent the storage ponds. Thus, the original bacterial water quality of the recycled water demonstrated immediately after disinfection cannot be guaranteed during storage.

Many studies document the occurrence of fecal indicator bacteria and other opportunistic pathogens in open-air reservoirs, but the public health risk associated with pathogens in recycled water storage ponds has not been well-documented. North Coast Water Board staff evaluated monitoring data for treated effluent discharges from the open-air, recycled water storage ponds at Vintage Greens used by the Town of Windsor. Monitoring results from the Town of Windsor for the period 2007-2011 indicate measurable concentrations of *E. coli* recycled water storage ponds after completion of disinfection. These results are shown in Figure 6.8.

In the Russian River Watershed, municipal wastewater treatment facilities that discharge to surface waters directly or indirectly after storage employ either chlorine or ultraviolet light as a means of wastewater disinfection. Research assessing the regrowth or photoreactivation of bacteria or pathogens in storage ponds is sparse; most recent work has focused on photoreactivation after exposure to ultraviolet light. One study reviewed by North Coast Water Board staff used biochemical fingerprinting to show that the fecal contamination in a golf course pond supplied with chlorine-disinfected recycled water was not related to the recycled water and that the fecal indicator bacteria did not regrow in the ponds (Casanovas-Massana 2012). Another case study (Basu 2007) of

fecal coliform bacteria regrowth in a full-scale operating wastewater treatment facility using ultraviolet disinfection concluded that bacterial regrowth in recycled water systems is a concern, but that exceedances of effluent limitations for fecal coliform in this study could be attributed to poor effectiveness of the ultraviolet disinfection system. The report also summarized recent research on the topic, indicating that photoreactivation of bacteria diminishes drastically after exposure to dosages of ultraviolet radiation above 50 MJ/cm².

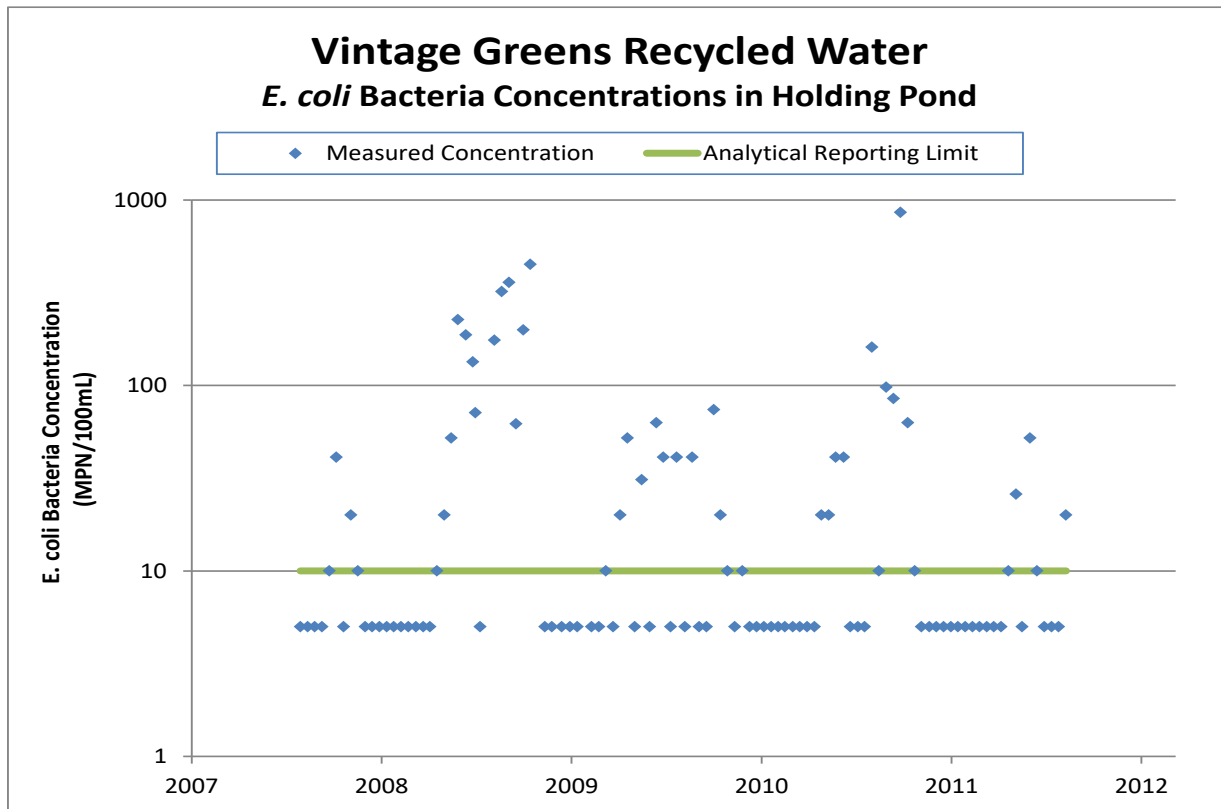


Figure 6.8: *E. Coli* Bacteria Concentrations In A Recycled Water Holding Pond At Vintage Greens In Windsor.

Table 6.1: Municipal NPDES Wastewater Treatment Facilities in the Russian River Watershed and Percent Compliance with Total Coliform Effluent Limitations

Hydrologic Area Name	Hydrologic Subarea Name	Facility Name	Permit No.	Capacity (mgd)	Treatment Type	Percent Compliance Daily Max.	Percent Compliance 7-Day Median	Percent Compliance Monthly Max.
Upper Russian River	Ukiah	City of Ukiah Wastewater Treatment Plant	CA002 2888	3.01	Tertiary	100.0%	93.9%	100.0%
Middle Russian River	Geyserville	City of Cloverdale Wastewater Treatment Plant	CA002 2977	1.0	Secondary	100.0%	100.0%	100.0%
Middle Russian River	Warm Springs	City of Healdsburg Water Reclamation Facility	CA002 5135	1.4	Tertiary	100.0%	98.4%	100.0%
Middle Russian River	Santa Rosa, Laguna, Mark West	Santa Rosa Subregional Water Reclamation System	CA002 2764	21.34	Tertiary	99.9%	100.0%	99.9%

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Hydrologic Area Name	Hydrologic Subarea Name	Facility Name	Permit No.	Capacity (mgd)	Treatment Type	Percent Compliance Daily Max.	Percent Compliance 7-Day Median	Percent Compliance Monthly Max.
Middle Russian River	Mark West	Town of Windsor Wastewater Treatment, Reclamation, and Disposal Facility	CA002 3345	1.9	Tertiary	100.0%	96.1%	100.0%
Lower Russian River	Guerneville	Graton Community Services District Wastewater Treatment, Reclamation, and Disposal Facility	CA002 3639	0.397	Tertiary	100.0%	100.0%	100.0%
Lower Russian River	Guerneville	Forestville Water District Wastewater Treatment, Reclamation, and Disposal Facility	CA002 3043	0.130	Tertiary	99.9%	83.6%	99.7%

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Hydrologic Area Name	Hydrologic Subarea Name	Facility Name	Permit No.	Capacity (mgd)	Treatment Type	Percent Compliance Daily Max.	Percent Compliance 7-Day Median	Percent Compliance Monthly Max.
Lower Russian River	Guerneville	Russian River County Sanitation District Wastewater Treatment Facility	CA002 4058	0.71	Tertiary	100.0%	100.0%	100.0%
Lower Russian River	Guerneville	Occidental County Sanitation District Wastewater Treatment Facility	CA002 3051	0.05	Secondary	100.0%	97.6%	100.0%

Based on these studies reviewed by North Coast Water Board staff, discharges of treated wastewater from recycled water holding ponds may contain *E. coli* and in concentrations above the TMDL targets (i.e., National criteria or statewide objectives). However, the studies indicate that the sources of detected *E. coli* bacteria in recycled water storage ponds are not necessarily of human origin and therefore may not pose a more significant threat to public health or be relevant to protection of the REC-1 beneficial use. More site-specific information is necessary to determine the sources of *E. coli* or other fecal indicator bacteria in recycled water storage ponds and whether the discharge from a recycled water storage pond contains pathogens that risk human illness before the holding pond can be eliminated as a pathogen source.

6.3.1.3 Sanitary Sewer Systems

Sanitary sewer systems collect and transport municipal wastewater from private residences, commercial buildings, industrial facilities, and institutional buildings to a wastewater treatment facility for treatment and disposal and/or reuse. Some sanitary sewer systems also convey storm water and groundwater that may inadvertently enter the system. Sanitary sewer infrastructure is comprised of some or all of the following components: service laterals, collector sewers, connections between laterals and collector sewers, interceptor sewers, manholes and cleanouts, pump stations, and force mains. Typically a public entity (e.g., municipality or county sanitation district) owns and is responsible for maintaining all components of the system except the service laterals, which connect the individual building to the sewer system and are located on private property. Where sewers are installed on private property such as a mobile home park or apartment complex, ownership and maintenance responsibility, including the connection point, is the responsibility of the property owners unless there are subdivision covenants or written agreements and easements which clearly indicate otherwise.

There are nineteen publicly-owned sanitary sewer systems within the Russian River Watershed, as shown in Table 6.2 and based on the most recent Questionnaire data.

Table 6.2: Sanitary Sewer Systems in the Russian River Watershed

Hydrologic Area Name	Hydrologic Subarea Name	Sanitary Sewer System	Population Served	Number of Service Connections	Miles of Force Main	Miles of Gravity Sewer	Miles of Publicly-owned Laterals
Upper Russian River	Ukiah	Calpella County Water District	450	110	0.3	2.9	1
Upper Russian River	Ukiah	Hopland Public Utility District	1,200	288	0.6	4.4	6
Upper Russian River	Ukiah	Ukiah Valley Sanitation District	5,000	4,971	1	43	44
Upper Russian River	Ukiah	City of Ukiah	16,500	5,642	0	44	44
Middle Russian River	Geyserville	City of Cloverdale	8,500	3,200	0.1	32.3	21
Middle Russian River	Geyserville	City of Healdsburg	11,564	4689	2.9	54	90

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Hydrologic Area Name	Hydrologic Subarea Name	Sanitary Sewer System	Population Served	Number of Service Connections	Miles of Force Main	Miles of Gravity Sewer	Miles of Publicly-owned Laterals
Middle Russian River	Geyserville	Geyserville Sanitation Zone	782	267	1	4.3	1.3
Middle Russian River	Laguna	City of Cotati	7,265	2,300	1	32	26.6
Middle Russian River	Laguna	City of Rohnert Park	40,794	8,427	7.5	77	71.8
Middle Russian River	Laguna	City of Sebastopol	7,507	2,800	2.7	25.6	53
Middle Russian River	Laguna	Sonoma State University	10,000	19	0	2.5	1.2
Middle Russian River	Laguna	South Park County Sanitation District	10,400	1,717	0	18.4	16
Middle Russian River	Santa Rosa	City of Santa Rosa	165,267	47,801	6.4	562	434

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Hydrologic Area Name	Hydrologic Subarea Name	Sanitary Sewer System	Population Served	Number of Service Connections	Miles of Force Main	Miles of Gravity Sewer	Miles of Publicly-owned Laterals
Middle Russian River	Mark West	Airport/Larkfield/Wikiup Sanitation Zone	9,306	1,937	1	10	9.2
Middle Russian River	Mark West	Town of Windsor	26,950	8,250	1	92	60
Lower Russian River	Guerneville	Forestville Water District	865	438	1.5	6	3.4
Lower Russian River	Guerneville	Graton Community Services District	1,815	445	0.3	6.5	4
Lower Russian River	Guerneville	Occidental County Sanitation District	610	71	1.5	1	0.3
Lower Russian River	Guerneville	Russian River County Sanitation District	7,377	2,467	5	35	11.7
--	--	Totals	333,226	96,543	33	1,070	899

Overflows of wastewater from the sanitary sewer can be caused by grease blockages, root blockages, sewer line flood damage, pump station power or mechanical failures, and surcharged pipe conditions from excessive storm water or groundwater inflow and infiltration (I/I). Releases of wastewater from the sanitary sewer can also occur as a result of poor sewer design, pipe or material failures, construction-related damage, or lack of a preventive maintenance program, which includes sufficient planning for system rehabilitation and replacement. Private building laterals can crack, become disjointed or displaced, and blocked with roots or other debris and result in an overflow. Untreated sewage from sanitary sewer system releases can contain high levels of pathogenic microorganisms and other pollutants.

All federal and state agencies, municipalities, counties, districts and other public entities that own or operate sanitary sewer systems greater than one mile in length that collect and/or convey untreated or partially treated wastewater to a wastewater treatment facility are required to enroll for coverage under General Waste Discharge Requirements for Sanitary Sewer Systems, Water Quality Order No. 2006-0003-DWQ (General Order) and any future iterations thereof. The General Order establishes minimum requirements to prevent sanitary sewer overflows (SSOs). Reporting requirements are included to ensure adequate and timely notifications are made to appropriate local, state, and federal authorities in the event of SSOs from publicly-owned sewer infrastructure. Table 6.3 lists the details for SSOs reported to the CIWQS SSO database since 2007, resulted in a discharge to a drainage channel and/or surface waters, or discharged to a storm drain and were not fully captured and returned to the sanitary sewer system. These data are based on information retrieved from CIWQS in July 2017. Though any SSO is a violation of permit conditions, the reported levels shown in Table 6.3 indicate that SSOs from publicly-owned sewer infrastructure are not a large source of bacterial contamination of the Russian River Watershed. However, SSO reporting from small communities is inconsistent, which may result in under reporting of SSOs.

Private sewer laterals are owned and maintained by the property owner. Private sewer laterals are not regulated under the General Order and, therefore, owners of private laterals are not required by permit to report SSOs that occur as a result of a failure or blockage in the lateral. Because of the sheer number of private laterals connected to a municipal sewer system and the limited jurisdiction that municipalities have over sewer laterals on private property, SSOs from private sewer laterals often go unreported and corrective actions to stop the SSO may be delayed. Most municipalities have established local ordinances that require property owners connected to the municipal system to design and install new laterals in accordance with local standards and maintain existing service laterals and cleanouts in good working order at the owner's expense. Local ordinances that require property owners to inspect their private service laterals at a property transfer, in response to chronic SSOs, or changes in use are rare in the Russian River Watershed. At least two public sanitation districts within the Russian River Watershed offer a program that enables eligible ratepayers to replace leaking or deteriorating service laterals at the expense of the municipality.

The available information indicates that the volume of SSOs from publicly-owned sewer systems that reach surface waters within the Russian River Watershed is relatively low, with the exception of a few SSOs caused by excessive inflow and infiltration or major pipeline failure. Because of the lack of consistent and complete reporting of SSOs from private sewer laterals, private lateral SSOs are potentially a significant source of pathogens as measured by fecal indicator bacteria in surface waters within the Russian River Watershed.

Table 6.3: Sanitary Sewer Overflows in the Russian River Watershed from 2007 to July 2017

Hydrologic Area Name	Hydrologic Subarea Name	Responsible Agency	Number of SSOs	Volume of SSO (gallons)	Volume that Reached Surface Water (gallons)	% that Reached Surface Water
Upper Russian River	Ukiah	Calpella County Water District	2	2,250	1000	44%
Upper Russian River	Ukiah	Hopland Public Utility District	3	295	0	0%
Upper Russian River	Ukiah	City of Ukiah	31	4,247	1,688	40%
Upper Russian River	Ukiah	Ukiah Valley Sanitation District	4	1,800	1,100	61%
Middle Russian River	Geyserville	City of Cloverdale	0	0	0	NA
Middle Russian River	Geyserville	City of Healdsburg	74	45,465	27,575	61%
Middle Russian River	Geyserville	Geyserville Sanitation Zone	1	200	0	0%

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Hydrologic Area Name	Hydrologic Subarea Name	Responsible Agency	Number of SSOs	Volume of SSO (gallons)	Volume that Reached Surface Water (gallons)	% that Reached Surface Water
Middle Russian River	Laguna	City of Cotati	12	2,012	98	5%
Middle Russian River	Laguna	City of Rohnert Park	10	1268	341	27%
Middle Russian River	Laguna	City of Sebastopol	32	210,369	198,029	94%
Middle Russian River	Laguna	Sonoma State University	6	22,867	0	0%
Middle Russian River	Laguna	South Park County Sanitation District	5	7,753	0	0%
Middle Russian River	Santa Rosa	City of Santa Rosa	42	69,567	49,272	71%
Middle Russian River	Mark West	Airport/Larkfield/Wikiup Sanitation Zone	3	510	50	10%
Middle Russian River	Mark West	Town of Windsor	19	15,090	4,317	29%
Lower Russian River	Guerneville	Forestville Water District	5	397	70	18%
Lower Russian River	Guerneville	Graton Community Services District	3	850	200	24%

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Hydrologic Area Name	Hydrologic Subarea Name	Responsible Agency	Number of SSOs	Volume of SSO (gallons)	Volume that Reached Surface Water (gallons)	% that Reached Surface Water
Lower Russian River	Guerneville	Occidental County Sanitation District	4	506	216	43%
Lower Russian River	Guerneville	Russian River County Sanitation District	19	1,448,554	1,445,969	100%
	Total	SSOs since 2007	275	1,834,000	1,729,925	94%

6.3.1.4 Sanitary Sewer Exfiltration

Exfiltration is different from SSOs. Sanitary sewer overflows from small diameter pipelines are usually caused by pipe blockages. In larger diameter pipelines, excessive infiltration and inflow (I/I) can lead to surcharged pipe conditions. These conditions can result in direct overflows to surface water or land or cause sewer backups into residential or commercial buildings. In contrast, exfiltration is generally described as a sewer leaking from its inside to its surrounding outside and occurs primarily at defective joints and cracks in service laterals, local mains and trunk sewer lines. Factors that contribute to exfiltration include: size and length of sewer lines, age of sewer lines, construction materials, and depth of flow in the sewer. Geological and climatic conditions that contribute to exfiltration include groundwater depth, soil type, faults, and rainfall.

Compliance with requirements for proper operation and maintenance of public sanitary sewer systems set forth in the Sanitary Sewer Systems General Order may help reduce or eliminate exfiltration over time. The occurrence of exfiltration is thought to be limited to those areas where sewer elevations lie above the groundwater table. Since groundwater elevations near surface waterbodies are typically near the ground surface, sewers near surface waterbodies generally are below the groundwater table and infiltration (rather than exfiltration) might be expected to dominate the mode of sewer leakage in these areas.

Where conditions and other factors are present that could result in exfiltration of untreated wastewater from sanitary sewer system, sanitary sewers systems are potential sources of pathogens, measured as fecal indicator bacteria to surfaces waters in the Russian River Watershed.

6.3.1.5 Other NPDES Facilities

Fish Hatcheries

There is one fish hatchery within the Russian River Watershed: Warm Springs Dam Fish Hatchery. The facility is owned by the U.S. Army Corps of Engineers and is operated by the California Department of Fish and Wildlife located at the base of Warm Springs Dam in Healdsburg. The facility is regulated under Waste Discharge Requirements Order No. 97-61 (NPDES Permit No. CA0024350).

The facility is designed to raise approximately 161,000 pounds (800,000 fish) per year for release to the Russian River, and it feeds up to 40,000 pounds of feed during the month of maximum feeding. Influent to the facility comes from Warm Springs Dam (Lake Sonoma) and, if necessary, from a series of wells adjacent to Dry Creek. Influent flow is aerated and routed to twenty ponds/raceways, which discharge to a single pollution control pond with a minimum detention time of 2.5 hours. Treated wastewater from the pollution control pond is discharged to Dry Creek, which is tributary to the Russian River, and also is used for landscape irrigation on less than five acres at an adjacent visitor center and day use area.

Waste Discharge Requirements Order No. 97-61 contains effluent limitations and monitoring requirements for effluent flow, suspended solids, settleable solids, and chloride. Fish intestines have been shown to contain *E. coli* bacteria, but the bacteria comes from ingestion of the bacteria from other sources and are not produced within the fish. A study of the role of fish as contributors of *E. coli* bacteria showed that the source of the *E. coli* in fish feces were likely from ingested bacteria from sediments, Canada geese, mallard ducks, and wastewater. Fish simply serve as a transport vehicle for *E. coli* bacteria transmission from other sources (Hansen et al. 2008). The fish themselves are not a direct source of bacteria. Therefore, fish hatcheries are not considered a source of *E. coli* bacteria for this TMDL.

Other Permittees

There are a number of other permittees in the Russian River Watershed that are regulated under NPDES permits for waste discharges to surface waters, but do not receive, treat or discharge domestic wastewater under conditions of the permit (Table 6.4). Domestic wastewater from the Sonoma West Holdings Food Processing Facility is treated in a lined aerated pond, then filtered and disinfected before application to land. Treated discharges are required to meet effluent limitations for total coliform bacteria as a condition of discharge. Discharges permitted under the aquatic herbicide and aquatic pesticide general NPDES permits and for JDS Uniphase, which is covered under an individual NPDES permit, are not expected to contain human or animal waste, and are therefore not probable sources of fecal bacteria. Utility structures may contain pathogens as measured by fecal indicator bacteria from natural sources or as a result of pass-through from municipal separate storm sewer systems. Even though there is a potential for bacteria to be present in these discharges, these permitted discharges are

not expected to be an original source of pathogens that contribute to the pathogen impairment in the watershed.

Table 6.4: Other NPDES Facilities in the Russian River Watershed

Hydrologic Area	Hydrologic Subarea	Permittee Name	Permit No.	Facility Type
Upper Russian River	Coyote Valley	Potter Valley Irrigation District	CAG990005	Aquatic Herbicide
Upper Russian River	Ukiah	Mendocino Forest Products Ukiah Sawmill	CA0005843 (terminated)	Sawmill
Middle Russian River	Laguna	Sonoma West Holdings Plant #2 Facility	CA0023655	Food Processing
Middle Russian River	Laguna	JDS Uniphase	CAG911001	Laboratory
Upper, Middle and Lower Russian River	Multiple HSAs	AT&T Statewide Cable System	CAG990002	Utility Structure
Upper, Middle and Lower Russian River	Multiple HSAs	Pacific Bell (AT&T)	CAG990002	Utility Structure
Upper, Middle and Lower Russian River	Multiple HSAs	Pacific Gas & Electric Company	CAG990002	Utility Structure

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Hydrologic Area	Hydrologic Subarea	Permittee Name	Permit No.	Facility Type
Upper, Middle and Lower Russian River	Multiple HSAs	Sprint	CAG990002	Utility Structure
Upper, Middle and Lower Russian River	Multiple HSAs	Verizon California	CAG990002	Utility Structure
Upper, Middle and Lower Russian River	Multiple HSAs	Sonoma County Water Agency	CAG990005 (terminated)	Aquatic Herbicide
Upper, Middle and Lower Russian River	Multiple HSAs	Marin/Sonoma Mosquito and Vector Control District	CAG990004	Pesticide/Vect or Control
Upper, Middle and Lower Russian River	Multiple HSAs	City of Santa Rosa	CAG990005	Aquatic Herbicide
Upper, Middle and Lower Russian River	Multiple HSAs	Sonoma County Regional Parks	CAG990005	Aquatic Herbicide

6.3.2 Storm water

The NPDES Storm Water Program regulates storm water discharges from municipal separate storm sewer systems (MS4s), construction activities, industrial facilities, and state highways. Permitted facilities in the watershed are listed in Table 6.5. Most storm water discharges are considered point sources, and operators of these sources may be required to receive an NPDES permit before they can discharge. In 1987, the U.S.

Congress broadened the definition of "point source" to include construction and industrial storm water discharges and municipal separate storm sewer systems (CWA §402(p)). As described below, storm water discharges to the Russian River Watershed are considered an important source of fecal waste in the watershed.

Table 6.5 Permitted Storm Water Facilities in the Russian River Watershed

Program	Number of Enrollees
Municipal Phase I MS4	10
Municipal Phase II MS4	1
Municipal Phase II MS4 (Small Non-Traditional)	1
Storm Water Construction	83
Storm Water Industrial	169
Caltrans	1
Total	265

6.3.2.1 Municipal Storm Water

The 1987 amendments to the Clean Water Act required the U.S. EPA to address storm water runoff in two phases. Phase I of the NPDES Storm Water Program began in 1990 and applied to large (serving 250,000 people or more) and medium (serving between 100,000 and 250,000 people) municipal separate storm sewer systems (MS4) and eleven industrial categories including construction sites disturbing five acres of land or more. Phase II of the NPDES Storm Water Program began in 2003 and applies to small MS4s (serving less than 100,000 people) including non-traditional small MS4s, which are facilities such as military bases, public campuses, prison and hospital complexes and construction sites disturbing from one up to five acres of land. The CWA requires that MS4 permits must "require controls to reduce the discharge of pollutants to the maximum extent practicable (MEP), including management practices, control techniques and systems, design engineering methods and such other provisions as the [U.S. EPA] Administrator or the State determines appropriate for the control of such pollutants." (33 U.S.C. 1342(p)(3)(B)(iii).).

A MS4 is defined in 40 CFR 122.26(b)(8) as a conveyance or system of conveyances (including roads w/drainage systems, municipal streets, catch basins, curbs, gutters, ditches, manmade channels, or storm drains) that is:

1. Owned or operated by a State, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to State law) including special districts under State law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribal organization, or a designated and approved management agency under section 208 of the CWA that discharges into waters of the United States.
2. Designed or used for collecting or conveying storm water.
3. Which is not a combined sewer.
4. Which is not part of a Publicly Owned Treatment Works (POTW), as defined in 40 CFR 122.2.

The current Phase I MS4 Permit, Order No. R1-2015-0030 (NPDES Permit No. CA0025054), names the County of Sonoma, City of Cloverdale, City of Cotati, City of Healdsburg, City of Rohnert Park, City of Santa Rosa, City of Sebastopol, Sonoma County Water Agency¹⁰, City of Ukiah, Town of Windsor as co-permittees. Portions of Unincorporated Mendocino County within the Russian River Watershed are enrolled as Traditional MS4s under the Phase II Small MS4 Permit (Order No. 2013-0001- DWQ effective July 1, 2013). Sonoma State University is regulated under the Phase II Permit as a Non-Traditional Small MS4.

Under terms of the Phase I MS4 Permit, permittees are required to possess the legal authority to prohibit discharges of non-storm water to the MS4 from dumping and disposal of materials such as litter, household refuse, and other materials that have the potential to impact water quality, including sources of pathogens as measured by fecal indicator bacteria. Phase I permittees are also required to implement, in coordination with other public entities, as appropriate, a Public Information and Participation Program (PIPP) that includes education materials to inform the public on the proper disposal and storage of animal wastes.

The Phase II MS4 Permit specifies actions needed by the permittee to reduce the discharge of pollutants in storm water to the maximum extent practicable to achieve compliance with water quality standards and objectives. Like the Phase I MS4 Permit, the Phase II Permit prohibits non-storm water discharges into municipal storm drain systems and watercourses within the permittees' jurisdiction. The Phase II MS4 Permit also identifies special provisions for non-traditional MS4 permittees to comply with including the requirement for an Education and Outreach Program, an Illicit Discharge Detection and Elimination Program, and a Pollution Prevention and Good Housekeeping Program.

¹⁰ The Sonoma County Water Agency does not have land use authority and can only control activities conducted by Sonoma County Water Agency staff or conducted on its own property. Therefore, not all requirements in the Phase I MS4 Permit are applicable to the Sonoma County Water Agency.

As of March, 2025, except for Sonoma State University, there are currently no other Phase II Small MS4 permittees in the Russian River Watershed designated as Non-traditional MS4s. However, other North Coast Water Boards have identified special districts that own and/or operate within transportation corridors as non-traditional MS4s needing coverage under the Phase II MS4 Permit, in recognition that these are sources of trash and human waste from homeless encampments entering MS4s and watercourses. Examples of special districts regulated as non-traditional MS4s include, AMTRAK, Bay Area Rapid Transit (BART), and CalTrain.

Pathogens in Urban Storm Water Systems was prepared by Urban Water Resources Research Council (UWRRC 2014). The report describes potential sources of fecal bacteria in urbanized areas (areas within MS4 boundaries) to include SSOs, illicit discharges to storm sewer systems (e.g., power washing), failing OWTS, wastewater treatment plants, urban wildlife, domestic pets, and agriculture. Further, the report found fecal indicator bacteria concentrations in wet weather discharges from urban MS4s orders of magnitude above primary contact recreation standards. Storm water samples are collected by the City of Santa Rosa, the County of Sonoma, the Town of Windsor, the City of Rohnert Park, the City of Cotati, and the City of Sebastopol as a requirement of the Phase I MS4 permit to implement an outfall monitoring program. These single samples cannot be directly assessed with the Basin Plan water quality objective for fecal coliform bacteria which requires 5 samples collected in a 30-day period. However, the fecal coliform concentrations measured in Santa Rosa Creek during storm events range from 170 – 5,000,000 MPN/100 mL. These very high concentrations supplement other evidence that Santa Rosa Creek is impaired/polluted due to high bacterial loads, especially during wet weather.

Additionally, the wet weather measurements of *E. coli* and enterococci bacteria concentrations draining from developed and sewered areas described in Section 6.2 were much higher than the U.S. EPA (2012) criteria and the state water quality objectives. *E. coli* bacteria concentration measurements showed a geometric mean of 5,372 MPN/100 mL, as compared to the numeric target of 100 MPN/100 mL. Enterococci bacteria concentrations measurements showed a geometric mean of 6,860 MPN/100 mL, as compared to the numeric target of 30 MPN/100 mL. These results confirm that municipal storm water draining from developed and sewered areas is an existing source of pathogens as measured by fecal indicator bacteria.

6.3.2.1.1 Pet waste

Domesticated pets can be a major source of pathogens as measured by fecal indicator bacteria, especially dogs and cats. Domesticated dogs can be a significant source of fecal waste based on their population density, high defecation rate, and pathogen infection rates (Schueler 2000). A single gram of dog feces contains 23 million fecal coliform bacteria (van der Wel 1995). Dogs have been found to be significant hosts for *Giardia*, *Salmonella*, and *Pseudomonas* bacteria (Pitt 1998). Lim and Oliveri (1982) concluded that dog feces were the single greatest source contributing fecal coliform and

fecal streptococcus bacteria in urbanized Baltimore catchments. Trial et al. (1993) reported that cats and dogs were the primary source of fecal coliform bacteria in urban catchments in the Seattle area.

Improper pet waste disposal has the potential to deliver pathogens to surface waters through storm water discharges. Because storm drains do not normally connect to treatment facilities, untreated animal feces often end up in surface waters.

Most pet waste management programs focus on increasing public awareness. Many communities implement pet waste management programs by posting signs in parks or other pet-frequented areas, by mass mailings, and by broadcasting public service announcements. Sign posting is one of the most common outreach strategies. Signs can designate areas where dog walking is prohibited, where waste must be recovered, or where dogs can roam freely. A "pooper-scooper" ordinance may be an effective solution. Many communities have pooper-scooper laws that mandate pet waste cleanup. Because pet waste management is focused on individual pet owners, the program is dependent on the participation and cooperation of all pet owners, and pet waste management programs must be enforced. With an increase in public knowledge of storm water regulations, proper disposal of pet wastes can lead to a significant reduction of bacteria discharged in storm water.

The monitoring and source assessment completed for the Russian River Watershed did not explicitly evaluate the contribution of pet waste to bacteria concentrations in surface waters. However, given the human population density in the watershed, it is assumed that pet waste is a source of indicator bacteria in the watershed. Because the pathogen load from pet waste is presumed to be closely associated with storm water discharges, pet waste management within the Russian River Watershed is being implemented by the NPDES MS4 co-permittees through work plans (i.e. Pathogen Reduction Plans).

6.3.2.2 Industrial Storm Water

The most common pollutants of concern in industrial storm water are suspended solids, oxygen-demanding substances (BOD), nutrients, and heavy metals. Most industrial categories are related to heavy industry and certain light industrial facilities and are unlikely to discharge a significant level of bacteria or other pathogens found in human domestic waste. However, some facilities that require coverage under a storm water permit, such as solid waste transfer stations, sewage treatment plants, and composting operations, are potential sources of pathogens and other public health-related pollutants.

Storm water discharges associated with industrial activities, unless otherwise excluded, are regulated under NPDES Industrial General Permit (Order 2014-0057-DWQ, NPDES No. CAS000001). Beginning on July 1, 2015, storm water discharges associated with industrial activities, unless otherwise excluded, are regulated under the NPDES Industrial General Permit (Order 2014-0057-DWQ). Industrial facilities obtain permit coverage based on whether or not their Standard Industrial Classification (SIC) code is

included in those specific categories. The Industrial General Permit requires the implementation of Best Available Technology Economically Achievable (BAT) and Best Conventional Pollutant Control Technology (BCT) to reduce or prevent pollutants in storm water discharges and authorized non-storm water discharges.

Compliance with requirements in the General Permit will ensure that storm water discharges from industrial sites are not a significant source of pathogens as measured by fecal indicator bacteria.

6.3.2.3 Construction Storm Water

Construction activities that result in a land disturbance equal to or greater than one acre are required to have coverage under the Construction General Permit (Order 2009-0009-DWQ, as amended by Order 2010-0014-DWQ and Order 2012-006-DWQ) and future iterations thereof. The objective of the Construction General Permit is to prevent or minimize the discharge of construction-related pollutants from sites during and after construction.

The primary potential sources of pathogens at construction sites are temporary sanitary facilities on sites that are poorly designed or maintained and thus are a potential source of pathogens as measured by fecal indicator bacteria. Operators of construction sites where there are no permanent sanitary facilities or where permanent facilities are too far from the construction site will provide sanitary facilities for construction personnel in one or more locations throughout the site. A well-designed and maintained site will include BMPs for portable sanitary facilities that include setbacks from waterbodies, storm drains, and gutters, location of toilets on surface areas that will absorb spills instead of transporting contamination to surface waters, and provisions to prevent vandalism and toppling of the enclosures due to exposure to high winds. Recommended maintenance activities include establishment of an appropriate cleaning and maintenance schedule, and inspection schedules to detect damage, leaks, and spills, and disposal for rinse water from cleaning activities into a sanitary sewer system.

Compliance with requirements in the Construction General Permit will ensure that storm water discharges from construction sites are not a significant source of pathogens as measured by fecal indicator bacteria.

6.3.2.4 CalTrans Storm Water

The California Department of Transportation (Caltrans) is responsible for the design, construction, management, and maintenance of the state highway system, including freeways, bridges, tunnels, and associated properties. Major state highways in the Russian River Watershed include Highways 101, 116, 128, and 12.

Caltrans is subject to the storm water permitting requirements of Clean Water Act section 402(p). Caltrans is currently operating under a statewide storm water permit that regulates all storm water and non-storm water discharges from Caltrans MS4s and

maintenance facilities. Caltrans' Storm Water Management Plan, which is updated annually, describes the procedures and practices used to reduce or eliminate the discharge of pollutants to storm drainage systems and receiving waters. Construction activities associated with Caltrans projects are currently covered under the general construction stormwater permit.

The State Water Board adopted Order 2014-0077-DWQ as an amendment to the Caltrans permit to add requirements related to completed TMDLs. Under the statewide permit and TMDL amendment, Caltrans is required to prioritize reaches across the state and then to implement best management practices and control measures to achieve 1,650 Compliance Units each year in the highest priority reaches. One Compliance Unit is equal to one acre of Caltrans right-of-way from which runoff is retained, treated, or otherwise controlled prior to discharge to the relevant reach. Caltrans is encouraged to establish cooperative implementation agreements with other parties that have responsibility to attain a TMDL.

Also under the statewide storm water permit, Caltrans is required to prepare a TMDL Status Review Report to be submitted with each Annual Report. The TMDL Status Review Report includes (1) a summary of the effectiveness of the control measures installed for each reach that has been addressed, as a result of BMP effectiveness assessment, (2) a determination as to whether the control measures have been or will be sufficient to achieve WLAs and other performance standards by the final compliance deadlines, (3) where the control measures are determined not to be sufficient to achieve WLAs or other performance standards by the final compliance deadlines, a proposal for improved control measures to address the relevant pollutants, and (4) a summary of the estimated amount of pollutants that were prevented from entering into the receiving waters.

Homeless encampments within the Caltrans right-of-way are a source of both trash and pollutants in waterways. As described in a 2013 study for the Contra Costa County Flood Control and Water Conservation District, larger, well-established encampments usually have a designated "toilet area," but it is likely that occupants also use the water to dispose of waste (DeVono-Powell 2013). Where the disposal of urine and human fecal waste in water occurs, there is a high potential that this is a source of pathogens as measured by fecal indicator bacteria. In areas within Caltrans rights-of-way that do not contain bacteria-generating sources such as homeless encampments, restroom facilities, garbage bins, etc., Caltrans finds that the contribution of fecal bacteria to waterbodies is not believed to be a significant source of pathogens that present a human health risk (Caltrans 2012).

6.3.3 Point Source Conclusions

More site-specific information is necessary, however, to determine the sources of *E. coli* or other fecal indicator bacteria in recycled water storage ponds and whether the discharge from a recycled water storage pond contains pathogens that are infectious to humans before the holding pond can be eliminated as a pathogen source. Similarly,

requirements in the industrial and construction General Permits are designed to ensure that storm water discharges from industrial and construction sites are not a significant source of fecal indicator bacteria and pathogens. As discussed below, monitoring data of storm water discharges from MS4s demonstrate that these areas can be a significant source of pathogens as measured by fecal indicator bacteria. The reported levels and frequencies indicate that SSOs from publicly-owned sewer infrastructure are not a large source of bacterial contamination of the Russian River Watershed.

More site-specific information is necessary, however, to determine the sources of *E. coli* or other fecal indicator bacteria in recycled water storage ponds and whether the discharge from a recycled water storage pond contains illness-causing pathogens before the holding pond can be eliminated as a pathogen source. Where conditions and other factors are present that could result in exfiltration of untreated wastewater from sanitary sewer system, sanitary sewers systems are potential sources of pathogens, measured as fecal indicator bacteria to surface waters in the Russian River Watershed.

Untreated sewage from sanitary sewer system releases can contain high levels of pathogenic microorganisms and other pollutants. SSOs from private sewer laterals are potentially a significant source of pathogens as measured by fecal indicator bacteria in surface waters within the Russian River Watershed. Homeless encampments within the Caltrans right-of-way are a source of both trash and pollutants in waterways. In areas within Caltrans rights-of-way that do not contain bacteria-generating sources such as homeless encampments, restroom facilities, garbage bins, etc., Caltrans finds that the contribution of fecal bacteria to waterbodies is not believed to be a significant source of pathogens that present a human health risk (Caltrans 2012).

Additionally, the wet weather measurements of *E. coli* and enterococci bacteria concentrations draining from developed and sewered areas described in Section 6.2 were much higher than the statewide objective for *E. coli* and U.S. EPA (2012) criteria for enterococci. *E. coli* bacteria concentration measurements showed a geometric mean of 5,372 MPN/100 mL, as compared to the numeric target of 100 MPN/100 mL. Enterococci bacteria concentrations measurements showed a geometric mean of 6,860 MPN/100 mL, as compared to the numeric target of 30 MPN/100 mL. These results confirm that municipal storm water is an existing source of pathogens as measured by fecal indicator bacteria.

In summary, the Russian River Watershed has widespread point sources throughout the watershed that have the potential to deliver pathogens to surface waters. Assessment of potential fecal waste sources and fecal bacteria do not inform relative contributions between the point sources (waste loads) and/or nonpoint sources (loads). All identified potential point sources of fecal waste to surface waters provide an elevated risk of pathogen discharge and impairment of REC-1 beneficial uses. As such, all identified potential point sources of fecal waste to surface waters require a program of implementation and monitoring to prevent and assure that fecal waste and potential

pathogens are not discharged to surface waters. *Chapter 9 – Implementation* describes the implementation and Chapter 10 – Watershed Monitoring describes the monitoring program designed to assure the TMDL waste load and load allocations are achieved.

6.4 WASTE DISCHARGES TO LAND

The following sections identify known waste discharges to land in the Russian River Watershed and discuss the likelihood that these discharges are sources of fecal waste and pathogens to the Russian River and its tributaries via indirect discharge. This TMDL treats these potential sources as nonpoint sources because direct discharges to the Russian River and its tributaries from these facilities are not authorized in accordance with an NPDES permit.

6.4.1 Municipal Wastewater Discharges to Land

The Russian River Watershed contains five municipal wastewater treatment facilities that are authorized under WDRs to discharge treated domestic wastewater to land (Figure 6.9). Table 6.6 summarizes these facilities (based on information obtained from CIWQS in November 2013) and describes their treatment capabilities and methods of effluent disposal or reuse.

Municipal wastewater treatment facilities discharging to land in the watershed rely primarily on aerobic pond systems for waste treatment to achieve the effluent quality necessary to protect groundwater quality. Disinfection using chlorine is commonly used to comply with an average monthly effluent limitation for total coliform of 23 MPN/100 mL. Final disposal of treated effluent is through percolation or irrigation to pasture land. The eventual receiving water for these discharges is groundwater. Through adequate treatment and disposal system design, which includes disinfection units and separation of the disposal area from streams, lakes, and reservoirs, the risk of transport of pathogens to surface waters is low.

Municipal wastewater disposed through surface irrigation from facilities that are operating properly, irrigating at agronomic rates, and conforming to conditions prescribed in waste discharge requirements is not expected to cause pathogenic contamination of groundwater or surface waters. Municipal wastewater discharged to percolation ponds that are proximate to surface waters have the potential to contribute to pathogenic loading in surface waters via shallow groundwater connection to surface water as do unpermitted releases, depending on site specific conditions. Importantly, groundwater monitoring data to assess the water quality impact of wastewater discharges to land in the Russian River Watershed is currently lacking and should be addressed in future permit updates.

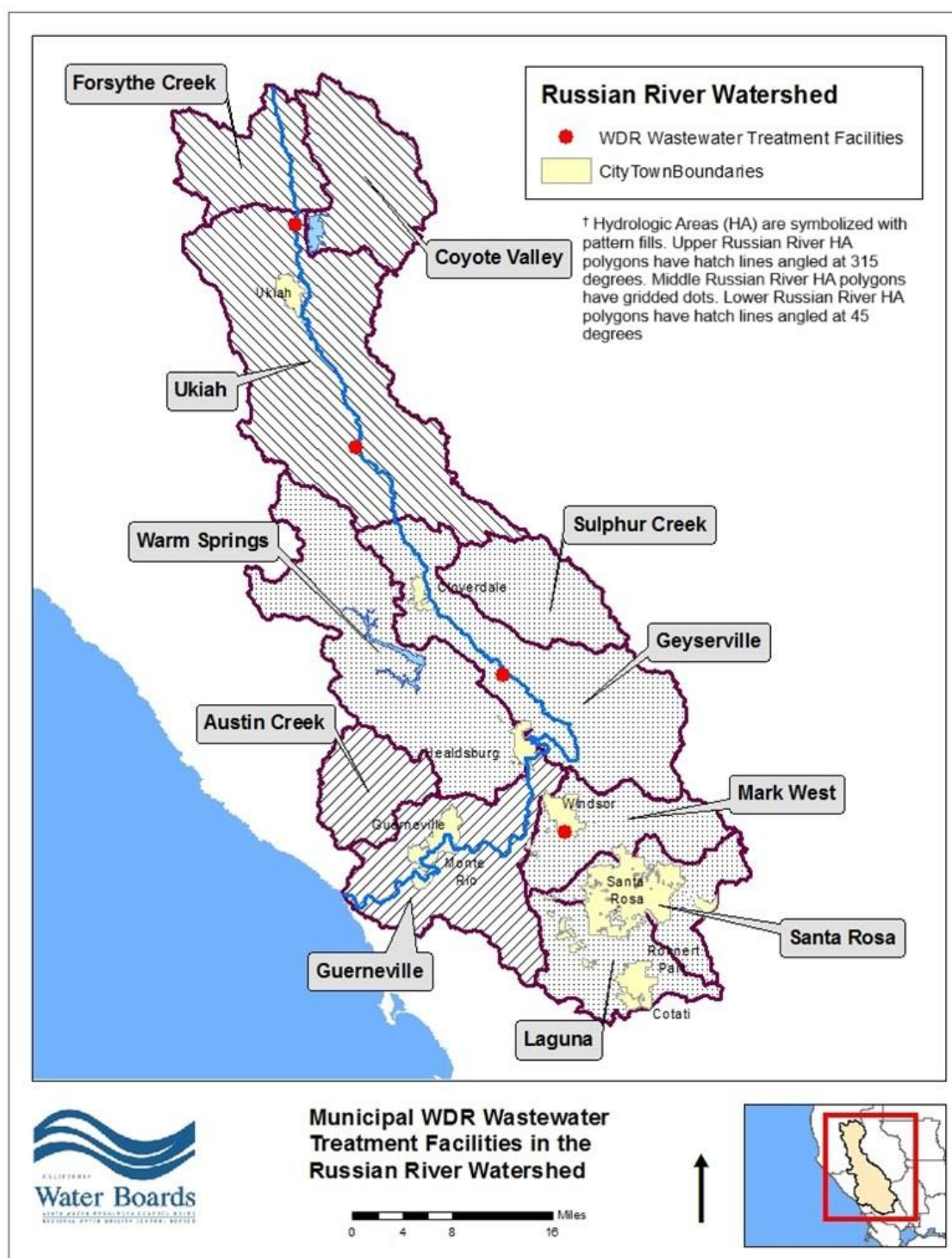


Figure 6.9: Municipal WDR Wastewater Treatment Facilities In The Russian River Watershed

Table 6.6: Municipal WDR Wastewater Treatment Facilities in the Russian River

Hydrologic Area Name	Hydrologic Subarea Name	Facility Name	Permit No.	Capacity (mgd)	Treatment Type/Disposal Method
Upper Russian River	Ukiah	Calpella County Water District	R1-2019-0010	0.04	Aerated pond treatment, disinfection and percolation disposal
Upper Russian River	Ukiah	Hopland Public Utility District	R1-2023-0013	0.09	Aerated pond treatment, disinfection, and percolation disposal
Middle Russian River	Geyserville	Geyserville Sanitation Zone	R1-2019-0013	0.092	Aerated pond treatment, disinfection, and percolation disposal
Middle Russian River	Mark West	Airport-Larkfield-Wikiup Sanitation Zone	R1-2019-0007	0.9	Aerated pond treatment, microfiltration, disinfection, and spray irrigation disposal

6.4.2 Land Application of Municipal Biosolids

Both Class A (Exceptional Quality) and Class B municipal biosolids contain pathogens, including bacteria, parasites, and viruses. Exposure to these pathogens may occur through direct contact with biosolids, through inhalation, ingestion of food that has come into contact with biosolids or through contact with vectors (flies, mosquitos, birds, rodents, etc.) that can transport pathogens from biosolids to humans. Federal regulations establish minimum standards for the regulation of biosolids using various risk assessment methodologies. (40 C.F.R. part 503.) Compliance with these regulations will minimize the human health risk associated with the land application of municipal biosolids.

In July 2004, the State Water Board adopted General Waste Discharge Requirements for the Discharge of Biosolids to Land for Use as a Soil Amendment in Agricultural,

Silvicultural, Horticultural, and Land Reclamation Activities, Water Quality Order No. 2004-12-DWQ (General Order). The General Order incorporates the minimum standards established by the Part 503 Rule and expands upon them to fulfill requirements of the California Water Code.

When biosolids are applied to ground surfaces where there is an increased risk that biosolids may migrate off the application site, the North Coast Water Board Executive Officer may require an Erosion Control Plan to assure containment of biosolids on the application site. Site specific conditions that may require submission of an Erosion Control Plan include, but are not limited to, sites where ground slopes are greater than 10 percent and areas with minimal riparian buffer between the biosolids application area and surface waters.

The City of Santa Rosa is the only public or private entity that is permitted to apply municipal biosolids to land in the Russian River Watershed. The City of Santa Rosa currently land applies Class B biosolids at three city-owned properties: Alpha Farm, Brown Farm, and Stone Farm, all of which are located within the Laguna Hydrologic Subarea. There is no available evidence that biosolids applied to land by the City of Santa Rosa have migrated outside the authorized application areas and entered surface waters. However, mobilization pathways may present a risk of pathogen discharge where biosolids are applied on sites near waterbodies with erosion potential.

6.4.3 Recycled Water Discharges from Landscape Irrigation

Although advanced wastewater treatment systems in the Russian River Watershed are operated to produce recycled water that is essentially pathogen-free and suitable for water recycling, this same recycled water, when stored in open-air holding ponds, may become contaminated as a result of regrowth of bacteria or through contribution of fecal waste from wildlife, particularly birds that frequent the storage ponds.

Most major municipalities in the watershed are either actively participating in water recycling programs or are contemplating becoming involved. The largest water recycling program in the region, the Santa Rosa Subregional Water Reclamation System, accepts and treats municipal wastewater from the communities of Santa Rosa, Cotati, Rohnert Park, and Sebastopol for use as recycled water for urban and agricultural irrigation on over 6,400 acres of land. Other communities, such as the Town of Windsor, Guerneville, City of Ukiah, and the Airport-Larkfield-Wikiup communities also use recycled water for local irrigation projects. The production and use of recycled water in the North Coast Region is permitted via water recycling requirements directly incorporated into the discharge permit of a facility (i.e., WDRs or NPDES permit), or the discharger may choose to enroll under a statewide general permit (i.e., General Order WQ 2016-0068-DDW (General WRR)).

In addition, the Santa Rosa non-storm water Discharge Best Management Practices (BMP) Plan was required by NPDES MS4 Permit Order No. R1-2015-0030 and sets forth approved protective measures that are required of all applicable recycled water

uses in order to minimize or prevent the effects of non-storm water discharges (City of Santa Rosa 2013). The BMP Plan describes runoff control measures to be implemented for both landscape irrigation in urban settings and agricultural irrigation in rural settings. By controlling runoff from recycled water use areas, these BMPs will also help reduce human-source bacteria entering receiving waters.

Although local recycled water programs are well-managed, unintentional spills of recycled water occur periodically. Large volume spills are rare and usually the result of broken recycled water lines in rural properties. Large volume spills of recycled water have the potential to adversely impact water quality but are a low risk to contribute pathogens as measured by fecal indicator bacteria because the recycled water has been disinfected to meet tertiary treatment standards prior to entering the recycled water distribution system. Small volume spills occur more frequently, though not common, as a result of unintentional overspray, mechanical breaks, vandalism, or other unforeseen conditions. The contribution of pathogens from small volume spills and other incidental runoff events is de minimus and not expected to be a source of fecal indicator bacteria in amounts that contribute to exceedances of water quality standards.

6.4.4 Private Domestic Wastewater Discharges to Land (with flow greater than 10,000 gallons per day)

Discharges of domestic wastewater or combined industrial/domestic wastewater systems to the ground surface and discharges to the subsurface where the projected wastewater flow is greater than 10,000 gallons per day (gpd) are regulated under state-issued WDRs or individual waste discharge requirements. Discharges of domestic wastewater to the subsurface under 10,000 gpd may be authorized by a local agency under a Local Agency Management Plan (LAMP) approved by the North Coast Water Board in accordance with the *Water Quality Control Policy for Siting, Design, Operation, and Maintenance of Onsite Wastewater Treatment Systems* (OWTS Policy).

There are nineteen large and medium-sized private domestic wastewater treatment facilities in the Russian River Watershed currently regulated under WDRs that discharge to land through conventional septic tank/leachfield systems, subsurface drip irrigation systems, percolation ponds, or spray irrigation. Table 6.7 summarizes these facilities and describes their treatment capabilities and methods of disposal.

WDRs for large wastewater discharges include effluent limitations, discharge prohibitions, and other conditions established to protect water quality and beneficial uses. Septic systems are designed in accordance with minimum standards for siting, design, and operation contained in the Basin Plan and other requirements set forth by the applicable local regulatory agency. Minimum standards that are critical to effective onsite treatment and disposal of waste include adequate separation to groundwater and drinking water sources, favorable soil characteristics and geology to maximize soil treatment, and suitable waste application rates. Land disposal systems conforming to prescribed minimum standards and operating properly are not expected to cause bacterial contamination of groundwater and surface waters. But, land disposal through

percolation ponds that are proximate to surface waters have the potential to contribute to bacterial loading in surface waters, depending on site specific conditions, and require site-specific evaluation. Importantly, groundwater monitoring data to assess the water quality impact of wastewater discharges to land in the Russian River Watershed is currently lacking and should be addressed in future permit updates.

Table 6.7: Private Domestic WDR Wastewater Treatment Facilities in the Russian River Watershed (with flow greater than 1,500 gallons per day)

Hydro-logic Area Name	Hydro-logic Subarea Name	Facility Name (Location)	Permit No.	Capacity (gpd)	Treatment Type/ Disposal Method
Upper Russian River	Ukiah	Camp Wente (Ukiah)	97-10-DWQ	10,875	Conventional septic tank/leachfield system
Upper Russian River	Ukiah	City of Ten Thousand Buddhas (Talmage)	WQ 2014-0153-DWQ	33,271	Subsurface flow wetland treatment followed by subsurface disposal to leachfield system
Middle Russian River	Geyserville	Coppola Winery (Geyserville)	97-10-DWQ	12,000	Aerobic pretreatment, disinfection, and subsurface drip irrigation
Middle Russian River	Geyserville	Jordan Vineyard and Winery (Healdsburg)	97-10-DWQ	3,500	Aerobic pretreatment and mound disposal
Middle Russian River	Geyserville	Old Crocker Inn (Cloverdale)	97-10-DWQ	1,875	Conventional septic tank/leachfield system
Middle Russian River	Geyserville	Rio Lindo Academy (Healdsburg)	87-094	75,000	Solids separation with evaporation/percolation disposal
Middle Russian River	Geyserville	Salvation Army-Lytton Springs Rehabilitation Facility (Healdsburg)	97-10-DWQ	11,000	Aerated pond treatment, disinfection, and spray irrigation disposal
Middle Russian River	Mark West	Camp Newman (Santa Rosa)	97-10-DWQ	20,000	Aerobic pretreatment with subsurface drip irrigation

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Hydro-logic Area Name	Hydro-logic Subarea Name	Facility Name (Location)	Permit No.	Capacity (gpd)	Treatment Type/ Disposal Method
Middle Russian River	Mark West	Humane Society of Sonoma County	R1-2003-0068	2,423	Aerobic pretreatment and mound disposal
Middle Russian River	Mark West	Kendall-Jackson Wine Center (Fulton)	97-10-DWQ	5,850	Aerobic pretreatment with subsurface drip irrigation
Middle Russian River	Mark West	Mayacama Golf Club (Santa Rosa)	97-080	4,900	Aerated pond, microfiltration, disinfection, spray irrigation
Middle Russian River	Mark West	Sonoma-Cutrer Vineyards (Santa Rosa)	97-10-DWQ	1,800	Aerobic pretreatment with subsurface drip irrigation
Middle Russian River	Mark West	Vintner's Inn (Santa Rosa)	R1-2002-0087	32,000	Activated sludge system with surface drip irrigation
Lower Russian River	Guerneville	Bohemian Grove (Monte Rio)	R1-2006-0053	2,250,000	Aerated pond treatment, disinfection, and spray irrigation disposal
Lower Russian River	Guerneville	Gurdjieff Foundation (Guerneville)	97-10-DWQ	2,490	Aerobic pretreatment with subsurface drip irrigation and at-grade disposal system
Lower Russian River	Guerneville	Odd Fellows Recreation Club (Forestville)	98-125	45,000	Clustered, conventional septic tank/leachfield system
Lower Russian River	Guerneville	Rodney Strong Vineyard (Healdsburg)	88-064	60,000	Aerated pond treatment, disinfection, and percolation disposal
Lower Russian River	Guerneville	The Farmhouse Inn (Forestville)	97-10-DWQ	3,285	Aerobic pretreatment and subsurface drip irrigation

Hydro-logic Area Name	Hydro-logic Subarea Name	Facility Name (Location)	Permit No.	Capacity (gpd)	Treatment Type/ Disposal Method
Lower Russian River	Austin Creek	Camp Royaneh (Cazadero)	97-10-DWQ	16,600	Aerated pond treatment and percolation disposal

6.4.5 Wine, Beverage and Food Processors

Wine, beverage, and food (WBF) processing facilities located within the Russian River Watershed include, but are not limited to alcoholic (e.g., wineries, breweries, cider houses) and non-alcoholic beverage producers, fruit and vegetable processors, meat wrapping, and dairy product manufacturers. These facilities range in size from small in-home operated, non-commercial establishments to large, industrial or commercial establishments. In 2016, the North Coast Water Board adopted General Waste Discharge Requirements for Discharges of Wine, Beverage and Food Processor Waste to Land, Order No. R1-2016-0002, and Conditional Waiver of Waste Discharge Requirements for Discharges of Wine, Beverage and Food Processor Waste to Land, Order No. R1-2021-0001 to regulate discharges to land from WBF processing facilities that could affect the quality of waters of the state. A number of WBF processors in the Watershed are regulated under facility-specific WDRs because they are not eligible for coverage under either general order or because permit coverage has not yet been transferred to a general order. Finally, additional Wineries are covered under State Water Resources Control Board Order WQ 2021-0002-DWQ, General Waste Discharge Requirements for Winery Process Wastewater. It is the intent of the State Board that all eligible wineries in the state transition this order, though no firm timeline for that transition is in place at this time.

Process wastewater from these facilities is not expected to contain illness-causing pathogens as measured by fecal indicator bacteria, and not considered a source of fecal waste in this TMDL. Domestic, human waste is commonly disposed of in individual onsite wastewater treatment systems (OWTS) separate from the process wastewater disposal systems and regulated by the local regulatory agency or by the Regional Water under WDRs. WBF processing facilities that combine process and domestic wastewater streams and dispose of the effluent through land application are potential sources of pathogens in surface waters unless permit conditions contain disinfection requirements or disposal requirements to prevent the migration of pathogenic organisms in the effluent to groundwater and surface water.

There are five food processing facilities in the Watershed that discharge process wastewater to land and are regulated under individual WDRs or a waiver of WDRs (Table 6.8). These facilities were identified as a result of a query of the CIWQS database in November 2013. None of these permits contain effluent limitations. Other food processing facilities in the watershed have been identified by North Coast Water

Board staff. It is expected many of these facilities will enroll under general WDRs or waiver of WDRs for WBF processors.

Generally, Good Manufacturing Practices (GMPs) and Sanitation Standard Operating Procedures (SSOPs) are the foundations for food safety programs for food processors. GMP regulations are designed to control the risk of contaminating foods with chemicals and microbes during their manufacture and include practices for the cleaning and sterilization of equipment, pest control, and quality assurance assessment. SSOPs are specific, written procedures necessary to ensure sanitary conditions in the facility. SSOPs are required in all meat and poultry processing plants, in accordance with C.F.R. title 9 Part 416. Compliance with these practices and procedures will prevent contamination or adulteration of food products and will minimize the bacterial load discharged from the facility.

The concentration of bacteria associated with process wastewater effluent from food processors is not currently known. However, proper and appropriate sanitation safeguards implemented during food processing will ensure that bacterial contaminants do not enter the waste stream from the food processing stream. Domestic waste discharges related to the operation of food processing facilities are separate from the process wastewater stream and treated in domestic waste treatment system permitted by the State or authorized by local permits or programs. Consequently, North Coast Water Board staff has determined that these facilities are not expected to be a source of pathogens that contributes to the pathogen impairment in the watershed.

Table 6.8 Private Food Processors Individual WDR Wastewater Treatment Facilities in the Russian River Watershed

Hydrologic Area Name	Hydrologic Subarea Name	Facility Name (Location)	Permit No.	Design or Permitted Flow	Treatment Type/ Disposal Method
Middle Russian River	Laguna	Santa Rosa Meat and Poultry Company (Santa Rosa)	No. 79-019	1,000 gpd	Specialty meat shop where industrial and domestic wastewater flows through a septic tank, one tank for industrial waste and one tank for domestic waste, the flows are then combined and chlorinated before disposal into an evaporation/percolation pond.

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Hydrologic Area Name	Hydrologic Subarea Name	Facility Name (Location)	Permit No.	Design or Permitted Flow	Treatment Type/ Disposal Method
Middle Russian River	Laguna	Sonoma West Holdings-South (Sebastopol)	No. 88-071	50,000 gpd	Multi-tenant food and beverage processing facility that generates wash water. During dry weather, wash water is spray irrigated on 2.6 acres. Runoff from the spray fields is collected and re-irrigated, discharged to percolation beds, and/or retained in storage tanks. During wet weather, all wash water is directed to the percolation ponds and/or to storage tanks. Domestic wastewater is disposed of through an OWTS.
Lower Russian River	Guerneville	Manzana Products Company (Graton)	No. 85-079	25,000 gpd	Apple processing and canning plant that discharges wash water to a spray irrigation system during seasonal operations.

6.4.6 Mobile Homes Parks and Campgrounds

There are 133 mobile home and special occupancy (RV) parks in the Russian River Watershed (CDHCD 2014). About two-thirds of these mobile home parks (MHP), RV Parks, and campgrounds are located within municipal sewer districts and discharge domestic wastewater to treatment facilities. However, forty-five of these parks are located outside of sewered areas and consequently dispose of domestic waste onsite via individual septic systems. Figure 6.10 shows the locations of these facilities. Septic systems associated with mobile home parks and campgrounds are commonly large capacity, located adjacent to surface waterbodies, and often poorly maintained or overloaded. Consequently, North Coast Water Board staff determined that these facilities, when poorly sited, inadequately operated or maintained, are a probable source of pathogens as measured by fecal indicator bacteria in surface waters in the Russian River Watershed.

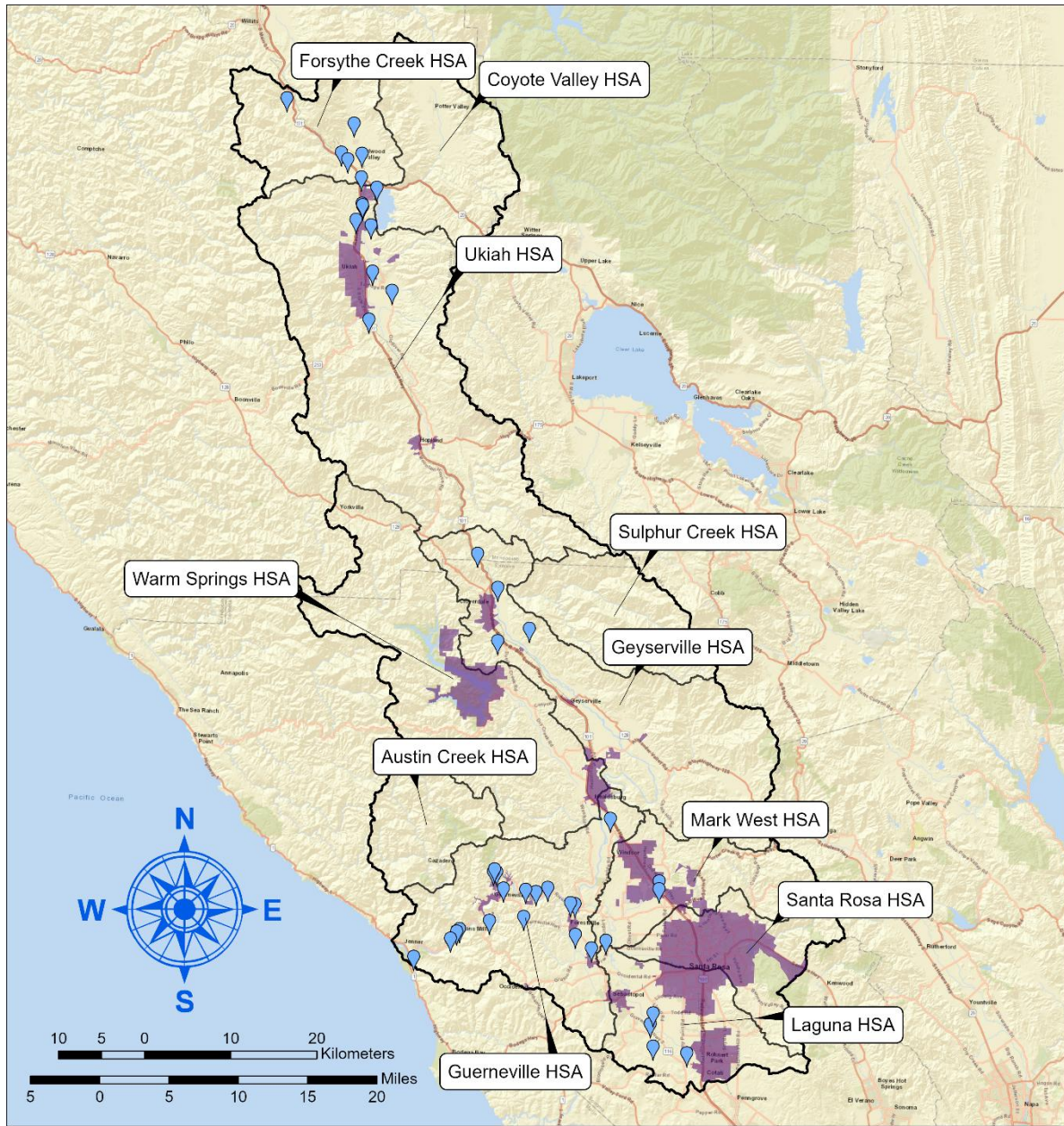
Table 6.9: Unsewered Mobile Home Parks and Campgrounds in the Russian River Watershed





Mobile Home Park or Campground Name	County
Golden Rule Mobile Village	Mendocino
Golden Rule RV Park	Mendocino
Sanders Park	Mendocino
Williams	Mendocino
Capps MHP	Mendocino
North Valley MHP	Mendocino
River Lane Mobile Home Estates	Mendocino
Meadow Oaks	Mendocino
Ukiah Mobile Home & RV Park	Mendocino
Ukiah Mobile Estates	Mendocino
Caravan Mobilehome Park	Mendocino
Hillcrest Trailer Court	Mendocino
The Meadows	Mendocino
Green Acre Park	Mendocino
Valley Village Mobile Home Park	Mendocino
Oak Park MHP	Mendocino
Mirabel Tp	Sonoma
Clem Mora Rentals	Sonoma
River Bend Campground	Sonoma
Hilton Campground LLC	Sonoma
Burkes Mirabel Park	Sonoma
Riens Sandy Beach	Sonoma
Helen G Skaines Park	Sonoma
Ferndale MHP	Sonoma
Heaven's Half Acre	Sonoma
Blue Spruce MH Lodge	Sonoma
Les Redwood	Sonoma
One Oak MHP	Sonoma
School House Canyon Campground	Sonoma
Little Big Horn Trailer Haven	Sonoma
Creekside Mobile Home Park	Sonoma
Sweet Reunion Inn/Resort	Sonoma
Redwood Village	Sonoma
Old 101 Mobile Manor	Sonoma
Colonial Park	Sonoma

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Mobile Home Park or Campground Name	County
Stonegate MHP	Sonoma
Ginger Rose RV Park	Sonoma
Russian River	Sonoma
Dutcher Creek Village	Sonoma
Cloverdale Koa Camping Resort	Sonoma
Gilmore Park	Sonoma
Casini Ranch Family Campground	Sonoma
Duncans Mills Camping Club	Sonoma
Bridgehaven Park	Sonoma
Spring Creek MHP	Sonoma

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed



-  Mobile Home Parks and Campgrounds without Sewer Connections
-  Sewered Areas[†]
-  Hydrologic Subareas
-  Russian River Hydrologic Unit

[†] Sewered areas were delineated using boundary and infrastructure (e.g., sewer mains) lines from data produced by municipalities, county and private wastewater service districts, and Local Agency Formation Commissions.

**Russian River Watershed
Mobile Home Parks and
Campgrounds without
Sewer Connections**



Figure 6.10: Unsewered Mobile Home Parks And Campgrounds

6.4.7 ONSITE WASTEWATER TREATMENT SYSTEMS

For the purposes of this TMDL, OWTS are identified as a waste discharge to land since treated wastewater disperses through a leachfield with no intentional outlet to a surface waterbody. About one-fourth of all American households rely on onsite wastewater treatment systems (OWTS) to dispose of their wastewater, which translates to about 20 million individual systems nationwide (Wilhelm et al. 1994). Table 6.10 presents estimates of the houses and population that are connected to sanitary sewers in the Russian River Watershed. The estimates show that about 31% of the houses in the watershed are not connected to a sanitary sewer and are assumed to use OWTS for treatment of domestic waste. The estimates were made from the 2010 U.S. Census.

Table 6.10: Estimates of Houses, Population & Acres of Sewered and Non-Sewered Areas in the Russian River Watershed

Areas	Houses Count	Houses Percent	Population Count	Population Percent	Acres Count	Acres Percent
Sewered	113,631	69%	288,225	72%	83,644	9%
Non-sewered	51,537	31%	111,147	28%	866,608	91%
Total within Russian River Watershed	165,168	100%	399,372	100%	950,252	100%

Conventional OWTS operate simply: after solids are trapped in a septic tank, typically a 1,000 to 1,500-gallon concrete or fiberglass tank, wastewater is distributed to a subsurface drain field and allowed to percolate through the soil. Bacteria in the wastewater are effectively removed by filtering and straining water through the soil profile. Viruses are not effectively filtered in soil because of their small size. Instead viruses are removed through adsorption to soil particles and by inactivation in the soil.

Effective pathogen removal in OWTS is dependent on proper siting and installation of the OWTS components, proper maintenance, and operation of the system within design specifications. Pathogens may enter the groundwater and surface water from OWTS when wastewater rises to the ground surface, is intercepted by high groundwater, or passes through the soil profile without adequate treatment.

North Coast Water Board staff conducted a focused study on the potential influence of OWTS on the discharge of pathogens, as measured by fecal indicator bacteria concentrations in receiving surface waters. The sampling methods, results, and an analysis of the data are presented in the “Onsite Wastewater Treatment System Impact

Study Report” (NCRWQCB 2013a). In this study, North Coast Water Board staff selected catchments for monitoring based on the risk of FIB transport to surface waters and parcel density. Parcel density was determined using parcel data from the Sonoma County Assessor. Risk of FIB transport was determined using an in-house geospatial model developed based on risk factors derived from the North Coast Water Board’s “Policy on the Control of Water Quality with Respect to On-Site Waste Treatment and Disposal Practices” in the Basin Plan (NCRWQB 2011). Three sample locations were selected to represent catchments draining each of the following four categories, for a total of twelve sites:

- High parcel density with a high risk of FIB transport from OWTS
- High parcel density with a low risk of FIB transport from OWTS
- Low parcel density with a high risk of FIB transport from OWTS
- Low parcel density with a low risk of FIB transport from OWTS

Three additional sample locations were selected to represent catchments that drain areas served by OWTS that have high parcel density and are near a stream. Locations were selected from the Fitch Mountain area near Healdsburg, downtown Monte Rio, and Camp Meeker.

Water quality data was collected from each location five times during the study period, measuring for *E. coli*, enterococci, and *Bacteroides* bacteria. Statistical analyses were conducted to determine any correlations between the water quality data and catchment characteristics. Multiple potential characteristics were evaluated, including the modeled FIB transport risk, catchment size and parcel density. Of these characteristics, parcel density showed a positive correlation with water quality data. That is, when parcel densities were higher, so were downstream concentrations of FIB.

Figure 6.11 shows the distribution of these concentrations by parcel densities. Note that the STV for *E. coli* is 320 cfu/100 mL and for enterococci is 110 cfu/100 mL. High parcel densities range from 0.8 to 4 parcels per acre (0.2 to 1.3 acres/parcel). Low parcel densities ranged <0.1 parcels per acre (9 to 100 acres/parcel).

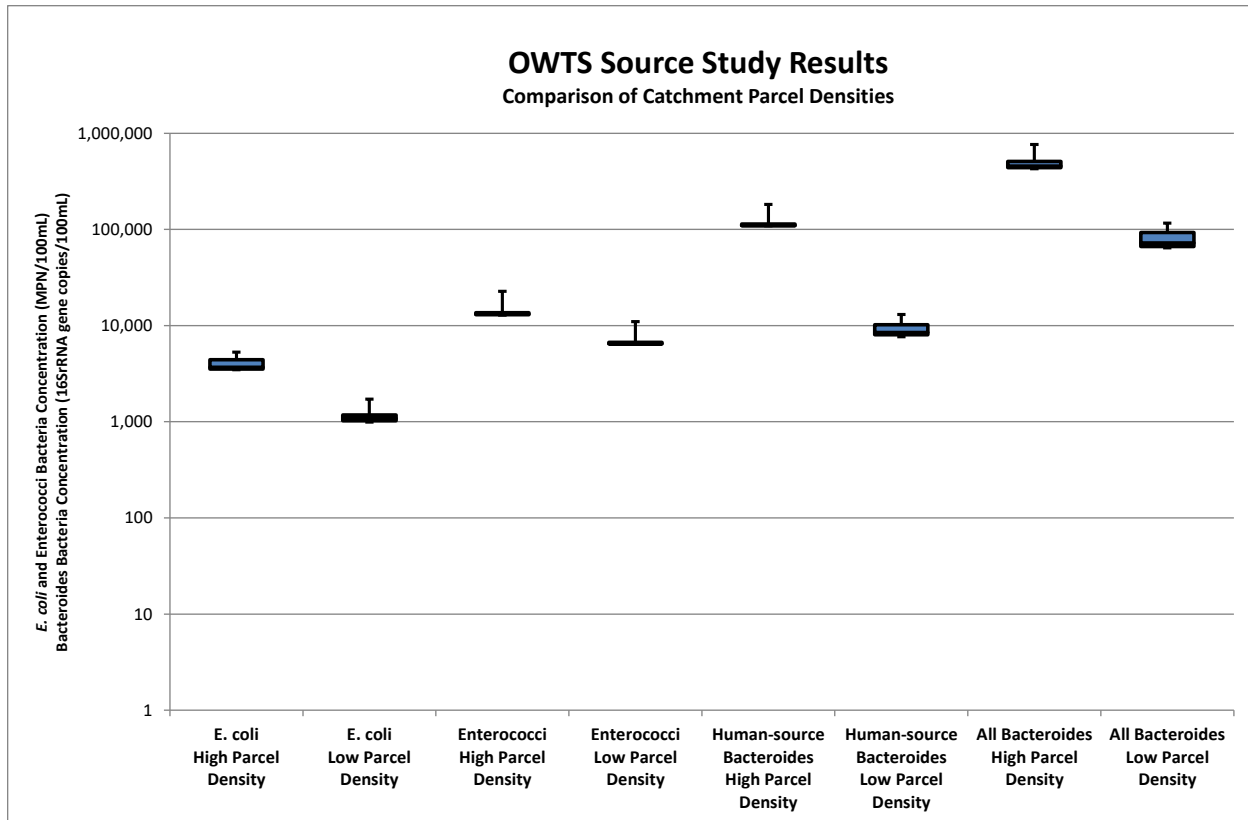


Figure 6.11: Comparison Of The Distribution Of E. Coli, Enterococci And Bacteroides Bacteria Concentrations By Parcel Densities.

Bacteroides bacteria were analyzed with the AllBac and HuBac genetic marker following U.S. EPA (2010) Method B.

These findings confirm that OWTS are a source of FIB, particularly from high parcel density areas. The findings indicate the need to consider parcel density when prioritizing investigations within the Advanced Protection Management Program (APMP) boundary.

6.4.8 Discharges to Land Source Conclusions

The Russian River Watershed has numerous land discharge sources throughout the watershed, some of which have the potential to deliver pathogens to surface waters. Discharges from some of these land discharge categories are already controlled under a program of implementation that are working well to prevent pollution. Other identified land discharge sources of fecal waste either require a program of implementation and monitoring to prevent and assure that fecal waste and potential pathogens are not discharged to surface waters or require update. *Chapter 9 – Implementation* describes the implementation and monitoring program designed to assure the waste load and load allocations are achieved.

6.5 NONPOINT SOURCES

The term "nonpoint source" is defined as any source of water pollution that is not from a discernible, confined, and discrete conveyance. Per definitions in the Clean Water Act, agricultural discharges are also considered nonpoint sources even when conveyed through a pipe. Nonpoint source pollution typically comes from many diffuse sources and is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, depositing them into streams and other waters.

This section primarily focuses on controllable nonpoint sources in developed areas and agricultural areas, since the runoff from these areas show the highest concentrations of fecal indicator bacteria.

6.5.1 Recreation at Public Beaches

There are many public swimming beaches along the mainstem Russian River. Several of the most popular beaches are shown in Table 6.11 and Figure 6.12. Swimming and other water contact recreation in the river can be a source of bacteria and other pathogens through direct human urination or defecation in the water or along the shore. Pathogens may also be washed off the body during immersion.

North Coast Water Board staff conducted a focused study on the potential influence of intensive recreation on fecal indicator bacteria concentrations at public beaches (NCRWQCB 2013b; Appendix B). Water samples were collected for analysis of *E. coli*, enterococci, and human-source *Bacteroides* bacteria at Veterans Memorial Beach and Monte Rio Beach during the week of the Independence Day holiday in 2013.

Table 6.11: Popular Swimming Beaches along the Russian River

Hydrologic Area Name	Hydrologic Subarea Name	Recreational Beach Name	Location
Upper Russian River	Coyote Valley	Mill Creek Park	Potter Valley
Upper Russian River	Forsythe Creek	Mariposa Swimming Hole	Redwood Valley
Upper Russian River	Ukiah	Vichy Springs Park	Ukiah
Upper Russian River	Ukiah	Mill Creek Park	Ukiah

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Hydrologic Area Name	Hydrologic Subarea Name	Recreational Beach Name	Location
Middle Russian River	Geyserville	Cloverdale River Park	Cloverdale
Middle Russian River	Geyserville	Wildhaven Sonoma Glamping	Healdsburg
Lower Russian River	Guerneville	Veteran Memorial Beach	Healdsburg
Lower Russian River	Guerneville	Riverfront Park	Windsor
Lower Russian River	Guerneville	Mirabel Park Campground	Forestville
Lower Russian River	Guerneville	Steelhead Beach	Forestville
Lower Russian River	Guerneville	River Access Beach	Forestville
Lower Russian River	Guerneville	Sunset Beach	Forestville
Lower Russian River	Guerneville	Johnson's Beach	Guerneville
Lower Russian River	Guerneville	Monte Rio Beach	Monte Rio
Lower Russian River	Guerneville	Casini Ranch Campground	Duncans Mills



Figure 6.12: Popular Swimming Beaches Along The Russian River

Water samples were collected during the afternoon when human recreational use was the highest. Sonoma County Park staff counted recreators on the beach and in the water at Veterans Memorial Beach each day at 14:00 hours (Figure 6.13). Recreator counts were not available for Monte Rio Beach.

Relationships between these variables were investigated using the Spearman's rank correlation coefficient (ρ) (Helsel and Hirsch 2002). Spearman's rank correlation coefficient is a nonparametric statistical measure of the dependence between two variables. Spearman correlation coefficients approach either plus one ($\rho \sim +1.0$) or minus one ($\rho \sim -1.0$), as the relationship become stronger. A small correlation coefficient (between -0.5 and 0.5) indicates a weak relationship between the variables.

The study found that the percentage of human-specific *Bacteroides* showed a relatively strong positive correlation (Spearman Correlation Coefficient = 0.72) with swimming recreation, with the higher percentages of human-specific *Bacteroides* observed on days with a larger number of people swimming. Moderately positive correlations were found for *E. coli* bacteria concentrations (Spearman Correlation Coefficient = 0.55) and enterococci bacteria concentrations (Spearman Correlation Coefficient = 0.51) with swimming recreation. The results indicate that intensive human contact recreation at public beaches on the most popular hot summer days contributes to *E. coli*, enterococci and *Bacteroides* bacteria concentrations in surface waters. The less intensive recreation periods that is more common during summer weekdays and throughout the non-summer season results in lower *E. coli*, enterococci and *Bacteroides* indicator bacteria concentrations compared with the times of high intensity use.

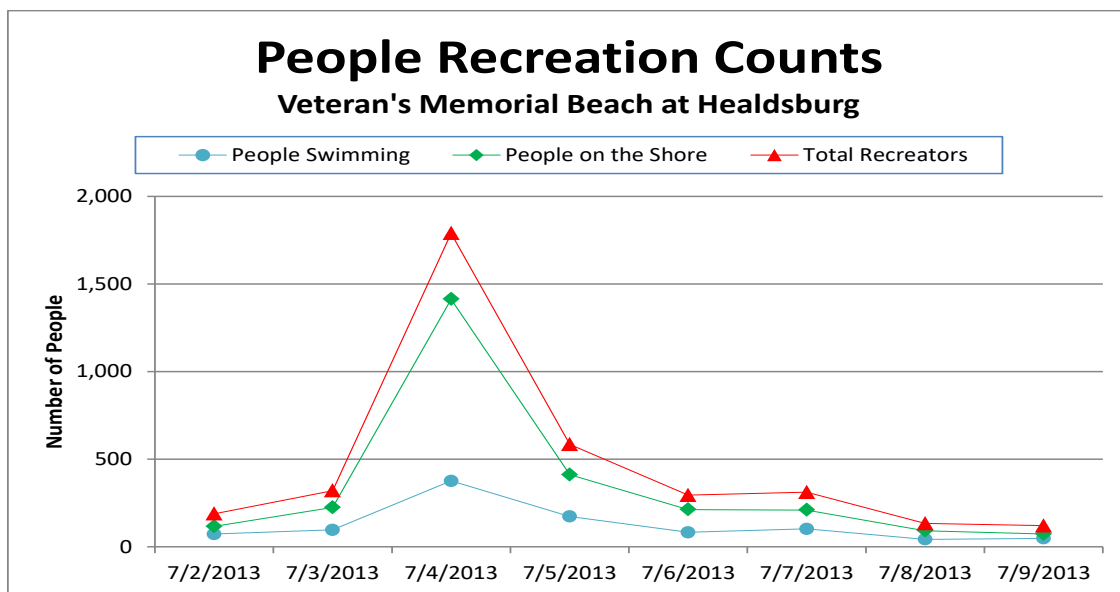


Figure 6.13: Counts Of People Recreating At Veterans Memorial Beach In Healdsburg

6.5.2 Homeless Encampments

Homeless encampments and sites of other illegal camping are potential sources of pathogens. Many riparian areas within the Russian River Watershed attract homeless people and these areas most often do not have sanitary disposal facilities. The discharge of untreated human waste directly to surface waters within these riparian corridors from homeless encampments could be one of the causes of the presence of fecal indicator bacteria found in undeveloped areas.

The Russian River Watershed covers large areas of Mendocino and Sonoma counties. Applied Survey Research (2005) estimates that 5,335 people were homeless in Mendocino County in 2005 and 78% of those were unsheltered. This represents 6% of the overall population of 90,816 people in Mendocino County. Applied Survey Research also estimates that 9,749 people were homeless in Sonoma County in 2005 and 77% of those were unsheltered. This represents 2% of the overall population of 484,102 people in Sonoma County.

The source analysis for this Pathogen TMDL did not attempt to assess the potential of pathogen contamination specifically associated with homeless encampments or sites of other illegal camping. However, monitoring results for Santa Rosa Creek downstream of known homeless encampments routinely indicate high levels of fecal indicator bacteria. Further, anecdotal reports of poor waste disposal practices by the occupants of the encampments lead North Coast Water Board staff to conclude that homeless encampments are a likely potential source of pathogens in surface waters as measured by fecal indicator bacteria. The same potential applies to sites of other illegal camping, in close proximity to surface water and without adequate sanitation facilities.

6.5.3 Livestock Waste

A large number of pathogens found in manure from livestock have the potential to cause illness in humans. These organisms include, but are not limited to, *Salmonella*, *Campylobacter*, *E. coli*, *Leptospira*, and *Clostridium* bacteria (U.S. EPA 2009). Human-infectious pathogens relevant to livestock sources in the Russian River Watershed also include *Giardia* (cattle), *Campylobacter jejuni* (chickens), and hepatitis E serogroup C (hogs). Several viruses found in livestock waste have the potential to cross from animals to humans, and thus have the potential to cause disease in humans (Mattison et al. 2007; McAllister and Topp 2012). Pathogens can be discharged directly to watercourses when livestock have access to streams. They can also be carried to surface waters in storm water runoff or in runoff resulting from over-application of liquefied manure to pasture land.

The estimated number of different types of animals in Sonoma and Mendocino counties is shown in Table 6.12. The Russian River Watershed covers large areas of both counties. Data presented in this table were obtained from several sources, as described below. Discussion of categories of livestock animals as potential sources of fecal waste to the Russian River Watershed is provided in greater detail in the following sections.

Table 6.12: Inventory of Livestock Animals in Mendocino and Sonoma Counties

Animal Type	Mendocino County Number of Animals	Mendocino County Citation	Sonoma County Number of Animals	Sonoma County Citation
Laying Hens and Pullets	8,973	USDA (2007)	5,764,700	Linegar (2013)
Cattle and Calves	18,100	Morse (2012)	68,762	Linegar (2013)
Horses	2,509	USDA (2007)	17,794	Benito (2005)
Sheep and lambs	9,000	Morse (2012)	22,543	Linegar (2013)
Goats	1,454	USDA (2007)	2,146	Linegar (2013)
Hogs	1,450	Morse (2012)	1,029	Linegar (2013)

6.5.4 Dairies, Manure Holding Ponds, & Landscape Applications of Manure

Any release of manure to surface waters from holding ponds from confined animal facilities has a significant potential to impact bacterial water quality due to the large amount stored and the high concentration of bacteria in raw manure (up to 100 million fecal coliform per gram). Most commercial dairies in the Russian River Watershed store manure in large lagoons that can hold millions of gallons of liquid manure. Waste lagoons can break, spill, leak, or fail. Lagoon linings can crack and allow liquefied manure to seep into surface waters or shallow groundwater. Pipes and hoses connecting to lagoons or spray fields may fail or leak (Marks 2001). In addition, many dairies spread or spray liquefied manure on pasture land. When liquid waste is over-applied or inappropriately applied to farm fields through irrigation, runoff of manure to surface waters can result.

The North Coast Water Board implements the Water Quality Compliance Program for Cow Dairies. Initiated in 2012, this program currently includes a General WDR permit for dairies. This regulatory tool requires management of process water, manure, and other organic materials at dairy operations including holding ponds and the application of such materials to cropland. The General WDR was last revised in 2019. The North

Coast Water Board currently has no enrollees in a Concentrated Animal Feeding Operations (CAFO) permit for waste discharges to surface waters..

The dairy permits require retention ponds and manured areas at confined animal facilities in operation on or after November 27, 1984, to be protected from inundation or washout by overflow from any stream channel during 20-year peak stream flows. Retention ponds are required to be lined with, or underlain by, soils which contain at least 10 percent clay and not more than 10 percent gravel or artificial materials of equivalent impermeability. Manure ponds constructed after January 19, 2012, must include a pond liner that does not exceed a unit seepage rate of 1×10^{-6} centimeters per second. While these permit requirements protect against manure discharges from holding ponds, discharges can occur when streams exceed the 20-year peak stream flow rate. The dairy permits specify that waste storage facilities constructed after January 19, 2012 shall be located outside of 100-year floodplains, unless site restrictions require location within a floodplain, in which case, the waste storage facility shall be protected from inundation or damage from a 100-year flood event. The dairy permits also authorize the application of manure and process waters to land only if such application is at rates that are reasonable for the crop, soil, climate, special local situations management systems, and type of manure.

As described in Section 6.2, wet weather measurements of *E. coli* and enterococci bacteria concentrations draining from agricultural areas were much higher than the statewide objective and U.S. EPA (2012) criteria, respectively. *E. coli* bacteria concentration measurements showed a geometric mean of 880 MPN/100 mL, as compared to the numeric target of 100 MPN/100 mL. Enterococci bacteria concentrations measurements showed a geometric mean of 1,556 MPN/100 mL, as compared to the numeric target of 30 MPN/100 mL. These results confirm that runoff from agricultural areas is an existing source of bacteria. Additionally, the results for grazer fecal waste are included in Chapter 4, Evidence of Pollution, Table 4.7. Two sites in the Guerneville HSA showed strong evidence of grazer fecal waste pollution.

Figure 6.14 shows the results of the Bovine-source *Bacteroides* bacteria concentration measurements and the locations of dairies in the Middle Russian River Hydrologic Area. Visual comparison shows that higher concentrations of Bovine-source *Bacteroides* bacteria are near or downstream of the dairies. Figure 6.15 shows the results of the grazer fecal waste gene sequence measurements (the percentage of the grazer fecal waste gene sequences are shown) and the locations of dairies in the Middle Russian River Hydrologic Area. Visual comparison shows that higher levels of grazer fecal waste gene sequence measurements are near or downstream of the dairies. This source analysis approach does not distinguish between the various types of grazers, and in particular between cattle and dairy cows. However, based on an assessment of the data and the known distribution of cattle versus dairy operations, general assumptions regarding the relative contribution from cattle versus dairy cows are appropriate and Regional Board staff conclude that dairy operations are a probable source of pathogens.

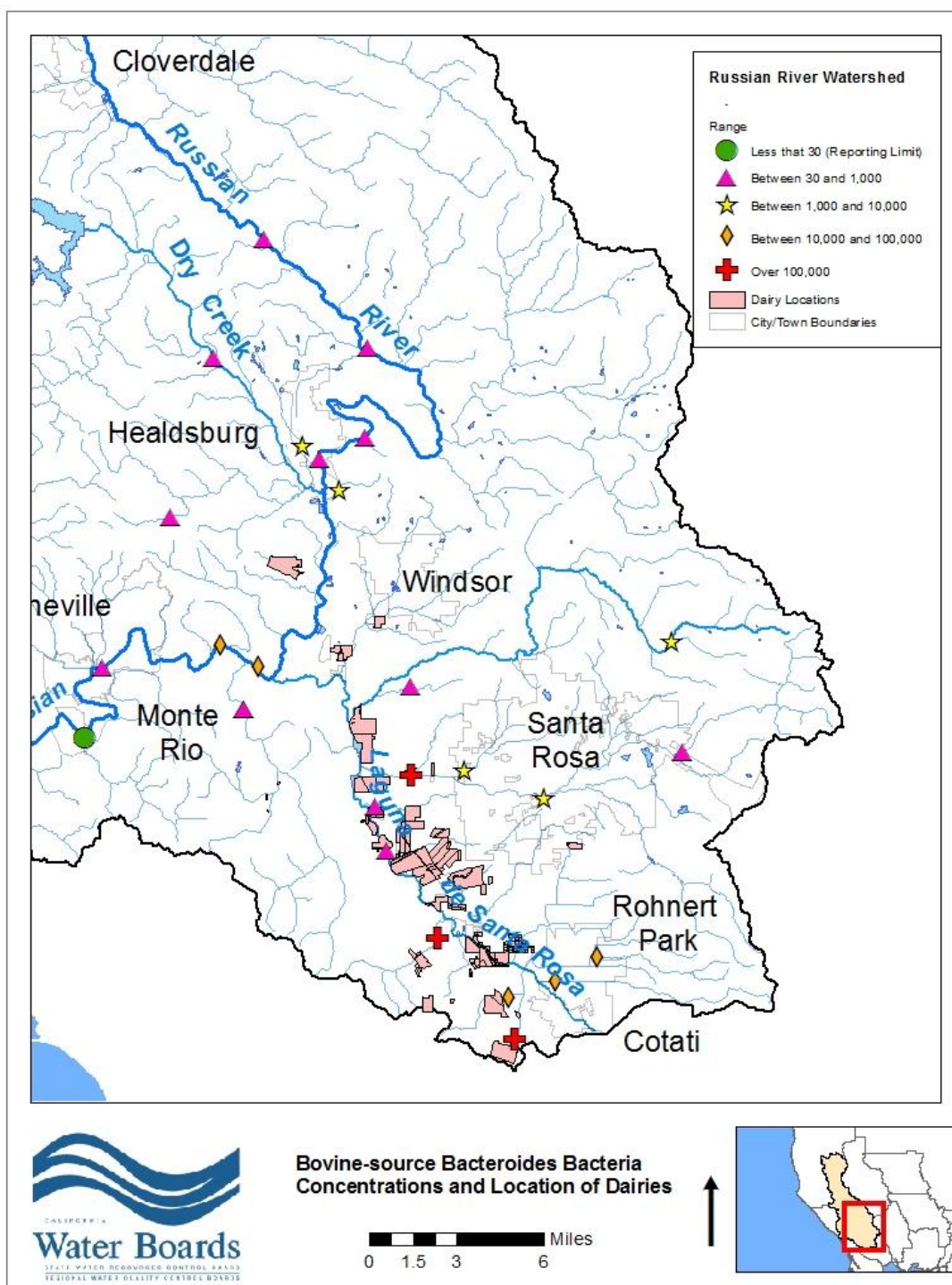


Figure 6.14: Locations Of The Bovine-Source Bacteroides Results And Dairies In The Middle Russian River Watershed.

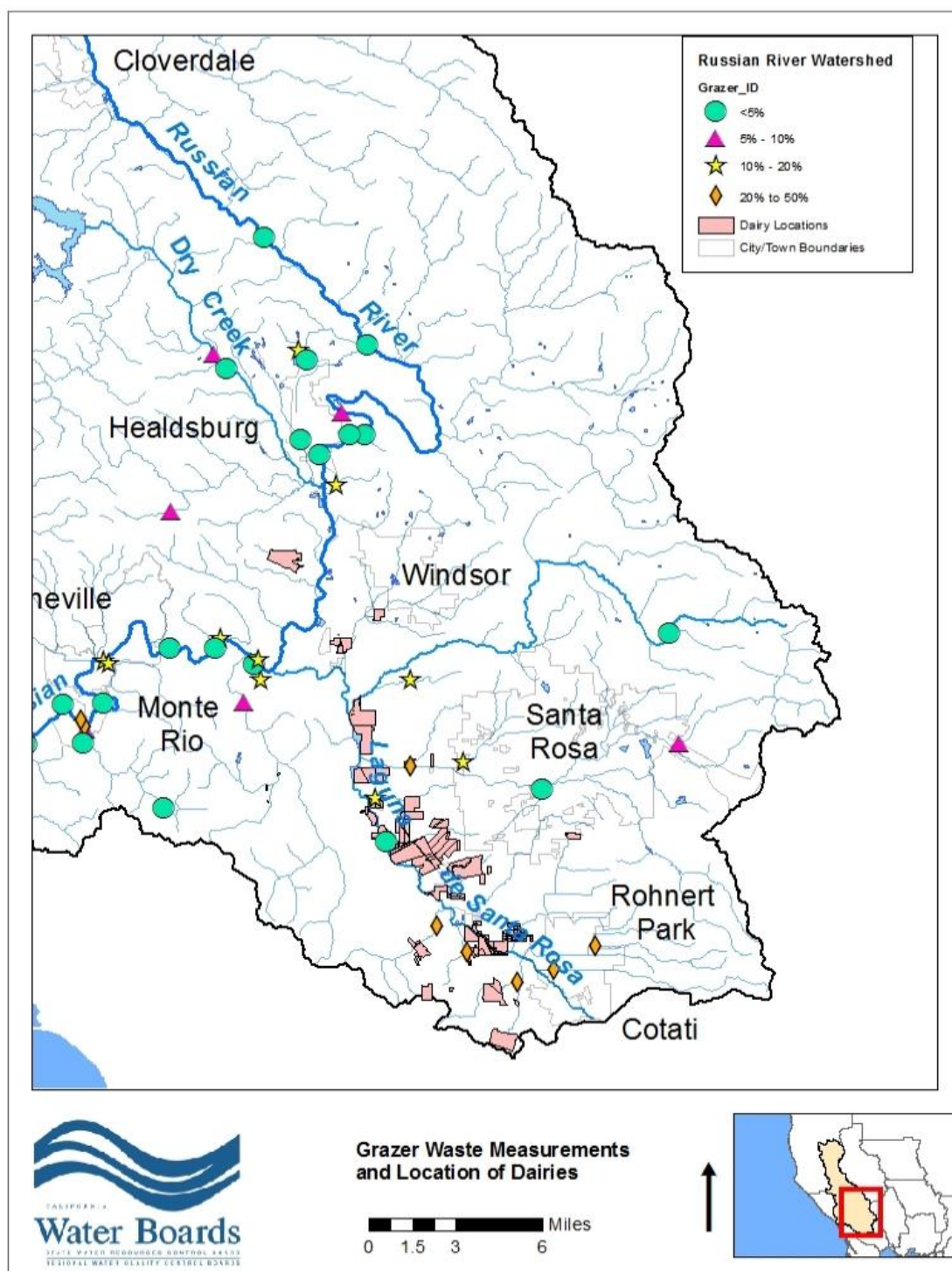


Figure 6.15: Locations Of The Grazer Waste Results And Dairies In The Middle Russian River Watershed

6.5.5 NonPoint Source Conclusions

The Russian River Watershed has widespread nonpoint sources throughout the watershed that have the potential to deliver pathogens to surface waters. Assessment of potential fecal waste sources and fecal indicator bacteria do not inform relative load contributions between the point sources and/or nonpoint sources, including runoff from facilities that discharge waste to land. All identified potential nonpoint sources of fecal waste to surface waters provide an elevated risk of pathogen discharge and impairment of REC-1 beneficial uses. The primary nonpoint sources of fecal waste include homeless encampments, recreational water uses and users, and manure from dairies and non-dairy livestock. As such, all identified potential nonpoint sources of fecal waste to surface waters require a program of implementation and monitoring to prevent and assure that fecal waste and potential pathogens are not discharged to surface waters. *Chapter 9 – Implementation* describes the implementation and *Chapter 10 – Watershed Monitoring* describes the monitoring program designed to assure the waste load and load allocations are achieved.

6.6 SOURCE ANALYSIS CONCLUSIONS

Potential sources of fecal waste within the Russian River Watershed are many and widespread. A significant number of potential sources are already covered under an individual or general permit and are controlled through use of treatment or best management practices.

In summary, staff analyzed sources of fecal waste with the potential to enter the Russian River or its tributaries in two different ways:

- By assessing fecal indicator bacteria concentrations associated with different types of land uses; and
- By identifying the types of point source, discharge to land, and nonpoint source facilities and activities that discharge or have the potential to discharge fecal waste to surface waters.

The source analysis does not estimate the volume of fecal waste entering the Russian River Watershed from any given potential source, nor does it stratify the sources based on order of magnitude. But, the multiple lines of evidence provide an understanding of the locations within the watershed with greatest risk from fecal waste, the land uses of most concern, and the point and nonpoint sources deserving further evaluation and/or control. For the purposes of this TMDL, the facilities/activities that discharge waste to land are considered nonpoint sources.

There is evidence of human and bovine fecal waste entering the waters of the Russian River Watershed during all times of the year, though higher during wet weather. Sewered and non-sewered developed areas are associated with exceedances of statewide objectives for *E. coli* and national criteria enterococci bacteria, indicating a

threat to recreational use. Similarly, agricultural areas are also associated with exceedances of the same objectives/criteria.

From these multiple lines of inquiry, it is possible to conclude that the following source categories have potential to discharge pathogens to surface waters in the Russian River Watershed:

Sources of Human Fecal Waste Material

- Treated Municipal Wastewater to Surface Waters including discharges from holding ponds;
- Untreated Sewage from Sanitary Sewer Systems;
- Wastewater from Percolation Ponds and through Spray Irrigation;
- Runoff from Land Application of Municipal Biosolids and Biosolids Storage Areas;
- Runoff from Irrigation of Recycled Water;
- Runoff from sites that receive discharges of waste to land;
- Onsite Wastewater Treatment Systems, including individual systems and large or multi-user systems;
- Recreational Water Uses and Users;
- Homeless and Illegal Camping; and
- Stormwater runoff entering Municipal Separate Storm Sewer Systems (MS4s) and entering water bodies outside established MS4 boundaries, including CalTrans stormwater runoff.
- Sources of Domestic Animal and Farm Animal Waste
- Pet Waste;
- Manure from Non-Dairy Livestock and Farm Animals; and
- Manure from Dairy Cows

Chapter 9 - Implementation describes the program of implementation by which these sources of fecal waste material are to be controlled, including completion of site specific studies/surveys, development and implementation of new or upgraded management plans and applicable regulatory mechanisms.

CHAPTER 7

TMDL CALCULATIONS AND ALLOCATIONS

7.1 OVERVIEW

A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality objectives. The TMDL equals the loading capacity of the waterbody for the pollutant plus a margin of safety (MOS) to account for any uncertainties. The MOS can be implicit by virtue of conservative assumptions or explicit, given as a measured or estimated term. The loads are allocated among the various sources of the pollutant. Anthropogenic pollutant sources are characterized as either point sources that receive a wasteload allocation (WLA) or nonpoint sources that receive a load allocation (LA). The natural background load is included in the load allocation, unless estimated separately.

$$\text{TMDL} = \Sigma \text{WLAs} + \text{LAs} + \text{MOS}$$

TMDLs can be expressed in terms of mass per time, toxicity or other appropriate measure. The TMDL must be set at a level not to exceed the loading capacity of the waterbody and at a level resulting in attainment of the water quality objective. It must be adjusted to account for seasonal variation, if appropriate.

7.2 LOADING CAPACITY, TMDL AND MARGIN OF SAFETY

The fecal coliform objective contained in the Basin Plan for protection of REC-1 is superseded by a statewide bacteria objective for *E. coli* in freshwater and enterococci in saline waters, adopted by the State Water Board in August 2018. As such, the loading capacity, and by extension the TMDL, are based on the statewide standard for the protection of REC-1. The statewide bacteria objective is based on the lower of the two acceptable illness rates identified by U.S. EPA (2012) (i.e., 32 gastrointestinal illnesses versus 36). As such, the TMDL includes an implicit margin of safety as represented by the lower of two acceptable illness rates.

7.3 WASTELOAD AND LOAD ALLOCATIONS

The loading capacity of the Russian River Watershed for pathogens is equivalent to the water quality objective, given as a concentration of the fecal indicator bacteria *E. coli* in freshwaters and enterococci in saline waters, as per the statewide objectives adopted by the State Water Board in August 2018. To attain these water quality objectives, the wasteload (WLA) and load allocations (LA) are also equivalent to the water quality objective and given as the same concentration of *E. coli* in freshwater and enterococci in saline waters, as described in Table 7.1. Natural background concentrations of *E. coli* and enterococci have not been estimated. For the purpose of this TMDL, natural

background concentrations are not represented by a separate term but included in the load allocation.

Table 7.1: Source Category Allocations

Source Category	Type of Allocation	Allocation
Municipal wastewater discharge to surface water (NPDES)	WLA	GM and STV for <i>E. coli</i> or enterococci depending on salinity
Municipal wastewater discharge to land (WDR)	WLA/LA	0
Sanitary Sewer Systems	LA	0
Land Application of Biosolids	LA	0
Recycled Water Irrigation Runoff	LA	0
Municipal Stormwater (NPDES)	WLA	GM and STV for <i>E. coli</i> or enterococci depending on salinity
CalTrans Stormwater (NPDES)	WLA	GM and STV for <i>E. coli</i> or enterococci depending on salinity
Large OWTS	LA	0
Individual OWTS	LA	0
Recreational Water Use and Users	LA	0
Homeless Encampments and Illegal Camping	LA	0
Non-dairy Livestock and Farm Animal Waste	LA	GM and STV for <i>E. coli</i> or enterococci depending on salinity

Source Category	Type of Allocation	Allocation
Dairies and CAFOs subject to NPDES permit	WLA	GM and STV for <i>E. coli</i> or enterococci depending on salinity
Dairies and CAFOs not subject to NPDES permit	LA	GM and STV for <i>E. coli</i> or enterococci depending on salinity

The sampling frequency and period of sampling is important to proper interpretation of monitoring results. The statewide *E. coli* objective for freshwater and enterococci objective for saline water requires that the geometric mean be calculated weekly based on a rolling 6 week period using a statistically relevant number of samples, generally a minimum of 5 within 6 weeks. The Statistical Threshold Value (STV) is to be exceeded no more than 10% of the time, calculated monthly. To remain consistent with the statewide *E. coli* objectives, the same sampling frequency and calculation approach are required here.

7.4 SEASONAL VARIATION

When establishing wasteload and load allocations, it is important to consider the seasonality of the discharge and beneficial use. A point source waste discharge prohibition applies in the Russian River Watershed, which limits point source discharge to the wet season, only. The existing waste discharge prohibition does not apply to nonpoint sources of waste. Chapters 4 and 6 provide evidence of fecal waste discharge during all times of the year, though measured concentrations of fecal indicator bacteria are highest in the wet season.

The beneficial use of concern to this TMDL is REC-1, which is designated as a year round use. REC-1 includes multiple forms of water contact recreation and is based on the potential to ingest water incidental to the recreational activity. While the use is designated as a year round use, and there is no restricted access to rivers and streams during the winter; nonetheless, full body contact is most prevalent during the dry season months when the Russian River Watershed swimming beaches are more commonly enjoyed.

Because fecal waste discharge and REC-1 occur during all times of the year, and the TMDL is based on concentrations of *E. coli* for freshwater and enterococci for saline water, regardless of river flow, there is no seasonal variation required for this TMDL. The use of concentration limits as the waste load and load allocation intrinsically accounts for seasonality. The TMDL is based on the maximum allowable concentration

of *E. coli* in freshwater and enterococci in saline water to protect public health during all times of the year.

7.5 REQUIRED REDUCTIONS

An estimate of the reductions necessary to achieve the TMDL are useful for implementation planning and required as one of the nine elements of a watershed plan, to be eligible for 319(h) grant funding. North Coast Water Board staff estimated the reductions in *E. coli* that would be necessary to achieve the TMDL, as reported in Butkus (2013d).¹¹ Staff evaluated historic *E. coli* data from 2002 to 2012 at numerous locations throughout the watershed, with a minimum of 5 samples required for the analysis. A statistical rollback method was applied to use the statistical characteristics of a bacteria concentration distribution to estimate future concentrations after abatement processes are applied to sources. The percent reductions necessary to achieve both the geometric mean and statistical threshold value established by the statewide *E. coli* objective were estimated at each location where sufficient historic *E. coli* data was available. The required reductions range from 49-99% and are particularly important in the tributaries.

7.6 TMDL SCHEDULE

Attainment of a TMDL and its wasteload and load allocations is generally required on the quickest schedule that can reasonably be applied. Chapter 9 describes the implementation actions that are necessary to identify and control individual fecal waste sources. The Action Plan establishes the time frame for achieving each of the elements of the program of implementation. Completion of all action and attainment of the TMDL are anticipated to occur within 20 years of Action Plan adoption and approval.

¹¹ [Russian River TMDL Webpage](http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/russian_river/)
(http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/russian_river/)

CHAPTER 8

LINKAGE ANALYSIS

The purpose of this chapter is to establish the link between 1) the sources of fecal waste on the landscape, 2) evidence of fecal waste discharge to the Russian River and its tributaries, 3) the risk of contact with human and domestic animal fecal waste when recreating in and around the Russian River and its tributaries, 4) the increased risk of illness that could potentially result from contact with pathogen-contaminated waters, and 5) the reduction in risk of pathogen contact and illness that will result from the control of fecal waste discharge in a manner described in the proposed Program of Implementation.

8.1 SOURCES OF FECAL WASTE ON THE LANDSCAPE

Chapter 6 presents an inventory of all of the known sources of fecal waste on the landscape within the Russian River Watershed. Though the inventory does not quantify the relative contribution from each of the sources or establish their actual potential to discharge from specific locations, it identifies each of the sources of fecal waste discharge within the Russian River Watershed.

8.2 EVIDENCE OF FECAL WASTE DISCHARGE

Chapter 4 provides evidence of human and bovine fecal waste discharge by describing the results of monitoring for *E. coli*, enterococci, and *Bacteroides* bacteria, among other measures of impact. *Bacteroides* bacteria are specific to their animal host. Ambient water quality samples were collected throughout the watershed: upper, middle and lower reaches. The results indicate the widespread presence of human-specific and bovine-specific *Bacteroides* bacteria throughout the watershed and exceedances of 1) statewide bacteria objectives and 2) national criteria for enterococci plus public health advisories in HSA's through the middle and lower reaches of the watershed.

Bacteroides bacteria can only have entered the Russian River having first originated in the gut of their animal host and are a good measure of recent discharge. The *Bacteroides* analyses do not directly associate any of the known sources of fecal waste with evidence of discharge, except to the degree that it distinguishes between human sources and bovine sources.

Chapter 4 also provides evidence of human and grazer fecal waste discharge through the use of PhyloChip™ DNA tracing. Water samples were analyzed for the presence of gene sequences that can be matched to a library of known animal fecal waste gene sequences. These data establish that human and grazer fecal waste are entering the Russian River Watershed at locations throughout the middle and lower portions of the watershed. The PhyloChip™ study indicates that the most significant fecal waste discharge of concern in the Laguna de Santa Rosa subwatershed may be from dairies, while the most significant problem in the Guerneville subwatershed is from humans. The

PhyloChip™ study does not directly associate any of the known sources of fecal waste with evidence of discharge, except to the degree that it distinguishes between human sources and grazer sources. But, Chapter 4 provides clear evidence that further investigation of the potential for discharge from the identified sources is warranted.

Chapter 6 confirms evidence of the discharge of human and bovine sources of fecal waste being associated with specific land cover types. Human-specific and bovine-specific *Bacteroides* and the other FIBs were associated with every landcover type during both dry and wet weather, but at levels nearly an order of magnitude higher during wet weather. The exception is with forestland, which has similar concentrations of both human-specific and bovine-specific *Bacteroides* and other FIBs during both dry and wet conditions. Non-sewered developed lands are identified as having the highest concentrations of fecal indicator bacteria during the dry season, while sewer developed lands had the highest during the wet season. Agricultural lands showed the largest concentrations of both human and bovine fecal waste sources during the wet season.

8.3 RISK OF CONTACT WITH FECAL WASTE

One of the general findings of the TMDL study is that the most significant discharge of fecal waste to the Russian River Watershed occurs as a result of storm water discharges. Another general finding is that the most significant recreational use of the Russian River Watershed is during the summer months when swimming, boating, and other water contact recreational activities are most common. With respect to public health protection, these findings are very good news: the most significant human health risk occurs during times of the year when the fewest people are in contact with water in the Russian River Watershed. It is important to keep in mind, however, that recreational use of the Russian River Watershed is allowed and occurs during all times of the year. Further, the North Coast Water Board has designated the water contact recreational beneficial use as a year round use, thereby obligating it to ensure protection during all months of the year. In other regions of the State, a seasonal recreational beneficial use is sometimes applied and requires structures (e.g., fences) that prevent the public from making use of the waterbody during dangerous times of the year. This is not the case in the Russian River Watershed.

Chapter 6 describes the results of a focused study of the effect of onsite waste treatment systems (OWTS) on water quality conditions. In the study staff collected water quality samples in locations in surface water determined to have a high density of OWTS upgradient. Samples were analyzed for human-specific *Bacteroides*, *E. coli* and enterococci. The results of this sampling was compared to the results of identical sampling at locations determined to have a low density of OWTS upgradient. Specific to assessing the risk of human contact with fecal waste, the study showed that higher OWTS density is directly associated with higher concentrations of FIBs, including

human-specific *Bacteroides*. Though, all OWTS Study locations showed evidence of fecal waste discharge.

Further, Chapter 6 describes the relationship between the number of summer time swimmers and evidence of human-specific fecal waste. Water samples were collected and analyzed for *E. coli*, enterococci, and human-source *Bacteroides* bacteria. Samples were collected at Veterans Memorial Beach and Monte Rio Beach during the week of the Independence Day holiday in 2013. The study found that the percentage of *Bacteroides* bacteria that were human-source showed a relatively strong positive correlation with swimming recreation, with the higher percentages of human-specific *Bacteroides* observed on days with a larger number of people swimming. These data provide compelling evidence that summer recreational use of the Russian River Watershed does present a risk of contact with fecal waste, particularly at recreational beaches and during holidays when a larger number of people are present.

Finally, Chapter 6 relates various land cover categories with ambient water quality results for *E. coli*, enterococci, and *Bacteroides* bacteria. The Land Cover Study confirms the potential for all land cover types to be associated with elevated FIBs (including evidence of human and bovine-specific bacteria); developed areas (both urban and rural) and agricultural areas show the highest concentrations.

PhyloChip™ results did not correlate with *E. coli*, enterococci, or *Bacteroides* on a sample by sample basis. But, when congregated with other FIB data, the PhyloChip™ data provides an additional line of evidence of fecal waste discharge that corroborates other findings. Most important to the question of human exposure to pathogens, the PhyloChip™ results indicate the presence of numerous pathogens at locations primarily in the lower river that cause not only gastrointestinal illness, but have the potential to cause urinary tract infections, dermal infections, pneumonia, meningitis, and in at least one location, the plague.

These studies effectively extend the area of concern to include the whole watershed, with a particular concern in urban areas, areas with a high density of OWTS, and areas such as shrubland, agricultural lands, and rural residential lands that include cows.

8.4 RISK OF PATHOGEN-RELATED ILLNESS

The primary mechanism by which the Action Plan assesses the potential for pathogen-related illness is through ambient water quality sampling for *E. coli* and enterococci using statewide bacteria objectives and U.S. EPA (2012) recommended criteria, respectively, as thresholds of concern. The TMDL assessment applied the specific thresholds that represent a risk to no more than 32 illnesses per 1000 recreators. Chapter 4 describes the results of the *E. coli* analyses in freshwater and enterococci analyses in saline water and freshwater, with exceedances of the statewide bacteria objective and national criteria (plus public health advisories) at numerous locations sampled. These data were augmented by an analysis using PhyloChip™ phylogenetic

DNA microarray. From the PhyloChip™ analysis, the genetic sequence of seven pathogenic bacteria species with the potential to cause human illness were identified at locations in the middle and lower Russian River Watershed. As many as 27 tributary locations and four mainstem locations showed evidence of contamination with *proteus mirabili*, *salmonella enterica*, *serratia marcescens*, *shigella flexneri*, *Staphylococcus epidermidis*, *Staphylococcus haemolyticus*, and *Yersinia sp.* Up to 41% of the samples collected showed the presence of one or more of these pathogenic bacteria, with potential to cause illnesses ranging from urinary tract infection, skin infections, gastroenteritis, pneumonia, meningitis, and the plague.

As above, local agencies have on occasion been compelled to close public beaches within the Russian River Watershed because of exceedances of public health criteria. The City of Santa Rosa posts a permanent advisory against swimming in Santa Rosa Creek at Prince Memorial Greenway. In addition, multiple advisories against public swimming have been posted in the period of 2013 through 2018 at Cloverdale River Park, Healdsburg Veteran's Memorial Beach, Johnson's Beach, and Monte Rio Beach due to elevated bacteria measurements.

To ensure a clear linkage of fecal waste discharge to fecal indicator bacteria concentrations, all the ambient water samples, which were analyzed for *E. coli* and enterococci, were also analyzed for human-source and bovine-source *Bacteroides* bacteria. Results show that four out of six Hydrologic Subareas with *Bacteroides* data contained stations with concentrations greater than 10,000 gene copies/100 mL. The same four Hydrologic Subareas also had exceedances of statewide or federal enterococci and *E. coli* objectives or criteria, respectively. These results provide evidence of the linkage between human and bovine fecal waste discharge and the fecal indicator bacteria concentrations.

PhyloChip™ results did not correlate with the other FIB results on a sample by sample basis, likely due to multiple factors including data limitations and environmental factors.

8.5 ATTAINMENT OF WATER QUALITY OBJECTIVES

Numeric targets to measure attainment of statewide water quality objectives are based on the statewide water quality objectives, themselves. Measurement of these metrics (i.e., *E. coli* in freshwater and enterococci in saline water) will allow assessment of the progress being made toward reducing fecal waste discharge and reducing potential public exposure to illness-causing pathogens. Similarly, attainment of the statewide bacteria objective will ensure protection of the REC-1 beneficial use and public health.

Following implementation of fecal waste control measures, *Bacteroides* measurements can be collected to help identify those locations where continued exceedances of statewide bacteria objectives are related to human or bovine fecal waste discharge versus other environmental factors, should such conditions persist. Further, PhyloChip™ or other similar microbial source tracking methods can also be used.

8.6 CONCLUSION

Fecal waste from animals and humans can contain pathogens. Indicator bacteria are associated with the presence of fecal waste and are routinely used as an indicator of pathogens. Ambient water quality samples were collected throughout the watershed: upper, middle and lower reaches. Monitoring data, including *Bacteroides* data, indicate that the Russian River Watershed is impacted by fecal indicator bacteria in multiple reaches during both dry and wet weather. Chapter 4 and Chapter 6 provide evidence of human and bovine fecal waste discharge throughout the watershed, indicating high concentrations of fecal indicator bacteria in the watershed, and multiple fecal waste sources within the Russian River Watershed, respectively. In combination, the evidence indicates that the entire Russian River Watershed is polluted or has the potential to become polluted due to pathogens.

The loading capacity is defined in terms of fecal indicator bacterial concentrations and is equivalent to the numeric targets. The numeric targets correspond to an acceptable level of human illness in recreational waters, use indicators that correlate with controllable sources of pathogens, and are indicators that are associated with gastrointestinal illness rates. The numeric targets are associated with a human health risk that will protect the REC-1 beneficial use, and therefore effectively measure progress toward attainment of the water quality standards.

Reductions in fecal waste discharge from the identified sources are expected to result in a reduction in the discharge of pathogens and therefore a reduction of receiving water column concentrations of *E. coli* in freshwater and enterococci in saline water where high natural background bacterial community richness is not the source of *E. coli* or enterococci exceedances. These reductions are expected to correlate with a decrease in illness rate and support of the REC-1 beneficial use. The numeric targets are identical to the statewide bacteria objectives and protective of recreational beneficial uses; hence the TMDL defines appropriate water quality conditions. Therefore, the loading capacity, waste load and load allocations, and proposed actions to reduce the discharge of fecal waste and therefore pathogens will result in attainment of the numeric targets and thus achieve water quality standards. Following implementation of the program of implementation, a confirmation study using *Bacteroides*, PhyloChipTM, or other microbial source tracking methods can be conducted, as necessary.

CHAPTER 9

PROGRAM OF IMPLEMENTATION

The purpose of the Program of Implementation is to describe the actions necessary to reduce and eliminate fecal waste discharges and attain water quality objectives. The North Coast Water Board has discretion in how it implements the Program of Implementation described in this chapter. The Program of Implementation is incorporated into an Action Plan, to be proposed to the North Coast Water Board for adoption as an amendment to the Basin Plan (Basin Plan Amendment). The Action Plan is included as Appendix A. The Program of Implementation identifies:

1. Actions that staff expect will reduce and eliminate fecal waste discharges and associated pathogens;
2. Implementing parties for these actions;
3. Regulatory mechanisms by which the North Coast Water Board will ensure that these actions are taken; and
4. A timeline for completion of actions.

9.1 FECAL WASTE DISCHARGE PROHIBITION

Discharges of fecal material from humans or from domestic animals to waters of the state are controllable water quality factors that shall conform to the bacteria water quality objective and be treated and managed in such a way as to ensure ambient fecal indicator bacteria concentrations are protective of REC-1. Controllable water quality factors are those actions, conditions, or circumstances resulting from human's activities that may influence the quality of waters of the state and that may be reasonably controlled.

In accordance with Water Code section 13243 and to achieve the bacteria water quality objective, to protect present and future beneficial uses of water, to protect public health, and to prevent nuisance, the Action Plan sets forth the following discharge prohibition:

Discharges of waste containing fecal material from humans or domestic animals¹² to waters of the state within the Russian River Watershed are prohibited.

Compliance with this prohibition can be achieved by any of the following means, as applicable:

¹² Examples of domestic animals include, but are not limited to, cows, horses, cattle, goats, sheep, swine, poultry, dogs, cats, or any other animal(s) in the care of any person(s).

1. Implement adequate treatment and/or best management practices to prevent the discharge of fecal waste material from humans or domestic animals from entering a water of the state either directly or indirectly.
2. Comply with all fecal waste/pathogen-related provisions of an applicable NPDES permit.
3. Comply with all fecal waste/pathogen-related provisions of an applicable WDR.
4. Comply with all fecal waste/pathogen-related provisions of an applicable general WDR or waiver of WDRs.
5. Implement the terms of a Memorandum of Understanding or equivalent agreement between the North Coast Water Board and relevant local agencies to address fecal waste discharge from homeless encampments, recreational water users, and any other additional sources identified after discussion between the relevant parties.
6. For non-dairy livestock, implement best management practices to achieve the assigned load allocation within 2 years of the effective date of this TMDL and, if required by the Executive Officer, (a) develop and implement an Executive Officer-approved Ranch Management Plan or (b) comply with all fecal waste/pathogen-related provisions of an applicable non-dairy livestock WDR or waiver of WDRs, adopted by the North Coast Regional Water Quality Control Board.
7. Existing, new¹³, and replacement¹⁴ OWTS shall comply with sections 6.3.7-7.2 and 6.3.7.7.3 of the Action Plan for the Russian River Watershed and the Russian River Pathogen Total Maximum Daily Load (Action Plan). New and replacement OWTS near impaired water bodies listed in Attachment 2 of the OWTS Policy shall comply with special provisions contained in an approved Local Agency Management Program (LAMP), or if there are no special provisions, comply with the requirements in Tier 3 of the OWTS Policy and section 6.3.7-6 of the Action Plan.
8. If deemed necessary and ordered by the North Coast Water Board, owners of OWTS must:
 1. Provide information about the OWTS to the North Coast Water Board or the local agency, and
 2. If necessary, contact the local agency to initiate corrective actions pursuant to

¹³ New OWTS means an OWTS permitted or approved after the effective date of the TMDL Action Plan

¹⁴ OWTS Policy (2013), section 1.0, defines replacement OWTS to mean an OWTS that has its treatment capacity expanded, or its dispersal system replaced or added to.

section 11 of the OWTS Policy and the local agency's LAMP, or

3. submit a report of waste discharge to the North Coast Water Board for possible establishment of waste discharge requirements or a waiver of waste discharge requirements for the domestic waste discharge.

9.2 IMPLEMENTATION ACTIONS

Water quality assessment and monitoring results indicate the following source categories have potential to discharge pathogens to surface waters in the Russian River Watershed:

Sources of Human Fecal Waste Material

- Treated Municipal Wastewater to Surface Waters, including discharges from holding ponds
- Untreated Sewage from Sanitary Sewer Systems
- Wastewater from Percolation Ponds and through Spray Irrigation
- Runoff from Land Application of Municipal Biosolids and Biosolids
- Storage Areas
- Runoff from Water Recycling Projects
- Runoff from sites that receive discharges of waste to land
- Leaking or failing Onsite Wastewater Treatment Systems, including individual systems and large or multi-user systems;
- Recreational Water Uses and Users
- Homeless and Illegal Camping
- Stormwater Runoff entering Municipal Separate Storm Sewer Systems (MS4s) and entering water bodies outside of established MS4 boundaries.

Sources of Domestic Animal and Farm Animal Waste

- Pet Waste
- Manure from Non-Dairy Livestock and Farm Animals
- Manure from Dairy Cows

The implementation actions included in the Action Plan address the control of fecal waste discharge and associated pathogens from specific controllable pathogen sources (as identified in Source Analysis, Chapter 6), including humans and domesticated animals. Each probable source, its implementing party(s), its applicable wasteload allocation (WLA) or load allocation (LA), and, where applicable, its implementation actions are described in the following sections. They include:

- Municipal wastewater discharges to surface waters
- Wastewater holding pond discharges to surface waters
- Percolation ponds and disposal by irrigation
- Sanitary sewer systems
- Land application of treated municipal sewage sludge (biosolids)
- Recycled water irrigation runoff
- Individual onsite wastewater treatment systems
- Large onsite wastewater treatment systems
- Recreational water uses and users
- Homeless encampments and illegal camping
- Municipal storm water runoff
- Caltrans storm water runoff
- Non-dairy livestock and farm animals
- Dairies and CAFOs

9.2.1 Municipal Wastewater Discharges to Surface Waters

There are municipal wastewater treatment facilities in the Russian River Watershed that are authorized pursuant to a National Pollutant Discharge Elimination System (NPDES) permit to collect, treat, disinfect and discharge fully-treated wastewater directly to the Russian River or its tributaries during the wet season up to certain percent of the river flow. These facilities are operated by:

- City of Ukiah

- City of Healdsburg
- City of Santa Rosa
- Russian River County Sanitation District

City of Cloverdale. The waste discharges are regulated under existing NPDES permits that include effluent limitations and disinfection specifications to ensure treatment processes achieve effective and reliable pathogen reduction. Disinfection requirements in these permits are derived from standards for tertiary-treated recycled water contained in title 22 of the California Code of Regulations. The Basin Plan describes discharge requirements for advanced treated wastewater. When a disinfection system operates properly and attains the effluent limitations for total coliform bacteria, it will also attain the wasteload allocation for *E. coli* in freshwater and enterococci in saline water that is described in the Action Plan. As a general matter, direct discharges of properly disinfected, treated wastewater to surface waters are not expected to contribute to an exceedance of fecal indicator bacteria concentration limits that are protective of REC-1.

In order to ensure ambient fecal indicator bacteria concentrations are protective of REC-1, discharges of wastewater from municipal treatment facilities directly to the Russian River or its tributaries shall attain the following effluent limitations in their NPDES permits and/or the wasteload allocation, whichever is most stringent:

1. The median concentration of total coliform bacteria shall not exceed 2.2 MPN/ 100 mL, using the daily bacteriological results of the last 7 days for which analyses have been completed; and
2. The number of total coliform bacteria shall not exceed 23 MPN/ 100 mL in more than one daily result in any 30-day period.

In order to ensure ambient fecal indicator bacteria concentrations are protective of REC-1, each entity shall maintain compliance with applicable waste discharge requirements for its wastewater treatment facility. To demonstrate compliance with limitations, discharges of treated wastewater directly to the Russian River and its tributaries shall comply with existing monitoring and reporting requirements, including daily effluent monitoring at a location or locations where a representative sample of the effluent can be collected. Dischargers shall provide to the North Coast Water Board periodic discharge monitoring reports and other reports, as necessary, to demonstrate compliance with effluent limitations and wasteload allocations.

9.2.2 Wastewater Holding Pond Discharges to Surface Waters

There are five municipal wastewater treatment facilities in the Russian River Watershed that collect, treat, dispose, or recycle municipal wastewater and discharge treated effluent from a wastewater holding pond to the Russian River or its tributaries. These facilities are operated by:

- Town of Windsor
- City of Santa Rosa¹⁵
- Forestville Water District
- Graton Community Services District
- Russian River County Sanitation District¹⁶

The federal Clean Water Act requires that all NPDES permits include effluent limitations and other requirements to control the amount of wastewater pollutants that are discharged to waters of the United States. All NPDES permits have a maximum duration of five years, at which time they expire, are administratively continued, or are renewed after consideration of information submitted by the discharger characterizing the discharge and demonstrating that the wastewater treatment and disposal systems adequately control wastewater pollutants in the discharge. In addition to applicable technology-based effluent limitations and standards, NPDES permits must also include water quality-based effluent limitations (WQBELs) to attain and maintain applicable numeric and narrative water quality criteria to protect the beneficial uses of the receiving water where a reasonable potential to exceed those criteria exists. The process for assessing whether a discharge has the reasonable potential to cause or contribute to an exceedance of applicable numeric and narrative water quality criteria is called a reasonable potential analysis (RPA).

All municipal wastewater treatment facilities discharging directly to surface waters in the Russian River Watershed are regulated under NPDES permits that include WQBELs and disinfection specifications to achieve pathogen reduction in the effluent. The regulated dischargers listed in Section 9.2.1 above maintain reasonably consistent compliance with these limitations and specifications. However, wastewater discharged from municipal wastewater holding ponds, although previously disinfected, is not routinely monitored after prolonged storage and prior to discharge to surface water to detect the presence of fecal indicator bacteria. In the absence of this effluent monitoring data, it is difficult to determine as part of a RPA whether the discharge has the reasonable potential to cause an exceedance of water quality objectives for bacteria, or a wasteload allocation for bacteria if one has been established.

The Action Plan requires the North Coast Water Board to begin conducting RPAs within seven years after the effective date of the Action Plan for entities authorized to discharge treated wastewater from holding ponds to the Russian River or its tributaries and, where reasonable potential to exceed water quality criteria or WLAs is determined, establish WQBELs that implement WLAs in an entity's NPDES permit. In order to complete the RPA for bacteria, the North Coast Water Board must have, at a minimum,

¹⁵ The City of Santa Rosa and the Russian River County Sanitation District also have the capability of discharging treated wastewater effluent directly to the Russian River or its tributaries.

effluent samples of a sufficient number collected at an appropriate frequency to fully characterize the discharge from the holding pond to surface water. The entity may also provide other pertinent information related to the discharge to determine whether discharges from the holding pond are attaining WLAs. This information could include an assessment of whether the discharge from the holding pond contains viable pathogens that are infectious to humans. An assessment affirming that the discharge of treated municipal wastewater from the holding pond contains no measurable human pathogens can be used by the North Coast Water Board to support a determination that there is no reasonable potential for the holding pond discharge to cause or contribute to an exceedance of the bacteria WLAs and obviates the need for WQBELs for bacteria applied at the point of discharge to the receiving water. All effluent monitoring data and any information to support a RPA must be submitted to the North Coast Water Board with the entity's application for permit renewal, which is due at least 180 days prior to the expiration of the NPDES permit. If an entity opts not to characterize the waste discharge from the holding pond to surface water, the effluent discharge will be deemed to have reasonable potential to exceed the bacteria water quality objective and the WLAs.

Based on the information provided by the NPDES entity with the application for permit renewal, the North Coast Water Board will complete the RPA and establish appropriate WQBELs, if necessary, in the entity's NPDES permit at the first renewal after the effective date of the Action Plan. The NPDES entity should consult with North Coast Water Board NPDES permitting staff regarding the scope and adequacy of any investigation or special study to determine the presence of human pathogens in a discharge from a holding pond to surface waters prior to initiating the study.

Based on an entity's request and demonstration that it is infeasible for the entity to achieve immediate compliance with adopted WQBELs, the North Coast Water Board may authorize a schedule of compliance in the NPDES permit. A schedule of compliance shall include a series of required actions to be undertaken by the discharger for the purpose of achieving adopted WQBELs. These actions shall demonstrate reasonable progress toward the attainment of WQBELs. The compliance schedule shall reflect a realistic assessment of the shortest practicable time to perform each task. The compliance schedule shall contain a final compliance date based on the shortest practicable time required to achieve compliance, but in no case exceed ten years from the effective date of the adopted NPDES permit. The deadlines for each action in the compliance schedule shall be specified in the NPDES permit and may be accompanied by interim requirements, such as, interim WQBELs and pollutant minimization measures. If the final compliance date extends beyond the term of the NPDES permit, the final compliance date and supporting explanation shall be included in the permit.

9.2.3 Percolation Ponds and Disposal by Irrigation

There are six municipal wastewater treatment facilities and five privately-owned wastewater treatment facilities in the Russian River Watershed that collect, treat, and

dispose of or recycle treated effluent to land via percolation ponds or by irrigation. These facilities are operated by:

- Bohemian Grove (private)
- Calpella County Water District (public)
- Camp Royaneh (private)
- City of Cloverdale (public)
- City of Ukiah (public)
- Geyserville County Sanitation Zone (public)
- Hopland County Water District (public)
- Rio Lindo Academy (private)
- Russian River County Sanitation District (public)
- Rodney Strong Vineyards (private)
- (Former) Salvation Army Lytton Springs Rehabilitation Facility (private)

The discharge of wastewater to surface water from percolation ponds and as a result of irrigation runoff is prohibited.

In order to ensure ambient fecal indicator bacteria concentrations are protective of REC-1, each entity shall maintain compliance with applicable waste discharge requirements for its wastewater treatment facility.

9.2.4 Sanitary Sewer Systems

There are nineteen publicly-owned sanitary sewer systems in the Russian River Watershed that collect and convey domestic wastewater to wastewater treatment facilities for treatment, and disposal or recycling. These facilities are operated by:

- Airport/Larkfield/Wikiup Sanitation Zone
- Calpella County Water District
- City of Cloverdale
- City of Cotati
- City of Healdsburg
- City of Rohnert Park
- City of Santa Rosa
- City of Sebastopol
- City of Ukiah
- Forestville Water District
- Geyserville County Sanitation Zone
- Graton Community Services District
- Hopland County Water District
- Occidental County Sanitation District
- Russian River County Sanitation District
- Sonoma State University

- South Park County Sanitation District
- Town of Windsor
- Ukiah Valley Sanitation District

Publicly-owned sanitary sewer systems greater than one mile in length are regulated under General Waste Discharge Requirements for Sanitary Sewer System, Water Quality Order No. 2006-0003-DWQ (Sanitary Sewer General Order) and Monitoring and Reporting Program WQ 2013-0058-EXEC. The Sanitary Sewer General Order prohibits the discharge of untreated or partially-treated wastewater from sanitary sewer systems to waters of the United States, including the Russian River and its tributaries.

In order to ensure ambient fecal indicator bacteria concentrations are protective of REC-1, each municipality and district shall maintain compliance with the Sanitary Sewer General Order and all amendments and subsequent updates to the Sanitary Sewer General Order.

9.2.5 Land Application of Treated municipal sewage sludge (Biosolids)

Currently, the City of Santa Rosa is the only public entity permitted for the land application of biosolids as a soil amendment in the Russian River Watershed. The City of Santa Rosa's biosolids application discharges are regulated under General Waste Discharge Requirements for the Discharge of Biosolids to Land for Use as a Soil Amendment in Agricultural, Silvicultural, Horticultural, and Land Reclamation Activities, Water Quality Order No. 2004-12-DWQ (Biosolids General Order), which prohibits the discharge of biosolids to surface water and includes biosolids management practices to reduce the risk to public health and the environment.

In order to comply with the Action Plan, the City of Santa Rosa and any proponent of a future project involving the land application of municipal biosolids shall maintain coverage for its biosolids land application projects under the Biosolids General Order, or individual waste discharge requirements adopted to regulate the discharge of biosolids to land.

9.2.6 Recycled Water Irrigation runoff

There are thirteen municipalities and special districts, three private entities, and one university in the Russian River Watershed that use recycled water for landscape irrigation, crop irrigation and other approved non-potable uses. These facilities are:

- Airport/Larkfield/Wikiup Sanitation Zone
- City of Cotati
- City of Healdsburg
- City of Rohnert Park
- City of Santa Rosa
- City of Sebastopol

- City of Ukiah
- Forestville Water District
- Graton Community Services District
- Occidental County Sanitation District
- Russian River County Sanitation District
- Sonoma State University
- Town of Windsor
- Mayacamas Golf Club (private)
- Vintner's Inn (private)
- Virginia Dare Winery (private)

Recycled water projects that beneficially reuse treated wastewater for landscape irrigation, agricultural irrigation, or other use allowable under California Code of Regulations, title 22, chapter 3, article 3, section 60303 through 60307 are regulated under water recycling requirements in State Water Resources Control Board Order WQ 2016-0068-DWQ, Water Reclamation Requirements for Recycled Water Use (Recycled Water General Order) or North Coast Water Board-issued waste discharge requirements. To prevent and/or minimize overspray, spills, and incidental runoff of recycled water that could reach surface waters, these projects rely on best management practices (BMPs). Water recycling BMPs are set forth in North Coast Water Board-issued waste discharge requirements as water recycling specifications. For recycled water projects regulated under the Recycled Water General Order, water recycling BMPs are described by a discharger in its Notice of Intent and implemented immediately upon permit issuance, in accordance with an Operations and Management Plan. Where the water recycling entity is also regulated under the Phase I Municipal Separate Storm Sewer Systems (MS4) Permit, recycled water BMPs are implemented in accordance with a non-storm water BMP Plan approved by the North Coast Water Board Executive Officer.

Title 22 prohibits the escape of recycled water from recycled water use areas as surface water flow that would enter surface waters. Accordingly, recycled water permits prohibit discharges of recycled water to surface water, except for when the runoff is deemed incidental. Incidental runoff is unintended amounts of runoff that are typically infrequent, low volume, not due to a pattern of neglect or lack of oversight, and are promptly addressed.

In order to ensure ambient fecal indicator bacteria concentrations are protective of REC-1, each municipality and district or other entity that is permitted to beneficially reuse treated wastewater for landscape irrigation, agricultural irrigation, or other use shall maintain compliance with its applicable water recycling requirements and shall develop and implement a Recycled Water BMP Plan, or equivalent BMP plan.

The Recycled Water BMP Plan shall include, at a minimum:

- BMPs to prevent overspray, spills, and incidental runoff;

- Setbacks from recycled water points of use to waterbodies, curbs, pavement and storm water inlets; and
- A compliance program that includes public outreach and progressive enforcement.

All permit applications for recycled water projects within the Russian River Watershed proposed after the effective date of the Action Plan shall submit a Recycled Water BMP Plan, or equivalent BMP plan, with the permit application. For Recycled Water BMP Plans being implemented prior to the effective date of the Action Plan, the implementing party shall submit written certification that their existing Recycled Water BMP Plan adequately prevents and/or minimizes overspray, spills, and incidental runoff. This certification shall be submitted to the North Coast Water Board Executive Officer within three months after the effective date of the Action Plan. Any entity currently recycling water, but without a Recycled Water BMP Plan or an equivalent BMP plan, shall develop and implement a Recycled Water BMP Plan within two years after the effective date of the Action Plan. Where the entity is the producer and user of recycled water, the entity shall also submit to the North Coast Water Board Executive Officer a Title 22 Engineering Report approved by the State Water Board Division of Drinking Water.

Where necessary, the North Coast Water Board will require the submission of a Recycled Water BMP Plan and/or Title 22 Engineering Report under authority of section 13267 subdivision (b) of the Water Code.

9.2.7 Individual Onsite Wastewater Treatment Systems

9.2.7.1 Regulatory framework for Onsite Wastewater Treatment Systems (OWTS) in the Russian River Watershed

As with other discharges of waste to land in California, OWTS require either Waste Discharge Requirements (WDRs) or a waiver of WDRs. On June 19, 2012, the State Water Resources Control Board (State Water Board) adopted the *Water Quality Control Policy for Siting, Design, Operation, and Maintenance of Onsite Wastewater Treatment Systems* (OWTS Policy). The OWTS Policy provides the framework under which OWTS can be covered under a statewide Conditional Waiver of Waste Discharge Requirements contained in the OWTS Policy. Like all waivers, the OWTS Policy waiver must be renewed every five years.

The OWTS Policy took effect on May 13, 2013. The North Coast Water Board, in accordance with the statewide OWTS Policy, amended the Basin Plan on June 18, 2015, to incorporate requirements of the OWTS Policy into the Basin Plan for the North Coast Region. The Basin Plan amendment was approved by the Office of Administrative Law on July 18, 2016. The most recent revision to the OWTS Policy is dated April 18, 2023, and is incorporated by reference into the Basin Plan. The OWTS Policy and its requirements are applicable statewide.

When the OWTS Policy was incorporated into the Basin Plan, regional requirements were retained for the Russian River Watershed in section 4.1.11 *Policy On The Control Of Water Quality With Respect To On-Site Waste Treatment And Disposal Practices Specific To The Russian River Watershed, Including The Laguna De Santa Rosa* (section 4.1.11). The Action Plan sets forth editorial changes removing section 4.1.11 from the Basin Plan, including the Russian River watershed cesspool and holding tank prohibitions, and highlights that OWTS must comply with the requirements of the OWTS Policy. In accordance with Section 4.2.1 of the OWTS Policy, OWTS systems within the Russian River Watershed continue to follow the existing Basin Plan requirements under section 4.1.11, until effective date of the Action Plan.

Cesspools and other wastewater systems not authorized under applicable state and local regulations, including the OWTS Policy, are not eligible for coverage under the OWTS Policy's Conditional Waiver of WDRs. Because cesspools do not meet the definition of an OWTS under the OWTS Policy, they cannot be authorized for continued use under that policy. The OWTS Policy expressly prohibits categorizing cesspools as existing OWTS and prohibits a local agency from authorizing a cesspool as a new or replacement OWTS under a Local Agency Management Program (LAMP). Cesspools are not authorized under the OWTS Policy's conditional waiver of waste discharge requirements. The Sonoma County OWTS Manual, adopted by the County Board of Supervisors on August 13, 2024, does not authorize the use of cesspools and requires their replacement with permitted systems when identified. Likewise, Mendocino County's LAMP also prohibits cesspools and requires their decommissioning when discovered.

Holding tanks are watertight receptacles used to collect and store wastewater prior to it being removed from a property. Holding tanks are not addressed by the OWTS Policy. They are authorized in Sonoma and Mendocino Counties under specific circumstances, such as to abate public health threats, where other means of waste handling are infeasible, or when serviced by a public agency. The holding tank reporting requirement in the Action Plan is consistent with long-held Regional Board policy, predating the OWTS Policy and contained in previous Basin Plan language, that holding tanks are not a long-term solution for wastewater management due to their lack of treatment capability and challenges with off hauling and maintenance.

Seepage pits are an excavation, either lined or gravel filled, that receives the effluent discharge from a septic tank or other OWTS treatment unit for dispersal. They are generally regarded as higher risk systems than standard leach line disposal designs. The OWTS Policy authorizes seepage pits under restricted circumstances. In Mendocino County, seepage pits are prohibited as new or replacement OWTS and must be decommissioned if found to be in failure. In Sonoma County, seepage pits are only authorized as new or replacement OWTS when a dispersal trench cannot be installed and only when consistent with the OWTS Policy. The seepage pit reporting requirement in the Action Plan is consistent with the higher degree of risk to water

quality posed by seepage pits and the need to ensure seepage pits' conformance with the requirements under which seepage pits can be authorized.

The OWTS Policy allows local agencies, e.g. Counties, to regulate OWTS. In the Russian River Watershed, siting and design requirements for individual OWTS within the Russian River Watershed are regulated Permit Sonoma (formerly known as the Sonoma County Permit and Resource Management Department in Sonoma County) and by the County of Mendocino Health & Human Services Agency – Department of Environmental Health in Mendocino County (DEH). These local agencies review development proposals that rely on individual OWTS for domestic waste treatment and disposal. Local agency staff also review permit applications and project plans for OWTS repairs and upgrades and issue repair permits as necessary in accordance with local policies. To ensure compliance with local regulations and technical standards for OWTS, local agency staff also conduct inspections at the time of OWTS construction and in response to complaints and reports of OWTS failures. For OWTS utilizing supplemental treatment components or enhanced effluent dispersal systems, both Permit Sonoma and Mendocino County DEH implement permit programs that include periodic inspections of the OWTS by County staff and/or a service provider and self-monitoring requirements imposed on OWTS owners.

9.2.7.2 Advanced Protection Management Program

Section 3.2 of the OWTS Policy allows the North Coast Water Board to approve individual Local Agency Management Programs (LAMPs) for local agencies that want to provide alternative minimum standards than those specified in the OWTS Policy for OWTS that pose the lowest threat to water quality and public health. LAMPs may also establish an Advanced Protection Management Program (APMP) that includes special provisions for OWTS near impaired waterbodies. In the absence of special provisions in an approved LAMP, the APMP follows the definitions stated in the OWTS Policy.

In the OWTS Policy, an APMP is a management program that establishes standards consistent with Tier 3 of the OWTS Policy for OWTS near impaired/polluted waterbodies. Attachment 2 of the OWTS Policy identifies waterbodies that are both on the 303(d) list of impaired waters for pathogens or nitrogen and that have also been identified by the State Water Board as having a likely OWTS contribution to the impairment. All new and replacement OWTS within 600 feet of waterbodies listed in Attachment 2 are subject to Tier 3 standards. Attachment 2 may be updated periodically as waterbodies are added or removed from the 303(d) list. When new waterbodies are added to the 303(d) list, the State Water Board, after receiving input from the North Coast Water Boards and affected local agencies, identifies which of them are to be added to Attachment 2. Similarly, waterbodies removed from the 303(d) list are considered by the State Water Board for removal from Attachment 2. Attachment 2 revisions become effective in accordance with the five year renewal cycle of the OWTS Policy waiver.

Section 10.1 of the OWTS Policy states that an APMP must specify its geographic area and the OWTS requirements that apply within that area. The APMP applies to any OWTS located on a parcel that is partially or fully contained within the APMP boundary.

The standards for OWTS in an APMP and the APMP area itself may be established by the following:

- A TMDL implementation plan (Action Plan) adopted by a North Coast Water Board;
- An approved LAMP with special provisions for OWTS that are near impaired/polluted waterbodies; or
- The default APMP requirements prescribed by section 10.0 of the OWTS Policy.

For OWTS within an APMP, (whether established by a TMDL implementation plan, special provisions in a LAMP, or by default) compliance with the APMP minimum requirements is a necessary condition for owners of OWTS to qualify for coverage under the OWTS Policy's Conditional Waiver of Waste Discharge Requirements. Failure to comply with conditions of the Conditional Waiver of Waste Discharge Requirements may result in revocation of waiver coverage or enforcement whether the OWTS is inside or outside the APMP. All OWTS within the APMP must meet any special provisions in an approved LAMP. If there is no approved LAMP or no special provisions in an approved LAMP, new or replacement OWTS in the APMP must meet the requirements in Tier 3 of the OWTS Policy. For existing systems in the APMP not covered by special provisions in an approved LAMP, the North Coast Water Board may issue requirements on a case-by-case basis where evidence indicates the discharge threatens or impacts water quality.

The Action Plan does not specify a geographic area for the APMP and defers to the area defined by the OWTS Policy or an approved LAMP. The 2023 OWTS Policy defines the APMP area as "600 linear feet [in the horizontal (map) direction] of a water body listed in Attachment 2 where the edge of that water body is the natural or levied bank for creeks and rivers, the high water mark for lakes and reservoirs, and the mean high tide line for tidally influenced water bodies, as appropriate." The APMP requirements apply to an OWTS if any portion of the OWTS is partially or fully contained within the APMP boundary.

The APMP measures will:

- Ensure that new and replacement OWTS in the Russian River Watershed are properly sited, designed, operated, and maintained to provide adequate removal of pathogenic organisms, comply with the Fecal Waste Discharge Prohibition, and attain numeric targets, waste load allocations, and load allocations.
- Establish minimum requirements for new and replacement OWTS that are fair, affordable, and implementable, while at the same time meeting the objective for the Action Plan, which is to return and maintain the Russian River Watershed to a condition of consistent compliance with bacterial water quality objectives.

Owners of existing, new, and replacement OWTS whose OWTS are located entirely outside the boundaries of the APMP must still comply with relevant requirements of the OWTS Policy, any approved LAMP, sections 6.3.7-7.1 through 6.3.7-7.3.6 of the Action Plan, and if applicable, individual and/or general WDR or waiver of WDRs.

9.2.7.3 Operation and Maintenance Requirements

Proper operation and maintenance are essential to the long-term performance of any OWTS. Routine inspections and service visits can provide early detection of problems that could result in malfunction of OWTS and allows for timely repair before an OWTS becomes a public health hazard. In accordance with section 2.5 of the OWTS Policy, owners of OWTS shall maintain their OWTS in good working condition, including inspections and pumping of solids, as necessary, or as required by local ordinances and requirements established in an approved LAMP, to maintain proper function and assure adequate treatment and disposal. The operation and maintenance requirements of the OWTS Policy are applicable immediately upon the effective date of the Action Plan.

9.2.7.4 OWTS Assessment and Inspections

Some wastewater systems within the Russian River Watershed may not be adequately documented or authorized under existing state and local regulations. The OWTS Policy establishes a conditional waiver of WDRs for systems that meet specific criteria, and the Sonoma County OWTS Manual and Mendocino County LAMP set requirements for the siting, design, operation, and maintenance of OWTS within Sonoma and Mendocino County, respectively.

To support implementation of the Action Plan and ensure that OWTS are complying with the Fecal Waste Discharge Prohibition and operating in a manner consistent with applicable standards, the North Coast Water Board is initiating an Assessment Program to collect information from property owners in areas where the type and status of wastewater systems in use are currently unknown or unclear. This information is necessary to evaluate compliance with regulatory requirements and to identify where further oversight, corrective action, or technical assistance may be needed.

The assessment may include a desktop evaluation or local record review, results of a sanitary survey, parcel data, building and septic permit records, public survey, questionnaire, a physical site inspection or evaluation, any combination of these methods, or other assessment methods that may become available. Information that may be used to ascertain the performance of an existing OWTS includes, but is not limited to: the OWTS type, age, approved variances, repair history, monitoring and inspection results, septic tank pumping records, maintenance records, peak hydraulic loading, and record of complaints received. Where records are incomplete or inconsistent, the North Coast Water Board may request property owners to confirm their system type, age, location, and status. The Water Board will use both information obtained through desktop review and the results of any inspections to assess compliance with applicable regulatory requirements. Property owners may incur modest

costs to investigate or confirm their system type (e.g. through inspection or record review). The North Coast Water Board has considered these potential costs and finds them reasonable in light of the public interest in protecting water quality and ensuring regulatory compliance.

In consultation with the local agency, the North Coast Water Board will notify property owners of the need to submit assessment information. The notification will describe the required information and the due date to submit the information to the North Coast Water Board. To effectively manage available staff resources, the North Coast Water Board may implement the Assessment Program in phases by geographic area or other appropriate mechanism. To support public health and beneficial uses, the collected information will be used by the North Coast Water Board to identify failing OWTS, cesspools, OWTS that may be contributing to a surface water impairment, OWTS that do not meet requirements of an approved APMP, OWTS otherwise in need of corrective action, and more broadly any OWTS that does not qualify for the OWTS Policy's Conditional Waiver of Waste Discharge Requirements.

In addition to the North Coast Water Board's assessment, owners and operators of cesspools, holding tanks, and seepage pits must report, in writing, their existence and use to the North Coast Water Board. This will more rapidly inform the North Coast Water Board of the presence of these features so that any needed corrective action can occur sooner. This accelerated corrective action is important for compliance with the fecal waste discharge prohibition, because these features pose a higher risk to water quality than other types of OWTS.

If notified by the North Coast Water Board or local agency, OWTS owners or operators must conduct a basic operational inspection as described in section 6.3.7-7.3.4.1 of the Action Plan and/or obtain an OWTS inspection conducted by a Qualified Professional as defined in the OWTS Policy. Basic operational inspections will evaluate, at a minimum, septic tank and pump systems and effluent dispersal areas. The resulting inspection report shall be submitted to the North Coast Water Board according to the date specified in the inspection request. If the inspection report indicates a need for corrective action, the inspection report shall be submitted to the North Coast Water Board within 90 days. The requirement to submit the report within 90 days will inform the Regional Board in a timely manner of the need for corrective action. This notification is important since OWTS in need of corrective action pose a risk to water quality.

9.2.7.5 Corrective Action Requirements

In addition to conditions requiring corrective action set forth in section 11.0 of the OWTS Policy, OWTS meeting any of the following criteria are also deemed to be in need of corrective action and must be replaced, repaired, or modified so as to comply with Tier 1 of the OWTS Policy, an approved LAMP, waste discharge requirements, or a waiver of waste discharge requirements:

- OWTS with projected wastewater flow exceeding the capacity of one or more components of the treatment and disposal system
- Violates the Fecal Waste Discharge Prohibition in the Action Plan

Property owners with OWTS in the watershed that require corrective action or otherwise do not meet minimum requirements established in the Action Plan may be required by the North Coast Water Board to contact the applicable local agency for a permit to repair or replace the OWTS or, where applicable, offered an opportunity to participate in the planning and completion of a community wastewater treatment and disposal system or equivalent alternative. Property owners that are required to upgrade, repair, or replace an existing OWTS or acquire a new OWTS must either (a) obtain the appropriate county permit in accordance with county ordinances and policies or (b) obtain from the North Coast Water Board waste discharge requirements or a waiver of waste discharge requirements, if applicable. Corrective actions must be completed within the time schedule established by the North Coast Water Board or local agency.

In accordance with an approved LAMP, the local agency may approve OWTS repairs and replacements in substantial conformance with the OWTS Policy on a case-by-case basis. Factors that the local agency may consider in determining that corrective actions substantially conform to the LAMP and OWTS Policy include but are not limited to circumstances where an OWTS owner has demonstrated a financial hardship and funding assistance is not available, and/or where due to unique site-specific factors, feasible compliance alternatives are unavailable. The North Coast Water Board maintains its authority to require corrective actions and issue orders to address threats to water quality, in substantial conformance with the OWTS Policy.

The local agency will continue to be the lead organization for plan review, local permit issuance, construction inspection and monitoring of new OWTS and upgrades, and repairs or replacement of existing OWTS. In the absence of a notification from the North Coast Water Board or local agency, all corrective actions necessary to comply with all applicable minimum standards must be completed no later than fifteen years from the effective date of the Action Plan.

9.2.7.6 Planning for Community-Based Systems

The development of a community-based OWTS management plan or Onsite Wastewater Management Authority or District, where authorized by a local agency, may be appropriate for some areas, particularly where there are significant numbers of existing OWTS that do not meet the applicable minimum standards defined and where repairs or replacement of individual OWTS to meet minimum standards are infeasible or cost prohibitive. For development of a community-based management plan to be orderly, fair, and provide a path to compliance, coordination between the North Coast Water Board, local agencies, affected homeowners, and other stakeholders is crucial.

The formation of community advisory groups to provide local stakeholder input to local agencies is essential for the successful development and implementation of community-based solutions. It is the intent of the North Coast Water Board to provide adequate time, through the use of time schedules or equivalent orders, consistent with section 11.6 of the OWTS Policy, for owners of failing and substandard OWTS to comply with this Action Plan and for local agencies to seek and obtain funding assistance for the planning and construction of community-based wastewater treatment and disposal systems, as necessary. Additionally, the North Coast Water Board intends to coordinate with local agencies to provide technical assistance in efforts to identify and seek funding for community-based solutions as well as to facilitate community outreach.

9.2.8 Large Onsite Wastewater Treatment Systems

For the purpose of the Action Plan, a large OWTS means any OWTS with a projected flow greater than 10,000 gpd, any facility, such as a campground or mobile home park, with multiple OWTS whose combined projected flows are greater than 10,000 gpd, or any individual or combined OWTS with projected flow greater than that specified in an approved LAMP. In the North Coast Region, large OWTS are commonly used for domestic wastewater disposal for mobile home parks and campgrounds.

Discharges of untreated or partially-treated wastewater to surface water from large OWTS are prohibited. Accordingly, the load allocations described in Chapter 7 apply to this source.

Owners of large OWTS in the Russian River Watershed not regulated by WDRs or a Waiver of WDRs on the adoption date of the Action Plan shall notify the North Coast Water Board by submitting a report of waste discharge containing information about their OWTS. The report of waste discharge shall be submitted to the North Coast Water Board no later than three months after the effective date of the Action Plan¹⁶. On an ongoing basis, the North Coast Water Board staff shall review WDRs or Waivers of WDRs for Large OWTS located in the Russian River Watershed

9.2.9 Recreational Water Uses and Users

Discharges of human waste to surface water from individuals engaged in recreational water use are prohibited. Accordingly, the load allocations described in Chapter 7 apply to this source.

However, the North Coast Water Board recognizes that the most effective strategy to reduce contamination from recreational water users will focus not on demanding compliance with a prohibition, but instead, through public outreach and education to increase the awareness of the connection between unhygienic activities and the

¹⁶ The effective date of the Action Plan follows approval by the Office of Administrative Law (OAL).

impairment of the recreational use of the Russian River and its tributaries. To this end, the County of Sonoma and the Sonoma County Community Development Commission have entered into a Memorandum of Understanding (MOU) with the North Coast Water Board that outlines a Joint Policy for addressing water quality impacts relative to recreational water use. The Joint Policy includes a concerted effort to engage private landowners, other public agencies, and river users through educational or regulatory activities designed to reduce pathogen load from recreational activities. The North Coast Water Board will coordinate with Mendocino County to develop a MOU or equivalent agreement to address water quality impacts from recreational water use in Mendocino County.

Potential joint implementation actions in both counties could include:

- Installing temporary or permanent restroom facilities and pet waste disposal stations near the recreation use areas and signage to effectively direct recreators to restroom facilities;
- Establishing interagency agreements with local sanitation districts to provide maintenance and waste disposal for temporary restroom facilities;
- Developing and distributing educational and outreach materials (fliers, brochures) to inform river recreators about proper waste disposal and sanitation at beaches and access points along the Russian River and tributaries;
- Conducting outreach to private recreational beach operators and commercial river outfitters to improve beach housekeeping and provide adequate sanitation facilities for customers;
- Publicizing locations of public restroom facilities on the county website and at recreational outfitters' headquarters; and
- Improving restroom facilities at popular private beaches.

9.2.10 Homeless Encampments and Illegal Camping

Discharges of human waste to surface water in excess of water quality objectives is prohibited. Accordingly, the load allocations described in Chapter 7 apply to this source.

However, addressing homelessness and its associated impacts to water quality is complex. Both Sonoma and Mendocino counties are developing and implementing strategies to engage unsheltered homeless people living near waterways in an effort to mitigate the impacts of homelessness, with the long-term goal of ending homelessness within their jurisdictions. The County of Sonoma and the Sonoma County Community Development Commission have entered into a Memorandum of Understanding (MOU) with the North Coast Water Board that outlines a Joint Protocol for addressing water quality impacts relative to homeless encampments. The Joint Protocol includes sharing of information and technical assistance as necessary to support the County's actions, and quarterly meetings between responsible public and private entities to discuss activities addressing homeless issues in the Russian River area. The North Coast Water Board will coordinate with Mendocino County to develop a MOU or equivalent

agreement to address water quality impacts from homeless encampments in Mendocino County.

Where suitable housing for homeless persons exists or is planned, and the housing unit is served by an individual septic system, community septic system, or other approved waste treatment and disposal system, the design, installation, and operation of the system shall comply with the Action Plan and the LAMP for the local agency with jurisdiction over individual OWTS or requirements set forth in WDRs or waivers of WDRs. Throughout implementation of the Action Plan, the North Coast Water Board will prioritize permitting for homeless-dedicated and affordable housing projects in the Russian River area for which North Coast Water Board permits are required.

9.2.11 Municipal Storm Water Runoff

Within the Russian River Watershed's urban boundaries, storm water runoff and non-storm water runoff is regulated under a Phase I Municipal Separate Storm Sewer Systems (MS4) Permit. The current Phase I MS4 Permit, Order No. R1-2015-0030 (NPDES Permit No. CA0025054) became effective on January 6, 2016 and continues in force until a new permit is issued. In addition, traditional Small MS4s within the watershed are enrolled under Water Quality Order No. 2013-0001-DWQ, National Pollutant Discharge Elimination System (NPDES) General Permit No. CAS000004, Waste Discharge Requirements (WDRs) for Storm Water Discharges from Small Municipal Separate Storm Sewer Systems (Phase II MS4 General Permit). The County of Mendocino is currently enrolled under the Phase II MS4 General Permit. Sonoma State University is enrolled under the Phase II General Permit as a Non-Traditional Small MS4 permittee.

Permittees currently named under the Phase I MS4 Permit are:

- City of Santa Rosa
- County of Sonoma
- City of Cloverdale
- City of Cotati
- City of Rohnert Park
- City of Healdsburg
- City of Sebastopol
- Sonoma County Water Agency
- City of Ukiah
- Town of Windsor

Under terms of the current Phase I MS4 Permit, only the City of Santa Rosa and the County of Sonoma are required to prepare work plans (i.e. Pathogen Reduction Plans) to reduce pathogens in storm water runoff. As of 2020, the City of Santa Rosa and County of Sonoma have submitted pathogen work plans that have been approved by the Executive Officer of the Water Board. The scope of work includes the

implementation of BMPs to reduce the levels of pathogens in the discharge to surface water. Implementation of the plans will be evaluated through adaptive management, with future modification potentially necessary, as supported by monitoring.

For Phase I and II MS4 Permittees without approved Pathogen Reduction Plans on the effective date of the TMDL Action Plan, the North Coast Water Board will require submission of the Pathogen Reduction Plans under authority of section 13267 subdivision (b) and/or section 13383 of the Water Code. The Pathogen Reduction Plan shall include, at a minimum:

1. An inventory of fecal waste sources from human and domestic animals;
2. Proposed BMPs to reduce the levels of pathogens in the discharge to receiving water;
3. A proposal to conduct field monitoring, investigation, or research to confirm the source(s) identified as significantly impacting water quality;
4. A monitoring proposal to verify BMP effectiveness; and
5. A proposed implementation schedule.

Compliance with the TMDL for Phase I and Phase II MS4 Permittees requires attainment of the wasteload allocations described in Chapter 7.

9.2.12 Caltrans Storm water Runoff

The California Department of Transportation (Caltrans) is regulated under General Storm Water Permit (NPDES Permit No. CAS000003), Waste Discharge Requirements Order No. 2022-00133-DWQas amended by future actions of the State Water Board. The statewide permit regulates storm water and non-storm water discharges from Caltrans's properties and facilities, and discharges associated with operation and maintenance of the state highway system. In order to comply with the Action Plan, storm water and non-storm water discharges from Caltrans' facilities and properties in the Russian River Watershed shall attain the waste load allocations described in Chapter 7.

Upon renewal of the statewide storm water permit or as soon as is practicable, North Coast Water Board staff will work with the State Water Board to establish the means by which Caltrans can achieve compliance with TMDL requirements.

9.2.13 Non-Dairy Livestock and Farm Animals

Owners and operators of animal facilities, including animal husbandry, livestock production, other similar agriculture operations, and commercial animal boarding facilities, shall implement BMPs for control of fecal wastes within two years after the adoption of the Action Plan. The BMPs may be included in a ranch management plan, or equivalent, and may be required by the Executive Officer. A ranch management plan may be designed to contain, stabilize, and reuse or dispose of waste in order to prevent discharge of fecal waste. Guidance on appropriate best management practices to

properly contain and dispose of waste and prevent potential water quality impacts resulting from surface runoff of animal waste can be found in the University of California Davis Ranch Water Quality Planning Short Course materials. Management practices may include:

- Regular cleanup of fecal waste and soiled bedding in animal habitation areas;
- Use of covered impermeable surfaces for storage of fecal waste;
- Siting of fecal waste storage areas away from water courses and off slopes;
- Use of onsite composting to stabilize and reuse fecal waste;
- Preventing storm water runoff from contact with fecal waste storage areas and compost;
- Minimization and reduction of storm water contacting paddocks, and kennel areas;
- Use of vegetated buffers to provide a barrier to offsite migration of fecal waste; and
- Limiting of animals' access to waterways.

Discharges of fecal waste from animal husbandry operations, livestock production, other similar agriculture operations, and commercial animal boarding facilities must comply with the fecal waste discharge prohibition. Accordingly, the load allocation as described in Chapter 7 applies to these sources.

The North Coast Water Board intends to develop general WDRs or a waiver of WDRs as the primary regulatory mechanism for compliance with the fecal waste discharge prohibition for non-dairy confined animal facilities and grazing operations. It is anticipated that North Coast Water Board adoption of the future general WDRs or waiver will take a number of years to complete. Until this time, owners and operators of animal facilities and grazing operators should implement BMPs listed above, or similar BMPs, that are feasible and appropriate to their operation.

9.2.14 Dairies and CAFOS

Each cow dairy and Confined Animal Feeding Operation (CAFO) in the Russian River Watershed is required to maintain compliance with a Conditional Waiver of WDRs, WDRs, or NPDES Permit, as applicable. The General WDR for dairies was revised in 2019. Point source discharge of dairy waste to waters of the United States that is subject to an NPDES permit is prohibited in the revised General WDR.

Within two years after the effective date of the Action Plan, in order to prevent discharges of fecal waste from dairies to surface water, each dairy within the Russian River Watershed enrolled under the General WDR for Dairies or subsequent dairy Orders shall update required management plans (i.e., Water Quality Plan (WQP) or Waste Management Plan or comparable plans) to address sources of fecal waste. The updated actions to be taken to address fecal waste shall be in addition to those currently required under the order.

At a minimum, the management plans shall be updated to:

- Prevent or minimize animal access to water courses;
- Provide a vegetated buffer along water courses; and
- Include an implementation schedule, with a commencement date not exceeding two years from the effective date of the Action Plan.

Monitoring of surface water will be required to provide information regarding the effectiveness of the required management plans, and other requirements of the Action Plan including: 1) compliance with the Fecal Waste Discharge Prohibition; 2) achievement of LAs; 3) attainment of the numeric targets; and 4) attainment of bacteria objectives and protection of beneficial uses.

The North Coast Water Board will incorporate these requirements to address sources of fecal waste into future revisions of the General WDR.

CHAPTER 10

WATERSHED MONITORING

10.1 OVERVIEW

As described in Chapter 2, the Russian River Watershed is a large watershed, which spans two counties and includes numerous towns and cities, the City of Santa Rosa being the largest at nearly 176,000 people. The watershed, nonetheless, maintains an essential rural character and covers an area of about 1,484 square miles. There is a large array of local, state, and federal agencies; private entities; and nonprofit organizations that are fully engaged in multiple efforts to study and restore a functioning Russian River Watershed system. The Program of Implementation described in Chapter 9 of this staff report to restore bacteriological health to the watershed, is only one of many stewardship efforts. As such, the watershed monitoring program designed to assess the success of the Action Plan, should be well coordinated with other similar efforts.

10.2 MONITORING PURPOSE

Chapter 9 describes multiple implementation actions by which individual entities will assess and control discharges of fecal waste to the Russian River Watershed. The Program of Implementation relies both on existing regulatory mechanisms and the development of new or updated voluntary and regulatory mechanisms by which to promote and ensure control of fecal waste discharge and protection of public health from pathogen exposure. The North Coast Water Board intends to adaptively manage implementation of this TMDL by assessing the success over time of implementation actions with respect to the goal of reducing concentrations of fecal indicator bacteria in the Russian River and its tributaries. To this end, adaptive management of this TMDL requires a robust and thoughtful monitoring plan that is keyed to answering specific management questions, such as:

- Are individual implementation actions being correctly implemented and implemented on schedule?
- Are ambient water quality conditions improving from sewer developed areas, non-sewered developed areas, agricultural areas, and other impacted areas (e.g., areas with homeless encampments)?
- Are ambient water quality conditions improving at key locations, such as recreational beaches and in popular boating reaches?
- Are ambient water quality conditions meeting water quality standards and 303(d) delisting requirements?
- Is there evidence of fecal waste sources not yet identified or addressed by the Action Plan?
- Is there evidence that individual implementation actions should be adapted to better address fecal waste pollution?

These key questions, and others as developed with stakeholders, will be answered through monitoring and reporting requirements associated with permitted waste discharges and coordinated ambient water quality monitoring, including public health monitoring.

10.3 RUSSIAN RIVER REGIONAL MONITORING PROGRAM

The concept of a Russian River Regional Monitoring Program (R3MP) has been established, engaging multiple interested parties. The purpose of the R3MP is broadly defined but is consistent with the goals and purpose of the Russian River Pathogen TMDL. The R3MP will coordinate the monitoring efforts of its member agencies, including cities, towns, Sonoma and Mendocino Counties, and Sonoma Water. The Program is currently under development, but has to date formed a Steering Committee of local agencies, adopted initial management questions, a Charter, and is in the process of evaluating funding models. The R3MP is modeled after established regional monitoring programs, including those in the Klamath Basin and San Francisco's Bay and Delta. Coordination will likely include:

- Ambient conditions monitoring;
- Compliance monitoring;
- Status and trends monitoring;
- Standardized sampling methods, protocols, and Quality Assurance/Quality Control;
- Data sharing and visualization;
- Data assessment and interpretation;
- Special studies;
- Peer-reviewed publications and watershed health reporting to stakeholders and the public, and;
- Regular public meetings to share and discuss implementation activities, analytical results, research, and other information critical to water quality and the health of the Russian River Watershed.

The R3MP is being developed to accommodate growth to include multiple members with multiple purposes related to the restoration of the water quality and ecological health of the Russian River Watershed. Entities responsible for implementation under the Action Plan are encouraged to participate in the R3MP once it is fully established to ensure the best possible coordination among monitoring partners. Participation in the R3MP may in some cases satisfy requirements for certain monitoring actions required of individual responsible parties. The North Coast Water Board will be an active member of the R3MP and represent its own monitoring resources available through the State's Surface Water Ambient Monitoring Program (SWAMP).

10.4 INDIVIDUAL MONITORING & REPORTING REQUIREMENTS

As described in Chapter 9, dischargers and parties responsible for potential sources of fecal waste discharge will be required to assess and control sources of fecal waste and pathogens as measured by fecal indicator bacteria. Dischargers operating under existing, new or revised NPDES permits or WDRs will be required to monitor, assess, and report on the implementation of their assigned actions, including compliance with the implementation requirements and their effectiveness. For some identified pathogen sources, implementation actions are conducted in accordance with a memorandum of agreement or some other agreement between the North Coast Water Board and a local agency, or in accordance with requirements in a Local Agency Management Plan (LAMP).

Generally speaking, a point source discharge must be sampled at its point of entry to any surface water of the State to confirm source control effectiveness and compliance with wasteload allocations. Similarly, ambient water quality conditions must be sampled in receiving waters at reasonably close locations above and below the point of discharge to confirm water quality improvements and compliance with the fecal waste discharge prohibition.

A nonpoint source discharge is generally assessed by 1) inspection of best management practices (BMP) to confirm that they are properly installed and functioning, 2) photographic evidence of BMP performance and ambient conditions, and 3) ambient water quality monitoring at multiple locations above, associated with, and below a nonpoint source. Nonpoint source monitoring is necessary to confirm source control effectiveness, and compliance with the load allocations. Ambient water quality conditions are also sampled to confirm water quality improvements and compliance with the fecal waste discharge prohibition.

Discharges of waste to land must meet the discharge requirements specified in the applicable permit or order, to ensure proper treatment, disinfection, and disposal. Discharges of waste to land with the potential to result in impacts to groundwater or surface water via subsurface migration may be required to conduct site specific monitoring, including the installation of groundwater monitoring wells to characterize such potential impact or migration.

Leaks and spills with the potential to discharge directly to surface water, discharge indirectly to surface water via subsurface migration, or impact groundwater may also be required to conduct site specific monitoring, including the installation of groundwater monitoring wells to characterize such potential discharge, migration, or impact.

10.5 MONITORING RECREATIONAL USE

The Sonoma County Department of Health Services, Environmental Health and Safety Section currently conducts monitoring at several of the beaches with the authority to issue public warnings or close beaches, as conditions indicate. The North Coast Water

Board works in coordination with the County on this and other such issues of public health protection. Such coordination is critical to the successful implementation of the Action Plan, including the collection of data necessary to assess that success. North Coast Water Board staff anticipate continued coordination with the County on beach monitoring and assessment.

10.6 AMBIENT WATER QUALITY MONITORING

There are multiple approaches to successful ambient water quality monitoring, which the R3MP should be central to designing and implementing. With respect to the North Coast Water Board's specific interest in correcting the problem of fecal waste pollution and public health protection, there are a few key parameters that should be part of any ambient water quality monitoring, whether performed for effectiveness, water quality trends, compliance, or public health protection purposes.

The statewide bacteria objectives for the protection of REC-1 establish *E. coli* limitations for freshwater and enterococci limitation for saline water. Compliance with water quality standards for REC-1 protection will be determined based on attainment of these objectives. 303(d) delisting of impaired reaches will be based on the guidance contained in the 303(d) Listing Policy. As described in this staff report, fecal indicator bacteria each have their own particular sensitivities with respect to environmental influences, however. As such, the multiple lines of evidence approach is appropriate to ensure full and complete protection of water quality, beneficial uses, and public health. In the case of the Russian River Watershed, the fecal indicator bacteria that are most relevant and valuable are: *E. coli*, enterococci, and *Bacteroides* in freshwater and enterococci and *Bacteroides* in saline water as described in Chapter 3, Bacteria Standards and Other Indicators of Pathogen Pollution. At a minimum, ambient water quality monitoring should include these metrics. *E. coli*, enterococci, and *Bacteroides* results indicate whether or not there is evidence that there is a risk to REC-1 of unacceptable human exposure to illness causing pathogens.

There are multiple other lines of evidence that could provide important assessment information, however. Many other potential lines of evidence are described below for use in an ambient water quality monitoring program, including: individual or general monitoring and reporting requirements, the R3MP, SWAMP, and public health monitoring.

10.6.1 Bacteroides Bacteria

Because of the short life span, *Bacteroides* bacteria concentrations are often used to indicate recent fecal contamination of surface waters. *Bacteroides* bacteria are a suitable indicator of a waterbody's bacteriological quality since the bacteria come from the gastrointestinal systems of animals, they degrade rapidly outside of the body, and technology is available to trace the bacteria back to specific types of animals, including humans and domestic animals. Host-specific *Bacteroides* bacteria can be used to help assess the natural background of pathogenic indicator bacteria in minimally disturbed

waterbodies. Current recommended genetic markers and protocols for *Bacteroides* bacteria analysis are described by Griffith et al. (2013). Additional markers may also be appropriate in the future as technology advances to improve assay sensitivity and performance. As above, *Bacteroides* is recommended as part of a triad of metrics to assess the presence of fecal waste and the potential for exposure to illness-causing pathogens above water quality standards.

10.6.2 Bacteriophages

Measurement of *Bacteroides* bacteriophages may provide additional information on animal hosts. *Bacteroides* bacteria are rapidly inactivated by environmental oxygen levels, but *Bacteroides* bacteriophages are resistant to degradation. One group of phages that specifically uses *B. fragilis* strain HSP40 as host is found only in human feces and not in feces of other animals.

10.6.3 Viruses

Several analytic methods detect viruses excreted in feces and/or urine with high specificity to human waste and almost no cross-reactivity with other sources. Among the virus methods, markers for DNA viruses, such as human adenovirus and human polyomavirus, are among the more sensitive and robust. These viruses are fairly widespread among humans, and a sizable portion of the population sheds polyomaviruses passively. In addition, the DNA genomes of these viruses are less labile than those of common human enteric viruses with RNA genomes, which may make them more resistant to environmental degradation and therefore easier to detect.

10.6.4 Chemical Source Tracking

Chemicals found in wastewater might be useful for independently confirming human waste in ambient surface waters. Measurement of chemicals that could include optical brighteners used in laundry detergents, caffeine, fecal sterols (metabolic byproducts of human digestion processes), and metabolite of nicotine (cotinine) excreted by tobacco users. The collection of any water quality data must be in accordance with an approved QA/QC Plan. *E. coli* and enterococci data should be collected on a weekly basis to ensure an adequate number of samples to assess compliance with the targets. These data will be important for determining public health risk related to REC-1 impairment. Similarly, storm water monitoring also will be important to assessing the effectiveness of the Action Plan. A storm water monitoring plan should consider monitoring locations that allow assessment of: 1) the impact of known fecal waste discharges, 2) the location of unknown fecal waste discharges, 3) the water quality trends associated with specific areas (e.g., sewer and unsewered developed areas, agricultural areas) and 4) the water quality trends in waters contained within the Advanced Protection Management Program (APMP) area.

10.7 SPECIAL STUDIES

The Russian River Estuary may close throughout the year as a result of a barrier beach (closed sandbar) forming across the mouth of the Russian River at Goat Rock State Beach. Such closures usually occur during the spring, summer, and fall. Closures result in ponding of the Russian River behind the barrier beach creating lagoon conditions and, as water surface levels rise in the Estuary, flooding may occur. The barrier beach has been artificially breached by various parties for decades, mostly recently by Sonoma County Water Agency (Sonoma Water) for the purpose of alleviating potential flooding of low-lying properties along the Estuary. However, the National Marine Fisheries Service's (NMFS) Russian River Biological Opinion has concluded that the freshwater lagoon conditions that form behind the sand bar from May 15 to October 15 are beneficial to the growth of young steelhead and should be preserved, as possible. In order to comply with the requirements of the Russian River Biological Opinion, the Sonoma Water implements the Russian River Estuary Management Project (Estuary Project), which adaptively manages the Estuary with the dual objectives of enhancing rearing habitat for juvenile salmonids, particularly steelhead, and managing Estuary water levels to minimize flood hazard. From May 15 to October 15 ("lagoon management period"), a barrier beach/river mouth closure is managed to reduce tidal influence and to increase freshwater habitat available for salmon and steelhead, while minimizing flood risk and, avoiding historic artificial breaching practices. Artificial breaching outside of the lagoon management period is implemented consistent with historical practices. Water quality monitoring during the lagoon management period includes weekly grab sampling at multiple locations for pathogens, including total coliforms, *E. coli* and enterococcus. The TMDL analyses did not specifically include assessment of the degree to which the presence of the sand bar and freshwater lagoon at the mouth of the river affect upstream ambient water quality conditions. But, the Estuary Project's Environmental Impact Report concluded that there is a large variation in indicator bacteria levels observed through the different sections of the Estuary, that these variations were observed to occur under both open and closed mouth conditions and may be seasonal as well, and that there might be water quality impacts that are not mitigatable. Further assessment of the effects of these phenomena on water quality conditions and implementation of the pathogen TMDL is warranted.

10.8 REPORTING AND ASSESSMENT

North Coast Water Board staff will review and assess the monitoring results provided under individual or general monitoring and reporting requirements, the R3MP, SWAMP, and public health monitoring. Staff anticipates periodically compiling data and data assessments into a stewardship report, which is produced in collaboration with partners and public feedback, as a basis for adaptive management. For example, monitoring approaches may be revised, if data are inadequate to assess program effectiveness. Similarly, implementation requirements may be revised if data indicate that the assigned actions show no effect.

Continued and coordinated monitoring of the Russian River Watershed may lead to the inclusion of new reaches of the Russian River Watershed on the 303(d) List of Impaired Waters. Similarly, such monitoring may lead to delisting other reaches, as water quality conditions improve, overtime.

CHAPTER 11

CEQA SUBSTITUTE ENVIRONMENTAL ANALYSIS

The North Coast Water Board is the lead agency for evaluating the environmental impacts of a Basin Plan amendment pursuant to the California Environmental Quality Act (CEQA). The North Coast Water Board basin planning process is certified by the Secretary for Natural Resources as “functionally equivalent” to CEQA, and therefore exempt from the requirement for preparation of an environmental impact report or negative declaration and initial study¹⁷. Basin Plan amendments proposed for board approval must include or be accompanied by a Substitute Environmental Documentation (SED)¹⁸ which shall include, at a minimum, all of the following:

1. A brief description of the proposed project (Section 11.1; Details described in Chapters 1-10).
2. An identification of any significant or potentially significant adverse environmental impacts of the proposed project. (Section 11.4)
3. An analysis of the reasonably foreseeable alternatives to the proposed project. (Section 11.2)
4. An analysis of mitigation measures to avoid or reduce any significant or potentially significant adverse environmental impacts of the proposed project. (Section 11.4)
5. An environmental analysis of the reasonably foreseeable methods of compliance. (Chapters 9 and Section 11.4)

The SED shall contain an environmental analysis of reasonably foreseeable methods of compliance (compliance measures) for the project that include the following components:¹⁹

1. An identification of the reasonably foreseeable methods of compliance with the project. The reasonably foreseeable methods of compliance (hereinafter compliance measures) are the potential actions that responsible parties may employ to comply with the TMDL load allocations, numeric targets and the implementation measures in the Action Plan. (Chapter 11.4)
2. An analysis of any reasonably foreseeable significant adverse environmental impacts associated with the reasonably foreseeable methods of compliance.
3. An analysis of any reasonably foreseeable alternative methods of compliance that would have less significant adverse environmental impacts. (Chapter 11.2)

¹⁷ Cal. Code Regs., tit. 14, § 15251(g); Cal. Code Regs., tit. 23, § 3775.

¹⁸ Cal. Code Regs., tit. 23, § 3777.

¹⁹ Cal. Code Regs., tit. 23 § 3777(b)(4); Cal. Code Regs., tit. 14 § 15187(c); Cal. Pub. Resources Code, § 21159 (c).

4. An analysis of the reasonably foreseeable mitigation measures that would minimize any unavoidable significant adverse environmental impacts (Chapter 11.4)

The SED must take into account a reasonable range of:²⁰

1. Environmental, economic, and technical factors. (Chapters 1-12)
2. Population and geographic areas. (Chapters 1 & 2 & 11)
3. Specific sites (Chapters 9 & 11)

While the regulations require consideration of a “reasonable range” of the factors listed above, an examination of every site is not required.²¹ The statute specifically states that the agency shall not be required to conduct a “project-level analysis.”²² Rather, in most circumstances, the site-specific analysis will be performed by the responsible party or the agency with jurisdiction when an activity is conducted in conformance with the Basin Plan amendments.

Notably, the North Coast Water Board is prohibited from specifying the manner of compliance with requirements in waste discharge requirements or other Order,²³ and accordingly, the actual environmental impacts will necessarily depend upon the compliance strategy selected by the responsible party.

This Staff Report includes the CEQA checklist, along with the Action Plan. Following public review and comment, a response to comments document will be produced and modifications to the Action Plan, as necessary. The proposed Action Plan, resolution adopting the Action Plan, and public comments and response to public comments will be available prior to the public hearing. These materials fulfill the requirements of California Code of Regulations, title 23, section 3777, and the North Coast Water Board’s substantive CEQA obligations.

Any potential environmental impacts associated with implementation of the Action Plan depend upon the specific compliance projects selected by the responsible parties, many of whom are public agencies subject to their own CEQA obligations²⁴. Consistent with CEQA, the SED does not engage in speculation or conjecture but rather considers the

²⁰ Cal. Code Regs., tit. 23 § 3777(c); Cal. Code Regs., tit. 14 § 15187(d); Pub. Resources Code, § 21159 (c).

²¹ Cal. Code Regs., tit. 23 § 3777(c);

²² Cal. Code Regs., tit. 23 § 3777(c); Public Resources Code § 21159(d)

²³ Wat. Code § 13360

²⁴ Public Resources Code § 21159.2

reasonably foreseeable feasible mitigation measures, and the reasonably foreseeable methods of compliance, which would avoid, or minimize the identified impacts.

The North Coast Water Board recognizes that implementation actions may result in project-level impacts that the local public agencies determine cannot be avoided or minimized to have less than significant adverse impacts. To the extent there are unavoidable adverse environmental effects resulting from required methods of compliance with this Action Plan, improving public health by reducing pathogens and associated waterborne illnesses, and addressing water quality pollution and impairment in the Russian River Watershed (an action required to achieve the national policy of the Clean Water Act) outweigh the unavoidable adverse environmental effects. The potential significant impacts associated with the Basin Plan amendment are outweighed by the benefit of restoration and enhancement of beneficial uses, and reduction of pathogens in the Russian River Watershed.²⁵

In making this statement of overriding considerations, the North Coast Water Board has balanced the economic, legal, social, technological, and other benefits of this proposed TMDL against the unavoidable environmental effects in determining whether to recommend approval of this project. Upon review of the environmental information generated for this project and in view of the entire record supporting the TMDL, the North Coast Water Board has determined that the specific economic, legal, social, technological, and other benefits of this proposed bacteria TMDL outweigh the unavoidable adverse environmental effects, and that such adverse environmental effects are acceptable under the circumstances.

11.1 SUMMARY OF PROPOSED ACTION PLAN

North Coast Water Board staff developed a proposed *Action Plan for the Russian River Watershed Pathogen TMDL* (Action Plan) for amendment into the Basin Plan. The Action Plan consists of a description of the TMDL fecal indicator bacteria-related load allocations, numeric targets, and implementation actions necessary to comply with the

²⁵ California Code of Regulations title 23, section 3777 (d) requires the North Coast Water Board to make findings consistent with California Code of Regulations title 14 section 15093 when the SED identifies potentially unavoidable adverse environmental effects. This Basin Plan amendment does not attempt to identify every project specific impact that may result from implementation. Project specific approvals and resulting environmental impacts will typically be addressed in local agencies' approvals. In addition, where implementation actions specified under this Action Plan require the North Coast Water Board to issue WDRs, waivers of WDRs, or other orders, the environmental impacts of those actions will be addressed at the time of Order/project approval.

TMDL and for the protection of beneficial uses. The Action Plan also includes the following prohibition:

Discharges of waste containing fecal material from humans or domestic animals²⁶ to waters of the state within the Russian River Watershed are prohibited.

Compliance with this prohibition can be achieved in the following manner:

1. Implement adequate treatment and/or best management practices to prevent the discharge of fecal waste material from humans or domestic animals from entering a water of the state either directly or indirectly.
2. Comply with all fecal waste/pathogen-related provisions of an applicable NPDES permit.
3. Comply with all fecal waste/pathogen-related provisions of an applicable WDR.
4. Comply with all fecal waste/pathogen-related provisions of an applicable general WDR or waiver of WDRs.
5. Implement the terms of a Memorandum of Understanding or equivalent agreement between the North Coast Water Board and relevant local agencies to address fecal waste discharge from homeless encampments, recreational water users, and any other additional sources identified after discussion between the relevant parties.
6. For non-dairy livestock, implement best management practices to achieve the assigned load allocation within 2 years of the effective date of this TMDL and, if required by the Executive Officer, (a) develop and implement an Executive Officer-approved Ranch Management Plan or (b) comply with all fecal waste/pathogen-related provisions of an applicable non-dairy livestock WDR or waiver of WDRs, adopted by the North Coast Regional Water Quality Control Board.
7. Existing, new, and replacement OWTS shall comply with sections 6.3.7-7.2 and 6.3.7-7.3 of the Action Plan for the Russian River Watershed and the Russian River Pathogen Total Maximum Daily Load (Action Plan). New and replacement OWTS near impaired water bodies listed in Attachment 2 of the OWTS Policy shall comply with special provisions contained in an approved Local Agency Management Program (LAMP), or if there are no special provisions, comply with the requirements in Tier 3 of the OWTS Policy and section 6.3.7-6 of the Action Plan.

²⁶ Examples of domestic animals include, but are not limited to, cows, horses, cattle, goats, sheep, swine, poultry, dogs, cats, or any other animal(s) in the care of any person(s).

8. If deemed necessary and ordered by the North Coast Water Board, owners of OWTS must:
 1. Provide information about the OWTS to the North Coast Water Board or the local agency, and
 2. If necessary, contact the local agency to initiate corrective actions pursuant to section 11 of the OWTS Policy and the local agency's LAMP, or submit a report of waste discharge to the North Coast Water Board for possible establishment of waste discharge requirements or a waiver of waste discharge requirements for the domestic waste discharge.

The Action Plan is necessary to comply with existing federal and State laws, regulations, plans and policies. Technical information supporting the Action Plan is described in detail in Chapters 1-10 of this staff report. In summary, the Action Plan is proposed to include the following elements:

1. An analysis of the sources of pathogens within the Russian River Watershed
2. The Total Maximum Daily Load (TMDL) of fecal indicator bacteria that can be discharged to the Russian River Watershed and still attain water quality objectives
3. Waste load and load allocations for *E. coli* bacteria for freshwaters and enterococci bacteria for saline waters applicable to all controllable sources identified within the Russian River Watershed
4. A new Waste Discharge Prohibition specific to unauthorized fecal waste discharges within the Russian River Watershed.
5. Seepage pits may be authorized under site-specific conditions as specified in section 6.3.7-7.3.2 of the Action Plan.
6. Existing and prospective interagency agreements to cooperatively implement actions for OWTS, homeless encampments, and recreational water users
7. A discussion of permitting, implementation of the prohibition, and enforcement.
8. A discussion of monitoring and adaptive management
9. Requirements for responsible parties to develop, update, and implement the following for the reduction of fecal bacteria loads:
 - a. *A Recycled Water BMP Plan*, or equivalent BMP Plan, for recycled water projects;
 - b. *A Water Quality Management Plan, Waste Management Plan, or Nutrient Management Plan* for dairies;

- c. *Report of Waste Discharge* for unpermitted large private OWTS, OWTS.
- d. Corrective actions for OWTS not meeting conditions of the OWTS Policy's Conditional Waiver of Waste Discharge Requirements, or those consisting of cesspools or holding tanks;
- e. *A Pathogen Reduction Plan* for MS4 general permit enrollees.

11.2 ALTERNATIVES ANALYSIS

North Coast Water Board staff has identified two approaches (or alternatives) to address the pathogen impairment in the Russian River Watershed. The following sections discuss the two alternatives: 1) Adoption of the Action Plan (adoption of the proposed Basin Plan amendment), and 2) No Action.

11.2.1 Alternative 1 - Adoption of the Action Plan (Preferred Alternative)

The Preferred Alternative is adoption of the Action Plan, including establishment of the human and domestic animal fecal waste discharge prohibition for the Russian River Watershed. The Action Plan includes source assessment, waste load allocations and load allocations for each of the identified sources, and an implementation program describing the actions likely necessary to achieve the TMDL allocations and numeric targets. North Coast Water Board staff will conduct reviews to evaluate the success of implementation actions aimed at reducing loading to achieve the allocations. Individual monitoring and reporting requirements will provide data and information about whether the implementation actions are working, if beneficial uses are protected, and if the TMDL is being achieved. A coordinated monitoring program will help improve the consistency and cost-effectiveness of monitoring actions. The Action Plan requirements will be implemented through updates to existing permits, local agency MOUs, and through existing North Coast Water Board authorities. Staff have determined that this alternative is the most likely to result in attainment of water quality standards in a reasonable period of time and that most of the impacts resulting from this action are generally less than significant or can be mitigated. Therefore, this is the preferred alternative.

Coverage under the OWTS Policy's conditional waiver of WDRs will apply to OWTS that meet the conditions of the waiver. New and replacement OWTS within 600 feet of the waterbodies listed in Attachment 2 would have to meet applicable specific Tier 3 requirements of the OWTS Policy, or other special provisions established for these waterbodies by a LAMP. In conformance with the findings of the 2012 303(d) list of impaired waters, these reaches include:

- Lower Russian HA, Guerneville HSA, mainstem Russian River from Fife Creek to Dutch Bill Creek

- Lower Russian HA, Guerneville HSA, Green Valley Creek Watershed
- Middle Russian River HA, Geyserville HSA, mainstem Russian River at Healdsburg memorial beach and unnamed tributary at Fitch mountain
- Middle Russian River HA, Mainstem Laguna de Santa Rosa
- Middle Russian River HA, Mainstem Santa Rosa Creek

Additionally, funding opportunities for owners of OWTS will be more accessible because standard federal and state implementation grants and other funding sources are typically only available for projects located in watersheds that have an approved Action Plan or some other effective watershed-scale management plan in place.

11.2.2 Alternative 2 - No Action

Under the No Action alternative, no amendment to the Basin Plan would occur (no Action Plan adopted) and staff would continue to implement existing Regional and State Water Board programs and permits. The North Coast Water Board would not adopt a TMDL for the Russian River Watershed and would not require specific load reductions from each source and the proposed prohibition would not be enacted.

The North Coast Water Board is required under the *Policy for the Implementation and Enforcement of the Nonpoint Source Pollution Control Program*²⁷ (NPS Policy) to implement a WDR, waiver of WDR, or waste discharge prohibition to address sources of nonpoint source pollution. In the absence of the fecal waste discharge prohibition included in Alternative 1, the North Coast Water Board would have to develop a WDR or waiver of WDRs for any sources of fecal waste to the Russian River Watershed, which are not addressed through an existing WDR or waiver to conform to the requirements of the policy.

This no action alternative will likely result in some improvement in water quality, but it does not provide a framework for watershed-wide implementation and monitoring efforts, a timeline by which implementation must occur, and reasonable assurance that water quality objectives will be attained within the shortest, reasonable period of time. Further, the no action alternative does not conform to the NPS Policy.

Under the No Action alternative, property owners with OWTS owners that are within 600 feet of impaired waterbodies in the Russian River watershed and that are listed in

²⁷ [Plans and Policies](https://www.waterboards.ca.gov/water_issues/programs/nps/docs/plans_policies/nps_i_epolicy.pdf)

(https://www.waterboards.ca.gov/water_issues/programs/nps/docs/plans_policies/nps_i_epolicy.pdf)

Attachment 2 of the OWTS Policy will face significant regulatory consequences. Without an adopted TMDL, new and replacement OWTS in these areas must comply with the stringent Tier 3 requirements, which typically involve advanced treatment systems designed to significantly reduce pathogen and nutrient loading. This can result in substantially higher costs for OWTS owners due to the need for more sophisticated treatment technology, ongoing maintenance, and monitoring. Alternatively, if the affected counties retain their special provisions under an approved Local Agency Management Program, OWTS owners may still be subject to specific local requirements but could potentially avoid the full burden of Tier 3 regulations. However, the absence of a TMDL means that waterbodies will remain listed in Attachment 2, prolonging regulatory uncertainty and limiting future development options until a comprehensive water quality management strategy is implemented.

11.3 REASONABLY FORESEEABLE MEANS OF COMPLIANCE

This section presents an analysis of the potential environmental impacts associated with reasonably foreseeable methods of compliance with the proposed Action Plan (preferred alternative). North Coast Water Board staff solicited public input to help identify reasonably foreseeable compliance measures. Many of the measures listed below were identified by members of the public and agency staff during the CEQA scoping process. Current elevated fecal indicator bacteria densities exceed water quality objectives and are detrimental to the beneficial uses within the Russian River Watershed. The Action Plan provides a program addressing the adverse impacts of non-compliance with water quality objectives through progressive reduction in loading of fecal waste and pathogens (as measured by fecal indicator bacteria) to the Russian River Watershed using a schedule that is reasonable and as short as practicable.

The compliance measures and pollution controls necessary to comply with the Action Plan will depend on a number of site-specific conditions and factors. The following examples are not meant to be exhaustive of the suitable suite of compliance measures, but rather provide a reasonable range of measures that may be implemented. Many of the compliance measures listed below are often interchangeable as mitigation measures for potentially adverse environmental impacts associated with specific project activities. Additionally, though not listed below, public commenters encouraged the use of Low Impact Development (LID), including the construction of smaller homes, as possible mitigation measures.

11.3.1 Non-structural Controls

Non-structural controls are typically aimed at controlling sources of a pollutant and do not involve construction or other earth moving/landscape manipulations. Non-structural controls are those activities that are primarily planning or outreach in nature. Most of the non-structural controls identified are unlikely to have an environmental impact because they are not physical in nature; however, where they were found to have less than significant impacts or where they could be mitigated to less than significant, they are discussed in Section 11.4. No potentially significant impacts on the environment were

identified for these controls. Some of the possible non-structural controls that could be implemented as a method of compliance include:

- Education and Outreach: Conduct education and outreach about proper maintenance and upkeep for OWTS, water conservation, recycled water and graywater use, preventing illegal camping along waterbodies, proper human and domestic animal waste disposal and sanitation, and the effects of improper pet waste disposal. Publicize the locations of restrooms found at recreational beaches along the mainstem Russian River.
- Inspection and Maintenance: Require preventative maintenance and upkeep of OWTS. Inspect and perform routine maintenance of sewer laterals. Perform inspections and routine maintenance of sanitary sewer infrastructure and existing public restroom facilities at beaches along the Russian River. Perform regular beach clean-up to dispose of waste left on beaches. Manage irrigation to minimize leaks and ensure that overwatering and runoff do not occur.
- Municipal Wastewater Program Establishment, Evaluation, and Enforcement: Revise design standards for new and replacement sewer systems to add enhanced protection against overflows and exfiltration. Establish procedures and standards for the use of off-site easements, which include conditions, covenants, and deed restrictions, to facilitate properly designed and constructed OWTS serving multiple dwellings. Establish a local ordinance to require property owners to inspect their private sewer lateral upon property transfer, in response to chronic sanitary sewer overflows, or prior to change in property use. Establish a program and funding assistance for homeowners to promote voluntary inspections and repairs of private laterals. Develop an OWTS management program. Provide and/or improve options for shelters and transitional housing or other homeless services. Establish a hotline for reporting homeless/illegal encampments and facilitate their removal along stream corridors. Evaluate and if necessary improve management practices to prevent recycled water overspray, spills, and runoff. Implement programs to discourage or prevent illegal dumping. Explore expanding recycled water use to prevent discharge into surface waters. Enforce permit conditions, including water recycling requirements.
- Water Quality Plans: Require Best Management Practices (BMPs) for manure handling through the development or update of Water Quality Plans. BMPs for manure handling could include regular cleanup of manure and soiled bedding in animal habitation areas, locating manure storage areas away from water courses and off slopes (i.e., prevent storm water discharge), practicing onsite composting and reuse of manure, and storing manure on impermeable surfaces (i.e., prevent groundwater discharge).

11.3.2 Structural Controls

Structural controls for non-point sources divert, store, treat, and/or infiltrate storm water to prevent the discharge of waste material to the river as a result of runoff. Structural controls for point sources can also be implemented to treat waste before discharge and/or prevent the direct discharge of waste into a waterbody. Structural controls can involve activities that create potentially significant environmental impacts. Structural controls that were found to have impacts, both potentially significant and less than significant, are discussed in Section 11.4.

The following is a list of potential structural controls:

- Straw Waddles: Use straw waddles inoculated with mushrooms (i.e. mycofiltration), as appropriate, to filter bacteria from runoff.
- Buffer Strips, Vegetated Swales, and Bioretention: Construct and maintain vegetative buffers along roadsides and next to waterbodies to slow runoff velocity, increase filtration of pollutants, and increase storm water infiltration. Construct and maintain bioretention BMPs to provide onsite removal of pollutants, including fecal waste, from storm water runoff through landscaping features.
- Green Roofs and Rain Gardens: Replace existing roofs and gardens with “green” infrastructure such as green roofs and rain gardens to prevent or reduce clean storm water from coming into contact with fecal wastes.
- Exclusion: Construct fencing, hedgerows, livestock trails, and walkways to exclude animals from streams and riparian areas to prevent direct deposition of feces into surface waters. Construct fencing, shrubs, or other barriers to prevent camping & habitation under bridges and overpasses and in other rights-of-way.
- Waste Storage and Disposal: Install pet waste collection systems, which provide plastic bags to be used in the collection of domestic pet waste, throughout the watershed. Provide garbage cans, recycling bins, and diaper changing stations at public beaches.
- Municipal Composting of Biosolids: Ensure the elimination of pathogens from biosolids by upgrading treatment through the use of composting.
- Waterless Waste Treatment: Utilize waterless technology such as composting and incinerating toilets.
- Restroom Facilities: Provide and/or upgrade permanent or temporary restroom facilities at recreation beaches and at locations frequented by homeless and transient people.

- Sewer Lateral Replacement: Fix or replace private sewer laterals that have inflow and infiltration issues.
- Increase Wastewater Storage Capacity: Enlarge wastewater holding ponds to prevent discharge to the Russian River and its tributaries.
- Wastewater Treatment Plant Expansion and/or New Treatment Plant Construction: Expand or construct wastewater treatment plants to allow for new connections.
- Connect OWTS to a Centralized Wastewater Treatment Plant or Decentralized Community System: Connect individual wastewater treatment and disposal systems to a centralized treatment plant or decentralized community wastewater treatment system and discontinue use of individual OWTS.
- Treatment Plant Wastewater Disinfection: Upgrade treatment plant wastewater disinfection systems and disinfect holding pond effluent through the use of ozone, heat sterilization or ultrafiltration.
- OWTS Supplemental Treatment: Utilize supplemental treatment such as ultraviolet (UV) light disinfection or chlorine to ensure adequate treatment of effluent from OWTS.
- MS4 Sand Filters: Install and maintain sand filters, which are effective for pollutant removal from storm water. Sand filters may be a good option in densely developed urban areas with little pervious surface since the filters occupy minimal space.
- Replacement and/or Improvement of OWTS: Replace/upgrade leaking and poorly sited OWTS with OWTS that are correctly designed, sited, constructed, installed, operated and maintained. System status to be determined through site inspection.

11.4 ENVIRONMENTAL CHECKLIST

As stated previously, the environmental analysis must include an evaluation of the reasonably foreseeable environmental impacts of the methods of compliance and the reasonably foreseeable mitigation measures relating to those impacts. This section, consisting of the CEQA checklist and answers to the questions in the checklist, discusses the reasonably foreseeable compliance measures and alternatives and mitigation measures of those compliance methods.

In formulating the checklist answers, the impacts of implementing the non-structural and structural controls were evaluated. At this time, the exact compliance measures that might be implemented to comply with the Action Plan are unknown, and therefore this analysis considers a range of non-structural and structural measures that might be used. When specific measures are selected for implementation, a project-level/site-specific CEQA analysis will be performed by the responsible party, as necessary.

This evaluation considers whether the construction or implementation of the reasonably foreseeable compliance measures has the potential to cause a substantial, adverse change in any of the physical conditions within the area affected by the project. In addition, the evaluation considers environmental effects in proportion to their severity and probability of occurrence. In this analysis, the level of significance is based on the existing conditions of both the physical environment and regulatory baseline requirements. A significant effect on the environment is defined in regulation as “a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project, including land, air, water, minerals, flora, fauna, ambient noise, and objects of historic or aesthetic significance. An economic or social change by itself shall not be considered a significant effect on the environment. An economic or social change related to a physical change may be considered in determining whether the physical change is significant.” (14 Cal. Code regs, tit.14, § 15382.).

Potential reasonably foreseeable impacts of the reasonably foreseeable compliance measures were evaluated with respect to each of the factors on the checklist. Additionally, mandatory findings of significance regarding short-term, long-term, cumulative and substantial impacts were evaluated. In this analysis, the level of significance was based on baseline conditions (i.e., current conditions). Based on this review, it has been concluded that there may be some potentially significant impacts associated with certain reasonably foreseeable methods of compliance with the Action Plan. Reasonably foreseeable structural and non-structural controls that were found to have impacts, both potentially significant and less than significant, or that require mitigation are discussed in detail below.

Table 11.1: Environmental Checklist

-	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
I. AESTHETICS -- Would the project:				
a) Have a substantial adverse effect on a scenic vista?			✓	
b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?		✓		

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

-	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
c) Substantially degrade the existing visual character or quality of the site and its surroundings?		✓		
d) Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?		✓		
II. AGRICULTURE AND FOREST RESOURCES²⁸-- Would the project:				
a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?	✓			
b) Conflict with existing zoning for agricultural use, or a Williamson Act contract?	✓			

²⁸ AGRICULTURE AND FOREST RESOURCES: In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997) prepared by the California Dept. of Conservation as an optional model to use in assessing impacts on agriculture and farmland. In determining whether impacts to forest resources, including timberland, are significant environmental effects, lead agencies may refer to information compiled by the California Department of Forestry and Fire Protection regarding the state's inventory of forest land, including the Forest and Range Assessment Project and the Forest Legacy Assessment Project; and forest carbon measurement methodology

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

-	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
c) Conflict with existing zoning for, or cause rezoning or, forest land (as defined in Public Resources Code section 12220(g)), timberland (as defined by Public Resources Code section 4526), or timberland zoned Timberland Production (as defined by Government Code section 51104(g))?				✓
d) Result in the loss of forest land or conversion of forest land to non-forest use?				✓
e) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use?	✓			
III. AIR QUALITY:²⁹ -- Would the project:				
a) Conflict with or obstruct implementation of the applicable air quality plan?				✓
b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation?			✓	

²⁹ AIR QUALITY: Where available, the significance criteria established by the applicable air quality management or air pollution control district may be relied upon to make the following determinations.

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

-	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
c) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)?				✓
d) Expose sensitive receptors to substantial pollutant concentrations?				✓
e) Create objectionable odors affecting a substantial number of people?		✓		
IV. BIOLOGICAL RESOURCES -- Would the project:				
a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?		✓		

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

-	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations, or by the California Department of Fish and Wildlife or US Fish and Wildlife Service?		✓		
c) Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?		✓		
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?		✓		
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?		✓		

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

-	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?		✓		

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

-	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
V. CULTURAL RESOURCES AND TRIBAL CULTURAL RESOURCES -- Would the project:				
a) Cause a substantial adverse change in the significance of a historical resource as defined in §15064.5?		✓		
b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to §15064.5?		✓		
c) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?		✓		

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

-	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
d) Disturb any human remains, including those interred outside of formal cemeteries?		✓		
e) Would the project cause a substantial adverse change in the significance of a tribal cultural resource, defined in Public Resources Code section 21074 as either a site, feature, place, cultural landscape that is geographically defined in terms of the size and scope of the landscape, sacred place, or object with cultural value to a California Native American tribe, and that is:				
i) Listed or eligible for listing in the California Register of Historical Resources, or in a local register of historical resources as defined in Public Resources Code section 5020.1(k), or		✓		

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

-	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
ii) A resource determined by the lead agency, in its discretion and supported by substantial evidence, to be significant pursuant to criteria set forth in subdivision (c) of Public Resources Code Section 5024.1. In applying the criteria set forth in subdivision (c) of Public Resource Code Section 5024.1, the lead agency shall consider the significance of the resource to a California Native American tribe.		✓		
VI. GEOLOGY AND SOILS -- Would the project:				
a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:				
Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.		✓		
Strong seismic ground shaking?		✓		

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

-	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
Seismic-related ground failure, including liquefaction?		✓		
iv) Landslides?		✓		
b) Result in substantial soil erosion or the loss of topsoil?		✓		
c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?		✓		
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?		✓		
e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste- water disposal systems where sewers are not available for the disposal of waste water?		✓		
VII. GREENHOUSE GAS EMISSIONS -- Would the project:				

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

-	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
a) Generate Greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?		✓		
b) Conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases?				✓
VIII. HAZARDS AND HAZARDOUS MATERIALS -- Would the project:				
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?		✓		
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?		✓		

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

-	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?		✓		
d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?		✓		
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area?		✓		
f) For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area?		✓		
g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?				✓

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

-	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
h) Expose people or structures to a significant risk of loss injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?				✓
IX. HYDROLOGY AND WATER QUALITY -- Would the project:				
a) Violate any water quality standards or waste discharge requirements?		✓		
b) Substantially deplete ground water supplies or interfere substantially with ground water recharge such that there would be a net deficit in aquifer volume or a lowering of the local ground water table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?				✓
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site?		✓		

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

-	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
d) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site?		✓		
e) Create or contribute runoff water which would exceed the capacity of existing or planned storm water drainage systems or provide substantial additional sources of polluted runoff?		✓		
f) Otherwise substantially degrade water quality?		✓		
g) Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?				✓
h) Place within a 100-year flood hazard area structures which would impede or redirect flood flows?		✓		
Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam?				✓

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

-	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
j) Inundation by seiche, tsunami, or mudflow?				✓
X. LAND USE AND PLANNING -- Would the project:				
a) Physically divide an established community?				✓
b) Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?				✓
c) Conflict with any applicable habitat conservation plan or natural community conservation plan?				✓
XI. MINERAL RESOURCES -- Would the project:				
a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?				✓

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

-	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
b) Result in the loss of availability of a locally – important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan?				✓
XII. NOISE -- Would the project result in:				
a) Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?		✓		
b) Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?				✓
c) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?	✓			
d) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?		✓		

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

-	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?				✓
f) For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?				✓
XIII. POPULATION AND HOUSING -- Would the project:				
a) Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?	✓			
b) Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?		✓		

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

-	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
c) Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?		✓		
XIV. PUBLIC SERVICES				
a) Would the project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services:				
Fire protection?				✓
Police protection?				✓
Schools?				✓
Parks?				✓
Other public facilities?				✓

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

-	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
XV. RECREATION				
a) Would the project increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?			✓	
b) Does the project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment?				✓
XVI. TRANSPORTATION/TRAFFIC -- Would the project:				
a) Cause an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, the volume to capacity ratio on roads, or congestion at intersections)?			✓	
b) Exceed, either individually or cumulatively, a level of service standard established by the county congestion management agency for designated roads or highways?				✓

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

-	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
c) Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks?				✓
d) Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?				✓
e) Result in inadequate emergency access?				✓
f) Result in inadequate parking capacity?			✓	
g) Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks)?			✓	
XVII. UTILITIES AND SERVICE SYSTEMS -- Would the project:				
a) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?				✓

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

-	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
b) Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	✓			
c) Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?			✓	
d) Have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed?				✓
e) Result in a determination by the wastewater treatment provider which serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments?	✓			
f) Be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs?				✓

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

-	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
g) Comply with federal, state, and local statute and regulations related to solid waste?				✓
XVII. Wildfire				✓
XIX. MANDATORY FINDINGS OF SIGNIFICANCE				
a) Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?		✓		
b) Does the project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects)?	✓			

-	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
c) Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?	✓			

I. AESTHETICS

Would the project:

(a) – Have a substantial adverse effect on a scenic vista?

Answer: Less than significant.

The creation of buffer strips and vegetated swales may include planting of trees and shrubs. The addition of these types of vegetation to the landscape is generally regarded as having positive aesthetic effects. In some cases, the planting or retention of large woody vegetation could reduce visibility of an adjacent waterbody or of the surrounding landscape and therefore could alter the scenic vista. Although the creation of buffer strips and vegetated swales will modify the appearance of an area, the aesthetic effects are expected to be positive and will not likely result in a substantial adverse effect on the scenic vista and are considered less than significant.

(b) – Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?

(c) – Substantially degrade the existing visual character or quality of the site and its surroundings?

(d) – Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?

Answer: Less than significant with mitigation.

The changes to the visual character of a site due to the construction of wastewater treatment ponds and buildings associated with significantly expanded or new centralized or decentralized wastewater treatment facilities can be mitigated by building facility structures to house equipment and fences to provide a visual screen for

equipment and materials used in the everyday operations of the facility. Planting vegetation such as native trees, grasses, and wildflowers can provide a vegetative screen and result in an aesthetic that more closely reflects the surrounding landscape. Strategic siting of the facility structures on the landscape can also allow for the structures to be placed in locations that will have the least possible effect on the existing visual character of the surrounding area and allow them to avoid damaging scenic resources. Additionally, where scenic resources are identified at a site along a scenic highway, the use of standard construction techniques and sediment and erosion control practices would require revegetation and would not result in permanent alteration to the vegetation of scenic resources. The potential glare that could result from the construction of new wastewater treatment and effluent storage ponds could be mitigated by proper siting and the planting of vegetation screens around the ponds.

The construction of new restroom facilities at public beaches or other locations throughout the watershed could result in adverse aesthetic affects to the visual quality of the surroundings; however this effect can be mitigated through strategic siting of the restroom facility in a location that minimizes the effect on the visual character of the surrounding site. Additionally, the planting of trees, shrubs, and native plants can be used to screen the restroom from view and result in an aesthetic that more closely reflects the surrounding landscape. For restrooms constructed in urban locations, the selection of materials used to construct the exterior of the restroom should reflect the aesthetic and character of the surrounding location, which will allow it to blend it better with neighboring structures.

Increasing wastewater storage capacity, adding supplemental treatment to OWTS, composting biosolids, and installing pet waste collection systems, and garbage and recycling cans would result in less than significant impacts to the visual character and quality of the site and its surroundings. The enlarging of wastewater holding ponds would result in minimal changes from the existing baseline and therefore will have a less than significant impact on the visual character surrounding site. The composting of biosolids and addition of supplemental treatment to OWTS would result in minimal changes to the visual landscape as they can be housed in existing structures and the mechanisms to house supplemental treatment could even be placed underground with a cover for access. Pet waste collection systems are small and can be painted to blend with the surrounding environment. The presence of garbage and recycling cans will not substantially degrade the surrounding area and is expected to improve the aesthetics of the surroundings by preventing trash from being deposited on the ground.

II. AGRICULTURE AND FOREST RESOURCES

Would the project:

(a) – Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?

(b) – Conflict with existing zoning for agricultural use, or a Williamson Act contract?

(e) – Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use or conversion of forest land to nonforest use?

Answer: Potentially significant.

The creation of riparian buffers and exclusion of animals from riparian zones could cause incidental loss of agricultural use. These losses would affect only a very narrow band of land on either side of a watercourse. Additionally, some agricultural areas that are mapped as prime, unique or important may already have riparian buffers or exclusion fencing in place. Although there are many factors that affect this determination, it can be assumed that agricultural lands with a potential to discharge waste that contains pathogenic microorganisms to waters of the state and that implement riparian protection actions or compliance measures to comply with the Action Plan could be taking land out of production. While avoidance and minimization measures can be used to lessen impacts, and experience suggests that some modified management of riparian zones is often appropriate, there is no mitigation for loss of land where that occurs. Therefore, this is a potentially significant and unavoidable impact that cannot be reduced to a less than significant level with mitigation. The impact is overridden by project benefits as set forth in the SED.

(c) Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 12220(g)), timberland (as defined by Public Resources Code section 4526), or timberland zoned Timberland Production (as defined by Government Code section 51104(g))?

(d) Result in the loss of forest land or conversion of forest land to non-forest use?

Answer: No Impact.

None of the reasonably foreseeable structural or non-structural compliance measures will rezone or force the rezoning of Timberlands Production or result in the conversion of forested land to non-forested land. Therefore, there will be no impact on the classification or conversion of timberlands.

III. AIR QUALITY

Where available, the significance criteria established by the applicable air quality management or air pollution control district may be relied upon to make the following determinations.

Would the project:

- (a) – Conflict with or obstruct implementation of the applicable air quality plan?
- (c) – Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is not attainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)?
- (d) – Expose sensitive receptors to substantial pollutant concentrations?

Answer: No impact.

None of the structural or non-structural compliance measures would result in a violation of air quality plans, result in a cumulatively considerable increase in criteria pollutants, or expose sensitive receptors to substantial pollutant concentrations.

- (b) – Violate any air quality standard or contribute substantially to an existing or projected air quality violation?

Answer: Less than significant impact.

Construction activities can generate dust and combustion exhaust emissions that will be emitted into the atmosphere from construction equipment associated with wastewater treatment plant expansion and/or construction, treatment plant wastewater disinfection system upgrades, connecting OWTS to a centralized or decentralized wastewater treatment plant, adding supplemental treatment to OWTS, replacing or upgrading existing OWTS, increasing wastewater storage capacity, construction of new restroom facilities, creation of sand filters for storm water, sewer lateral replacement, and creation of green roofs and rain gardens. Air pollutants will be emitted from construction worker commutes. However, because of the temporary nature of construction activities, the proposed project is not likely to result in construction-related emissions that will result in significant impacts or require mitigation for any of the regionally significant pollutants.

- (e) – Create objectionable odors affecting a substantial number of people?

Answer: Less than significant with mitigation.

The repair and replacement of sewer laterals and upgrade, maintenance, and/or replacement of OWTS will decrease the potential for illicit discharges which would result in objectionable odors. Therefore, there would be no impact from those activities. The composting of biosolids can result in objectionable odors, however through the use of

indoor composting or the thoughtful siting and design of composting locations odors can be minimized. Other mechanisms that could be considered to mitigate composting odors include use of aeration and biofiltration, mixing with coarse dry bulking agents, and placing an aerobic biofilter layer over the biosolids. Therefore, the application of mitigation measures will result in less than significant impacts to air quality.

IV. BIOLOGICAL RESOURCES

Would the project:

- (a) – Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?
- (b) – Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations, or by the California Department of Fish and Game or US Fish and Wildlife Service?
- (c) – Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?
- (d) – Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?
- (e) – Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?
- (f) – Conflict with the provision of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?

Answer: Less than significant impact with mitigation.

There are numerous aquatic and terrestrial Federal and State listed endangered and threatened animals which are known to be present in the Russian River Watershed. Such species could potentially be adversely impacted by measures implemented to comply with the proposed Action Plan, if only temporarily. The location of sensitive species and habitat must be assessed on a project by project basis. When installing structural compliance measures that involve substantial earth moving or riparian restoration activities that have the potential to affect candidate, sensitive, or special status species, project proponents are required to consult with federal, state and local agencies, including but not limited to, the county, CDFW, North Coast Water Board, and

USFWS. Project proponents must ensure project actions avoid, minimize and/or mitigate for impacts to rare, threatened or endangered species.

Actions to limit the input of fecal indicator bacteria into water ways, such as riparian buffers, the use of straw waddles, and exclusion from riparian areas may conflict with the habitat requirements of certain flora or fauna and some could impede migration. Specific examples include non-native species out competing natives in constructed riparian buffers. Mitigation measures to reduce this potential impact include use of certified weed-free grass and project specific seed mixes to prevent the introduction of non-native or invasive species. Fencing can be selected that won't ensnare animals and migration corridors can be left to allow movement of fauna. Alternatively, rotational grazing practices and hotwire fences could be used where exclusionary fencing has the potential to affect wildlife and impede migration. The netting used in some straw waddles may ensnare small terrestrial fauna, and can be mitigated by the use of biodegradable, natural fiber netting. In most cases, impacts could be avoided by adjusting the timing and/or location of the actions to take into account candidate, sensitive, or special status species or their habitats. The process for designing, permitting, and implementing mitigation measures includes collaboration between North Coast Water Board staff and CDFW and USFWS staff to reach agreement on the most appropriate approach to protecting sensitive beneficial uses.

Construction activities may have a potential impact upon species identified as a candidate, sensitive, or special status, may conflict with a local policies or ordinances protecting biological resources, may fill federally protected wetlands as defined by Section 404 of the Clean Water Act, and may conflict with the provisions of an adopted Habitat Conservation Plan (HCP), Natural Community Conservation Plan (NCCP) or other approved local, regional, or state habitat conservation plan. Construction has the potential to cause adverse effects in several ways: filling of federally protected wetlands, short-term habitat destruction during construction, permanent displacement of sensitive species due to new structures, and, "take" of endangered species. It is likely that when an entity is choosing possible locations for the construction of a new centralized or decentralized wastewater treatment plant, new restroom, new sewer lines, or significant expansion of a wastewater treatment plant they would give preference to sites that did not fill federally protected wetlands or adversely affect biological resources. If a site containing endangered or threatened species was selected for new construction, the entity would be required to consult with federal, state, and local agencies to mitigate potential impacts. If a site were selected that would result in the fill of federally protected wetlands, the responsible party would be required to obtain a Clean Water Act (CWA) Section 404 permit from the Army Corps of Engineers and a CWA Section 401 Water Quality Certification from the North Coast Water Board. If a direct fill of a stream or wetland is absolutely necessary, then adequate compensatory mitigation in accordance

with federal and state regulatory programs will be required to replace the loss of functions and values in compliance with the State's No Net Loss Policy³⁰.

During project level construction activities to implement compliance measures, both structural and non-structural mitigation measures can be implemented to avoid, minimize or mitigate potentially significant impacts to sensitive species. Once a project plan is prepared and construction areas are delineated, measures must be implemented prior to and during construction to avoid, minimize, and mitigate impacts to sensitive animals and their habitat, and vegetation communities such as wetlands. For example, wetlands within 100 feet of any ground disturbance and construction-related activities (including staging and access roads) would be clearly marked and/or fenced to avoid impacts from construction equipment and vehicles. If new or temporary access roads are required, grading would be conducted such that existing hydrology would be maintained. In addition, water pollution control measures such as erosion control, sediment control, and waste management would be implemented to avoid and minimize potential water quality impacts from polluted storm water runoff to streams, wetlands and riparian areas. Other potential mitigation measures could include only constructing during the time of year where the species are not present or are at less vulnerable life stages or fencing off areas that contain sensitive species or their habitat so that they are not disturbed during construction.

Based on the information provided above and the variety of avoidance, minimization and mitigation measures available, the impacts to Biological Resources from compliance measures to address fecal indicator bacteria impairment are less than significant with mitigation incorporated.

V. CULTURAL RESOURCES AND TRIBAL CULTURAL RESOURCES

Would the project:

- (a) – Cause a substantial adverse change in the significance of a historical resource as defined in §15064.5?
- (b) – Cause a substantial adverse change in the significance of an archaeological resource pursuant to §15064.5?
- (c) – Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?

³⁶ Executive Order W-59-93

(d) – Disturb any human remains, including those interred outside of formal cemeteries?

(e) - Would the project cause a substantial adverse change in the significance of a tribal cultural resource, defined in Public Resources Code section 21074 as either a site, feature, place, cultural landscape that is geographically defined in terms of the size and scope of the landscape, sacred place, or object with cultural value to a California Native American tribe, and that is:

(i) Listed or eligible for listing in the California Register of Historical Resources, or in a local register of historical resources as defined in Public Resources Code section 5020.1(k), or

ii) A resource determined by the lead agency, in its discretion and supported by substantial evidence, to be significant pursuant to criteria set forth in subdivision (c) of Public Resources Code Section 5024.1. In applying the criteria set forth in subdivision (c) of Public Resource Code Section 5024.1, the lead agency shall consider the significance of the resource to a California Native American tribe.

Answer: Less than significant with mitigation.

For the majority of potential compliance measures, it is unlikely that their implementation will cause a substantial adverse change to cultural resources. Most of the reasonably foreseeable compliance measures will take place in areas that are already disturbed and are in highly urbanized areas, contain sewer laterals, septic systems, and/or other pipes. Implementation strategies that involve digging of a hole, such as for a fence post to contain livestock, may disturb previously unexcavated soil; however, the volume of soil excavated for post-holes is not significant and, therefore, does not pose a significant threat to cultural resources. Additionally, it is more probable that livestock owners will choose methods of compliance that are less costly than fencing a great length of ground, e.g. moving food and water sources away from riparian areas, which of course results in minimal excavation, if any. In the event cultural resources are discovered, implementation is not expected to have substantial adverse change in significance of the resources, destruction of unique cultural resources or sites with cultural value, or the disturbance of human remains. The digging of new fence post holes is a small-scale operation and the fence post could be relocated if cultural resources are found.

The Project is not expected to have a substantial adverse change in significance of tribal cultural resources. Strategic siting of facility structures or facility improvements on the landscape can allow for the structures to be placed in locations that will have the least possible effect on tribal cultural resources. Avoidance and preservation of the resource in place would minimize significant adverse impacts.

In cases where the installation of compliance measures may involve large scale excavations or earth disturbing activities, such as centralized or decentralized wastewater treatment plant construction, restroom construction, placing new sewer

lines, or expanding a wastewater treatment plant or pond, a cultural resources investigation should be conducted before any substantial disturbance. The cultural resources investigation will include, at a minimum, a records search for previously identified cultural resources, including sites, features, places, cultural landscapes, sacred places, and objects with cultural value pursuant to the California Register of Historical Resources or included in a local register of historical resources. Additionally, the lead agency will consider the impact of the project on tribal cultural resources and follow consultation requirements pursuant to Public Resources Code sections 21080.3.1, 21080.3.2, and 21082.3. Previously conducted cultural resources investigations of the project parcel and vicinity will also be identified and utilized.

Many activities required through the Action Plan rely upon permit compliance at existing facilities. However, projects such as centralized or decentralized wastewater treatment plant construction, restroom construction, placing new sewer lines, or expanding a wastewater treatment plant or pond may result from compliance needs and would be subject to site level CEQA analysis. In addition, the maintenance and/or installation of existing, new, or replacement OWTS, including OWTS needing repairs, may be subject to project-specific CEQA analysis that would address and mitigate potential adverse impacts to specific tribal cultural resources.

Mitigating indirect impacts would include compliance with state laws addressing tribal cultural resources as set forth in Public Resources Code §§ 21074, 5097.98, 5020.1(k), and 5024.1. While the regulations require consideration of a reasonable range of the factors, an examination of every site is not required. The statute specifically states that the SED is not required to present a project-level analysis. In most circumstances, the site-specific analysis will be required of the responsible party or the agency with jurisdiction when an activity that triggers site level CEQA analysis is conducted to meet requirements in the Action Plan.

All future actions must comply with the CEQA process and investigate, evaluate, and treat impacted significant cultural resources. A record search should be conducted that also includes contacting the appropriate information center of the California Historical Resources Information System, operated under the auspices of the California Office of Historic Preservation, and the relevant Regional Archaeological Information Center. In coordination with the information center or a qualified archaeologist, a determination regarding whether identified cultural resources will be affected by the proposed project must be made and if investigations were performed to satisfy the requirements of CEQA. If not, a cultural resources survey may need to be conducted. The purpose of this investigation would be to identify resources before they are affected by a proposed project and avoid the impact. If resources are identified, site-specific implementation will minimize impacts. This can include actions such as avoidance through relocation, changes in design, site capping and protection through barriers, fencing, and covering of the cultural resources. Taking into account tribal cultural values and meaning of the resource, other mitigation measures could include protecting the confidentiality of the

resource, protecting the cultural character and integrity of the resource, and its traditional use.

In addition, in the event that the ground disturbances uncover previously undiscovered or documented resources, California law protects Native American burials, skeletal remains, and associated grave goods regardless of the antiquity and provides for the sensitive treatment and disposition of those remains. (Health & Safety Code, Section 7050.5; Public Resource Code, Section 5097.9 et seq).

VI. GEOLOGY AND SOILS

Would the project:

(a) – Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:

i. Rupture of a known earthquake fault, as delineated on the most recent Alquist-

Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.

ii. Strong seismic ground shaking

iii. Seismic-related ground failure, including liquefaction?

iv. Landslides?

(b) – Result in substantial soil erosion or the loss of topsoil?

(c) – Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?

(d) – Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?

(e) – Have soils incapable of adequately supporting the use of septic tanks or alternative waste-water disposal systems where sewers are not available for the disposal of waste water?

Answer: Less than significant with mitigation.

It is possible that some soils in areas of the Russian River Watershed considered for the construction of new structures, including centralized or decentralized wastewater

treatment facilities, community OWTS, and restrooms, could be unstable, be located on expansive soil, or result in ruptured faults, seismic ground shaking, liquefaction, or landslides if construction were to occur on certain sites. The first step in preventing this possibility is to properly site such construction so as to avoid these potential outcomes.

If it were determined that construction would take place on a site with areas of unstable or expansive soils or in areas with fault zones, seismic shaking, or where liquefaction could occur it would be up to the project proponents to offer mitigation measures to reduce the impact to less than significant. Mitigation measures could include abstaining from constructing in areas with unsuitable or unstable geology, minimizing the disturbance of the areas of concern, anchoring the soils, adding structural piles, building a thicker foundation, deepening the footings of the foundation, and ensuring proper drainage so that rain-induced landslides do not occur. A site-specific CEQA evaluation would need to be completed for the project to outline any potential environmental effects. Additionally, a site-specific work plan and health and safety plan would be developed by a licensed geologist or engineer prior to implementation of the project. Such plans ensure conditions are assessed and impacts appropriately avoided prior to initiation of the project. The site manager must also be made aware of potential risks and management measures associated with any structures, soil instability, expansive soils, or other features associated with the unique nature of the project setting, with specific attention to potential risks to life or property and appropriate protections.

Construction activities may result in soil erosion of disturbed topsoil. Implementation of compliance measures such as expansion of restroom facilities, construction of centralized or decentralized wastewater treatment systems, green roofing, or wastewater storage ponds will result in temporary ground disturbances. These activities could result in erosion and sedimentation. However, construction related erosion impacts will be temporary and should cease with the cessation of construction activities. Standard best management practices (BMPs) to address erosion, sediment, and pollution prevention should be used during small-scale and large-scale construction activities to mitigate potential erosion issues. Facility pollution prevention plans should be developed to ensure that the correct BMPs are selected for the construction of wastewater treatment facilities, wastewater storage ponds, and of other treatment measures. For example, excavated soil should be covered or seeded prior to precipitation and replanted as soon as practicable to avoid contaminating storm water runoff and to prevent soil erosion. For construction activities that are greater than one acre, enrollment under the National Pollutant Discharge Elimination System (NPDES) construction storm water general permit will be necessary and the development of a storm water pollution prevention plan (SWPPP) required.

The proper implementation of mitigation measures, including those discussed above, will result in a less than significant impact to soil stability and erosion.

VII. GREENHOUSE GAS EMISSIONS

Would the project:

(a) Generate Greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?

Answer: Less than significant with mitigation.

Implementation of compliance measures at the project level could result in a temporary increase in greenhouse gases related to exhaust from equipment and vehicles used during construction activities. However, these emissions will be limited to a finite period of time and would result in less than significant impacts overall.

Greenhouse gases may be generated from wastewater treatment plant alterations or new construction, installation of new sewer lines, replacement of OWTS, and improvements, repair, and maintenance of OWTS, sewer laterals, and wastewater treatment facilities, as compared to the current baseline.

The daily operations of a new centralized or decentralized wastewater treatment plant, or significantly expanded plant, could result in increased greenhouse gas emissions as a result of greater power needs at the plant itself, as well as at lift stations to move a larger volume of waste. Possible mitigation measures include the use of ecofriendly power, including wind and solar power, and implementation of water and power conservation measures. Impacts associated with individual projects implemented to comply with the Action Plan will be evaluated for their potential to increase greenhouse gases by the parties responsible for implementing the compliance measures and appropriate mitigation implemented to reduce that potential.

(b) Conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases?

Answer: No Impact

All structural or non-structural implementation measures would need to be implemented in a manner consistent with plans, policies or regulations to reduce greenhouse gas emissions including those mentioned here. Any water quality control effort must be consistent with the State Water Board Resolution No. 2008-0030 which directs Water Board staffs to “require...climate change considerations, in all future policies, guidelines, and regulatory actions.” Also, the proposed project is intended to be implemented in a manner which conforms with the goals of the 2022 Scoping Plan for Achieving Carbon Neutrality (2022 Scoping Plan), the latest update to the Scoping Plan as required by Assembly Bill (AB) 32 (States, 2005, ch 488). The 2022 Scoping Plan lays out a path to achieve targets for carbon neutrality and reduce anthropogenic greenhouse gas emissions by 85 percent below 1990 levels no later than 2045, as directed by Assembly Bill 1279. AB 32 requires that greenhouse gas emissions be reduced to 1990 levels by 2020. This requirement relates to anthropogenic sources of greenhouse gases. In addition, the proposed project is also intended to be implemented

in a manner which conforms to Sonoma County's goal to reduce greenhouse gas emissions by 40% below 1990 levels by 2030 and 80% below 1990 levels by 2050 in the county.

VIII. HAZARDS AND HAZARDOUS MATERIALS

Would the project:

- (a) – Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?
- (b) – Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?
- (c) – Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?
- (d) – Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?
- (e) – For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area?
- (f) – For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area?

Answer: Less than significant with mitigation.

The existing regulatory baseline includes numerous federal, state and local laws regarding the designation, handling, transportation and disposal of hazardous substances. Nothing in the proposed TMDL Basin Plan amendment alters this existing regulatory baseline. However, the manner in which hazardous materials are handled and controlled can have environmental impacts as highlighted here.

Specifically, in any action involving chemicals or toxic pollutants, there is a potential for release of pollutants due to an accident or upset condition. The potential for such releases can be greatly reduced by proper planning. Measures to prevent releases of pollutants include such things as pollution prevention technology (e.g., automatic sensors and shut-off valves, pressure and vacuum relief valves, secondary containment, air pollution control devices, double walled tanks and piping), access restrictions, fire controls, emergency power supplies, contingency planning for potential

spills and releases, pollution prevention training and other types of mitigation measures. Before implementing structural compliance measures, it is important to consider site geology, hydrology, surrounding land uses and potential receptors, costs, and air quality control plans (including monitoring and contingency plans) if necessary.

Fuels, lubricating oils, and other petroleum products will be used during construction activities. Well established techniques for controlling spills, leaks, and drips should be incorporated in work plans, remedial action plans, treatment plans and site health and safety plans to assure the control of petroleum products and any other chemicals used during the cleanup activity. In order to mitigate the potential adverse effects, pollution prevention plans and waste management BMPs should be used in conjunction with the implementation of compliance measures.

Existing regulations require the proper storage, handling and use of these types of materials. In the event of an accident, responsible parties must comply with the requirements of the California Emergency Management Agency (CalEMA) Hazardous Materials Spill reporting process. Any significant release or threatened release of a hazardous material requires immediate reporting by the responsible person to the Cal EMA State Warning Center (800) 852-7550 and the Certified Unified Program Agency (CUPA) or 911.

The mitigation measures discussed above will likely reduce impacts to a less than significant level.

(g) – Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?

(h)– Expose people or structures to a significant risk of loss injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?

Answer: No Impact

Much of the Russian River valley includes rural residential dwellings and a loosely-defined urban/wildland boundary. The California Department of Forestry and Fire Protection (CalFire) has identified at least 3 communities in the Russian River valley as existing in a Very High Fire Hazard Severity Zone, including: Cloverdale, Santa Rosa, Ukiah. The proposed structural and non-structural compliance measures will not hinder emergency response plans or expose people or structures to wildfires above and beyond that which already exists as the baseline.

IX. HYDROLOGY AND WATER QUALITY

Would the project:

- (a) – Violate any water quality standards or waste discharge requirements?
- (c) – Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site?
- (d) – Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site?
- (e) – Create or contribute runoff water which would exceed the capacity of existing or planned storm water drainage systems or provide substantial additional sources of polluted runoff?
- (f) – Otherwise substantially degrade water quality?
- (h) – Place within a 100-year flood hazard area structures which would impede or redirect flood flows?

Answer: Less than significant impact with mitigation.

When replacing or repairing private sewer laterals and OWTS, and operating a centralized or decentralized wastewater treatment plant, it is possible that sewage could be released to surface waters and violate water quality standards and degrade water quality. Mitigation measures such as containment structures and absorption materials are available to reduce transfer of these substances to surface waters. Fuels, lubricating oils, and other petroleum products will be used during construction activities and could be accidentally discharged to surface waters. Well established techniques for controlling spills, leaks, and drips should be incorporated in work plans, remedial action plans, treatment plans and site health and safety plans to assure the control of petroleum products and any other chemicals used during the activity. In order to mitigate the potential adverse effects, pollution prevention plans and waste management BMPs should be used in conjunction with the implementation of permit compliance measures. Mitigation measures such as containment structures, absorption materials, and drip pans are available to reduce the transfer of these substances to surface waters. The possibility that composted biosolids could reach surface waters can be mitigated by siting compost piles away from water courses, covering the piles during storm events, using straw waddles around the piles to filter runoff, build storm water containment, and placing the piles indoors. Pet waste collection systems which provide plastic bags for pet waste cleanup, may cause violations of water quality standards if they are improperly discarded and enter waterbodies. This can be mitigated by providing waste receptacles near the pet waste collection systems to provide a location for people to place the used and unused bags.

Compliance measures related to construction activities could potentially cause an alteration of the existing drainage pattern of a site. In most cases however, these compliance measures would be installed with appropriately designed mitigation measures so as to limit any alteration of the existing drainage pattern, unless beneficial to the environment. In general, compliance measures could be constructed or installed without resulting in substantial erosion or siltation on- or offsite. For example, implementing BMPs such as using straw mulch and hydroseed on exposed areas, placing silt fencing and straw waddle to filter runoff, drip protection and vehicle cleaning for construction equipment, maintenance and site inspections are all methods that can be employed. Entities are commonly required to install and maintain erosion control measures (e.g. mulch, straw wattles, silt fencing) to prevent discharge of excess sediment from soil disturbing activities.

Construction of a new centralized or decentralized wastewater treatment plant, restroom facilities, or significant expansion of a wastewater treatment plant, may increase the amount of impervious surface and therefore could result in flooding or polluted runoff. Additionally, these structures may be placed within the 100-year flood hazard area. The possibility of flooding and polluted runoff can be mitigated through the use of Low Impact Development (LID). LID is utilized to infiltrate storm water and reduce changes in drainage patterns due to impervious surfaces and to filter storm water runoff. LID strategies integrate green space, native landscaping, natural hydrologic functions, and various other techniques to generate less runoff from developed land. Examples of LID that could be used are bio swales, green roofs, rain gardens, and sand filters.

(b) – Substantially deplete ground water supplies or interfere substantially with ground water recharge such that there would be a net deficit in aquifer volume or a lowering of the local ground water table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?

(g) – Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?

(i) – Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam?

(j) – Inundation by seiche, tsunami, or mudflow?

Answer: No impact.

The structural and non-structural reasonably foreseeable compliance measure identified would not deplete groundwater supplies and should not substantially increase the chances of risk of loss, injury, or death involving flooding, or increase the chance of tsunami or mudflow. No housing development is proposed as a result of this proposed Basin Plan amendment and therefore none will be placed within a 100-year flood hazard area or place housing in the 100-year flood plain.

X. LAND USE PLANNING

Would the project:

- (a) – Physically divide an established community?
- (b) – Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?
- (c) – Conflict with any applicable habitat conservation plan or natural community conservation plan?

Answer: No impact.

The reasonable foreseeable structural and non-structural compliance measures should not divide a community, conflict with land use, policy, or regulation of an agency with jurisdiction over the project, adopted for mitigation purposes, or conflict with any applicable habitat conservation plan or natural community conservation plan. All compliance measures would have to work within the existing regulatory baseline and comply with existing plans, policies, and regulations.

XI. MINERAL RESOURCES

Would the project:

- (a) – Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?
- (b) – Result in the loss of availability of a locally –important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan?

Answer: No impact.

None of the reasonably foreseeable structural or non-structural compliance measures would result in the loss of availability of a known mineral resource. Based upon a search of the internet in July 2015, including the California Geologic Survey website, water board staff did not find any evidence of current mineral mining practices taking place in the Russian River Watershed. Furthermore, reasonable foreseeable structural and non-structural compliance measures should not preclude the mining of mineral resources.

XII. NOISE

Would the project result in:

(a) – Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?

Answer: Less than significant with mitigation.

Temporary increases in noise levels would likely be associated with construction activities, including construction of structural compliance measures. Activities might include the use of heavy machinery and the movement of earth and debris, both of which can create noise and ground vibrations. Mitigation measures include the use of standard construction BMPs and operation of equipment according to a time schedule to prevent cumulative noise impacts resulting in further increased noise levels. The majority of the activities that would produce noise are not typically expected to exceed existing standards. Therefore, the temporary noise impacts from construction activities are considered less than significant with mitigation.

(b) – Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?

(e) – For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?

(f) – For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?

Answer: No impact.

None of the reasonably foreseeable structural or non-structural compliance measures would result in excessive noise levels. Groundborne vibration from construction would be at an extremely low level would be temporary and would not be notable above the existing baseline.

(c) – A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?

Answer: Potentially significant.

The every-day running of a new centralized or decentralized wastewater treatment plant may result in increased ambient noise levels above baseline levels for those within the project vicinity. To a large extent, these increases in noise may be mitigated by housing motors, pumps, generators, and other mechanisms that may make noise indoors. Additionally, sound walls and other sound barriers can be constructed if necessary to lessen the noise impacts of the running of the facility. A similar impact may result from

operation of supplemental treatment units for individual OWTS, where those prove necessary. Given that it may be impossible to minimize to less than significant all ambient noise impacts associated with the running of a wastewater treatment plant or supplemental treatment units for OWTS, the substantial permanent increase in ambient noise levels in the project vicinity may be a potentially significant impact that cannot be reduced to a less than significant level with mitigation. The impact is overridden by project benefits as set forth in the SED.

(d) – A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?

Answer: Less than significant with mitigation.

During construction activities there may be a brief period when the noise level is increased due to earth moving or construction machinery. Noise may also increase as a result of an increase in traffic due to installation of, or work on collection system lines under roadways. Temporary impacts can be mitigated to a less than significant level by implementing noise abatement procedures, for example, standard construction techniques such as sound barriers, mufflers, and restricted hours of operation. Appropriate mitigation measures should be evaluated on a case-by-case basis when specific projects are determined.

XIII. POPULATION AND HOUSING

Would the project:

(a) – Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?

Answer: Potentially significant.

The construction of a new centralized or decentralized wastewater treatment plant, or significant expansion of an existing plant, may have a potentially significant impact on population growth in the project area, as people who were considering constructing new homes but were not able to install OWTS due to space, soil, other limitations would potentially be able to connect their homes to the wastewater treatment plant. It is acknowledged that other services and infrastructure would need to be established before new development could occur, such as electric lines and roads, and therefore construction or expansion of a wastewater treatment plant would be one of several factors that may indirectly influence population growth. It is also possible that a new wastewater treatment plant or plant expansion could be done so it only served the existing population. All things considered, there may be potentially significant impacts from population growth associated with the construction or significant expansion of a wastewater treatment plant. These potentially significant impacts cannot be reduced to

a less than significant level with mitigation. The impact is overridden by project benefits as set forth in the SED.

(b) – Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?

Answer: Less than significant with mitigation.

Displacement of people from existing housing due to failing OWTS could be mitigated by connecting to a centralized or decentralized wastewater treatment plant, upgrading the OWTS to meet standards, or other efforts that would remedy the effects of the failing OWTS. A very limited number of systems may not be able to remedy their failing OWTS but the number is expected to be very low, will not necessitate the construction of replacement housing, and therefore does not rise to the level of significance.

(c) – Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?

Answer: Less than significant with mitigation

There is the potential that some properties will not have the site characteristics necessary to replace or repair failing OWTS with the risk of displacing people from those homes. There are a number of alternatives, however, to mitigate the risk including seeking a permit from the county for an alternative system, connection to a new or existing wastewater treatment system, connection to a new or existing community OWTS, or installation of other alternatives such as composting toilets and greywater systems. A very limited number of people may not be able to remedy their failing OWTS but the number is expected to be very low, will not necessitate the construction of replacement housing, and therefore does not rise to the level of significance.

XIV. PUBLIC SERVICES

(a) – Would the project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services:

- Fire protection?
- Police protection?
- Schools?
- Parks?
- Other public facilities?

Answer: No impact.

There are no reasonably foreseeable compliance measures that would cause environmental impacts, impeding acceptable service ratios and response times. Limiting parking near areas of the river without adequate restroom facilities would cause a negligible need for increased parking enforcement as compared to the existing baseline as the existing parking capacity at many areas along the river is already highly limited or is located on private property. Reasonably foreseeable compliance measures should not impede services. If roadway access is restricted due to construction equipment associated with the building of a restroom facility or if a roadway must be excavated for collection system maintenance, for example, access to and through that roadway for emergency vehicles should be maintained. Fences, if installed, will likely be constructed in areas that are not currently used as access for fire or police protection or that are not part of a park or school. If a fence is constructed at a park, it would likely surround the park and not impede its use as a park. Therefore, there would be no impact in terms of Public Services.

XV. RECREATION

(a) – Would the project increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?

Answer: Less than significant.

Publicizing the location of public beaches with restroom facilities and limiting parking near areas of the river without adequate restrooms would have a minimal impact on the existing public beaches and facilities compared to the existing baseline. The Russian River Watershed is currently a highly recreated area and the small increase in users at particular public beaches is not expected to cause substantial physical deterioration of the restroom facilities at those locations. Therefore, there would be a less than significant impact.

(b) – Does the project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment?

Answer: No impact.

Reasonably foreseeable compliance measures do not include the construction of recreational facilities. Thus, there will be no impact in terms of recreation.

XVI. TRANSPORTATION/TRAFFIC

Would the project:

(a) – Cause an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, the volume to capacity ratio on roads, or congestion at intersections)?

(f) – Result in inadequate parking capacity?

(g) – Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks)?

Answer: Less than significant impact.

During construction-related activities, there may be a brief period when traffic congestion will increase due to the presence of earth moving equipment and other construction equipment. Potential impacts would be temporary and less than significant because potential impacts could be reduced by limiting or restricting hours of construction so as to avoid peak traffic times and by providing temporary traffic signals and flagging to facilitate traffic movement. Additionally, a parking lot, street parking, or the alternate transportation infrastructure could potentially be temporarily blocked due to compliance measures that involve construction, particularly construction occurring in roadways and in urban areas. However, the blockage would be temporary and is likely negligible as compared to the existing traffic baseline. Therefore, these impacts would be less than significant.

(b) – Exceed, either individually or cumulatively, a level of service standard established by the county congestion management agency for designated roads or highways?

(c) – Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks?

(d) – Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?

(e) – Result in inadequate emergency access?

Answer: No impact.

None of the reasonably foreseeable structural or non-structural compliance measures will affect a level of service standard, air traffic patterns, increase hazards, or result in inadequate emergency access. Changes in traffic due to construction-related activities to install compliance measures should not exceed the service standard level established by the county as these types of activities currently occur, are part of the baseline, and the County's level of service standard should allow for the activities. There should be no change in air traffic patterns due to the reasonably foreseeable compliance measures. This is because the compliance measures in no way increase or decrease air traffic; and, structures should not be tall enough to have an effect on the

flight of an airplane. Traffic hazards will not substantially increase, as the reasonably foreseeable compliance measures do not require redesign of roads or incompatible uses. Reasonably foreseeable compliance measures should not impede emergency access and if roadways must be excavated for new sewer line installation or collection system maintenance, access to and through that roadway for emergency vehicles should be maintained. Fences will likely be constructed in areas that are not currently used as access for fire or police protection or that are not part of a park or school.

XVII. UTILITIES AND SERVICE SYSTEMS

Would the project:

(a) – Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?

Answer: No impact.

Any reasonably foreseeable compliance measure requiring compliance with wastewater treatment requirements of the North Coast North Coast Water Board, will be controlled via a permit adopted through a public process by the North Coast North Coast Water Board, and will include appropriate controls, limitations, and compliance schedules.

(b) – Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?

(e) – Result in a determination by the wastewater treatment provider which serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments?

Answer: Potentially significant.

The proposed Basin Plan Amendment could result in an existing wastewater treatment plant determining it doesn't have the capacity to serve the projects projected demand and thus result in the construction of a new centralized or community wastewater treatment plant or expansion of an existing plant or new, upgraded or replaced individual or community OWTS, as reasonably foreseeable compliance measures. The environmental effects associated with this type of construction, and of construction in general, have been discussed throughout this checklist, as appropriate. Potentially significant effects were identified and discussed in sections XI. Noise (c) and XII. Population and Housing (a). Any potentially significant adverse impacts that may result cannot be reduced to a less than significant level with mitigation. The impact is overridden by project benefits as set forth in the SED.

(c) – Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?

Answer: Less than significant.

Storm water infrastructure is already in place and it is not anticipated that large-scale construction will occur (such as a new subdivision). The expansion or construction of a new centralized or decentralized wastewater treatment facility will not result in significant environmental effects related to storm water drainage as storm water discharges from a wastewater treatment facility may be subject to NPDES industrial storm water general permit requirements that require protection of water quality and prevention of nuisance. Therefore, the effect will be less than significant.

(d) – Have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed?

(f) – Be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs?

(g) – Comply with federal, state, and local statutes and regulations related to solid waste?

Answer: No impact.

Reasonably foreseeable compliance measures should not require an increase in water supply. The solid waste from a new wastewater treatment plant, construction activities, or pet waste from collection receptacles is not expected to have any impact on landfills over current baseline conditions. Any actions related to solid waste must be in compliance with all existing federal, state, and local statutes and regulations related to solid waste. None of the reasonably foreseeable compliance measures would violate existing statutes and regulations.

XVIII. Wildfire

The Project is expected to have **no impact** on the exposure of people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands. The Action Plan focusses on sources of pathogens and would not affect the potential for wildland fires. Therefore, no impact from wildfires would result.

XIX. MANDATORY FINDINGS OF SIGNIFICANCE

(a) – Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?

Answer: Less than significant with mitigation.

Reasonably foreseeable non-structural compliance measures will not result in the substantial degradation of the environment for fish, wildlife, and threatened/rare plant and animal species because none of the measures would introduce any new physical effects above the baseline that could impact these characteristics.

Some of the reasonably foreseeable structural compliance measures, however, do have the potential to cause significant degradation of the environment for fish, wildlife, and threatened/rare plant and animal species if not mitigated. As discussed in section IV above, plant and animal species could potentially be adversely affected by construction related activities, creation of riparian buffers, installation of straw waddles, and by exclusion fencing. The mitigation measures discussed in that section, as well as others, could be implemented to ensure that unique, rare or endangered plant and/or animal species and their habitats are not taken or destroyed. When specific projects are developed and sites identified, a focused protocol plant and/or animal survey and/or a search of the California Natural Diversity Database should be performed to confirm that any potentially sensitive or special status plant and/or animal species in the site area are properly identified and protected as necessary. If sensitive plant and/or animal species occur on the project site, mitigation is required in accordance with the Endangered Species Act. Mitigation measures should be developed in consultation with CDFW and USFWS.

The adoption of the proposed Basin Plan amendment should result in improved surface water quality in the Russian River Watershed and will have a significant beneficial effect on the environment over the long-term. However, it should be noted that some of the structural compliance measures do have the potential to adversely impact the environment. In many cases, the impacts of the installation of the structural compliance measures will be temporary, and many of the effects caused by permanent structures can be avoided by adjusting the timing and/or location so as to take into account any candidate, sensitive, or special status species or their habitats. Therefore, with correctly implemented mitigation measures these impacts are considered less than significant.

(b) – Does the project have impacts that are individually limited, but cumulatively considerable? (“Cumulatively considerable” means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects)?

Answer: Potentially significant.

Cumulative impacts, defined in section 15355 of the California Code of Regulations, refer to two or more individual effects, that when considered together, are considerable or increase other environmental impacts. Cumulative impact assessment must consider not only the impacts of the proposed Basin Plan amendment, but also the impacts from other Basin Plan amendments, municipal and private projects which have occurred in the past, are presently occurring, and may occur in the future in the watershed during the period of implementation.

Impacts associated with implementation of the non-structural measures and most of the structural measures will be short-term, temporary, amenable to mitigation, and spatially distributed across the watershed, and will not contribute to significant adverse effects or cumulative impacts on the environment. However, structural compliance measures that involve substantial earth movement could have potentially significant cumulative impacts to traffic, greenhouse gas emissions, and noise when considered in conjunction with other past, present, and future construction; including but not limited to construction and repair of infrastructure (such as roads), housing construction, commercial construction activities, and restoration projects involving earth moving and construction equipment. North Coast Water Board staff's oversight of construction activities through permits, regulatory programs, and other authorities will provide an opportunity to limit the potential for cumulative impacts by ensuring that multiple projects proposing various compliance measures and implementation of BMPs with the potential to cause short-term impacts are phased appropriately to limit potential cumulative impacts.

Based on a review of the available information, and as a result of implementing various compliance measures including creating riparian buffers, exclusion fencing, construction and daily operations of a new wastewater treatment plant and expansion of an existing wastewater treatment plant, it has been determined that significant and unavoidable impacts to the environment have the potential to occur. Cumulative impacts are especially significant in areas that are already listed as impaired or otherwise degraded since the system or species has already lost resilience to external stressors. Due to the fact that many streams in the region are impaired/polluted and several rare, threatened and endangered are present throughout the region any adverse impact that has the potential to occur in multiple instances could be considered significant and unavoidable. Many of the potential impacts discussed throughout this CEQA analysis can be reduced through proper implementation of mitigation measures; however, cumulatively these impacts do have the potential for significant adverse effects on the environment that cannot be reduced to a less than significant level with mitigation. The impact is overridden by project benefits as set forth in the SED.

(c) – Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?

Answer: Potentially significant.

The purpose of the proposed Action Plan is to improve water quality conditions to protect human health as well as aquatic ecosystem health. Most of the potentially significant impacts to human beings, such as air quality, aesthetics, biological resources, greenhouse gas emissions, etc., are either short-term in nature, or can be mitigated to less than significant levels as previously discussed. However, some impacts were identified as being potentially significant including impacts to agricultural resources, noise levels, population growth, and utilities as detailed in those sections above. It is possible that when implemented at the project level, some of the reasonably foreseeable compliance measures identified as having potentially significant impacts could be mitigated so as to reduce the impacts to less than significant or that proposed projects could identify additional compliance measures that have less than significant impacts or impacts that can be mitigated. The overall effects of implementing the proposed Action Plan will be to improve water quality conditions and therefore are seen as a benefit for human beings and the environment. Any potentially significant environmental impacts that cannot be reduced to a less than significant level with mitigation are overridden by project benefits as set forth in the SED.

CHAPTER 12

ECONOMIC CONSIDERATIONS

12.1 OVERVIEW

This chapter describes the economic considerations associated with implementation of the Russian River Watershed Pathogen TMDL Action Plan (Action Plan). The triggers for North Coast Water Board consideration of economics or costs in basin planning include:

- Establishing water quality objectives that ensure the reasonable protection of beneficial uses.
- Compliance with the California Environmental Quality Act (CEQA)³¹ when North Coast Water Boards amend their basin plans. CEQA, and the regulations implementing CEQA, require that the Boards identify the reasonably foreseeable methods of compliance with draft performance standards and treatment requirements.³² This process must include discussion of economic factors.

Chapter 11 of this staff report (CEQA Substitute Environmental Analysis) discusses the potential environmental impacts, as required under CEQA, associated with adopting an amendment to the Water Quality Control Plan for the North Coast Region (Basin Plan) to include a Program of Implementation for the Russian River Watershed Pathogen TMDL, known as an Action Plan. Chapter 11 identifies the reasonably foreseeable compliance measures necessary to achieve compliance with the Action Plan. Compliance measures include treatment technologies and management practices most likely to be implemented to achieve compliance with load allocations, waste load allocations, numeric targets, and the water quality objectives for bacteria. There are no new water quality objectives proposed for adoption as part of the proposed Action Plan.

This chapter considers the potential costs of implementing the reasonably foreseeable compliance measures without considering whether compliance measures are currently part of the existing regulatory baseline. The costs are generally given as a range and are dependent on the specific characteristics of the land or operation to which given management practices are applied. A list of potential funding sources is also presented below.

For CEQA purposes, the economic and social impacts of the draft proposed project are considered to determine if they will cause or contribute to an adverse environmental impact, not whether the costs of the measures themselves are significant or will cause

³¹ Pub. Resources Code § 21159

³² Cal.Code Regs., tit., 23 § 3777 subdivision (b).

an economic hardship. Although the North Coast Water Board is required to consider economics during the Basin Plan amendment (Action Plan) process, it is not obligated to consider the balance of costs and benefits associated with implementation of the amendment.

Anticipating costs with precision is challenging for several reasons. Many of the actions, such as review, revision, and development of policies and ordinances by a governmental agency, could incur no significant costs beyond the program budgets of those agencies. However, other actions, such as establishing an ordinance to require property owners to inspect and repair their private sewer laterals carries discrete costs. Cost estimates are further complicated by the fact that some implementation actions are currently part of the baseline condition as they are already required by other regulatory requirements (e.g., NPDES Storm Water) or are actions anticipated regardless of Action Plan adoption. Therefore, assigning all these costs to implementation of the proposed Action Plan would be inaccurate.

While the below text discusses the cost of various control measures aimed at improving water quality, it does not discuss the effects (costs) of *not* improving water quality such as impacts to public health.

12.2 ESTIMATED COST OF COMPLIANCE

The majority of costs identified in this chapter were derived from the following sources of information:

- [U.S. Environmental Protection Agency \(USEPA\) Technology Fact Sheets](http://water.epa.gov/scitech/wastetech/mtbfact.cfm) (<http://water.epa.gov/scitech/wastetech/mtbfact.cfm>)
- [Water Environment Research Foundation \(WERF\). Performance & Cost of Decentralized Unit Processes. Final Report, 2010.](https://decentralizedwater.waterrf.org/documents/DEC2R08/DEC2R08web.pdf) (<https://decentralizedwater.waterrf.org/documents/DEC2R08/DEC2R08web.pdf>)
- [San Francisco Bay Regional Water Quality Control Board, Staff Report for Pathogens in the Napa River Watershed Total Maximum Daily Load \(TMDL\).](https://www.waterboards.ca.gov/rwqcb2/board_info/agendas/2006/November/8_ap_p_b.pdf) (https://www.waterboards.ca.gov/rwqcb2/board_info/agendas/2006/November/8_ap_p_b.pdf)
- [Federal Remediation Technologies Roundtable Screening Matrix and Reference Guide \(FRTR\)](https://frtr.gov/matrix/default.cfm) (<https://frtr.gov/matrix/default.cfm>)
- [Natural Resource Conservation Service \(NRCS\) Field Office Technical Guide \(FOTG\)](http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/fotg/) (<http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/fotg/>)
- [CDFW Coho Salmon Recovery Strategy](https://www.waterboards.ca.gov/water_issues/programs/tmdl/records/region_1/2010/ref3678.pdf) (https://www.waterboards.ca.gov/water_issues/programs/tmdl/records/region_1/2010/ref3678.pdf) and
- [California Department of Transportation \(Caltrans\) 2013 contract proposal award information](http://www.dot.ca.gov/hq/esc/oe/project_ads_addenda/) (http://www.dot.ca.gov/hq/esc/oe/project_ads_addenda/)
- Comment letters submitted by County of Sonoma

The cost information provided in the U.S. EPA guidance are available to assist the public and publicly owned treatment works, referred to here as wastewater treatment facilities (WWTFs), in understanding the necessary components and costs involved with implementing particular technologies. Many of the cost breakdowns are based on a variety of example sites throughout the county over the last two decades. Therefore, it can be generally assumed that these costs have increased with inflation, although some compliance measures have become more affordable as improvements in technologies are made. Generally, it can be assumed that labor rates will increase at a long-term average of three percent and capital cost inflation. The assumed potential cost ranges for compliance measures listed in the following tables will be at the long-term annual inflation rate of three percent assumed by the Engineering News Record (ENR) Construction Cost Index (CCI).

Cost ranges for construction and Operation and Maintenance (O&M) unit costs provided in the following tables are national averages and may not reflect actual construction costs for Sonoma County. Factors affecting the cost of construction in different areas of the county include: cost of transporting material and equipment to the project site, state and local taxes, construction wage requirements, labor supply, compliance with local codes, inflation, and managing local conditions such as weather and unusual soils. Cost indices to update old data and area modification factors to account for nationwide composite cost data are published by R.S. Means, Craftsman Book Company, and ENR, and others. Based on the 2015 National Building Cost Manual (Craftsman Book Company), the area modification factor for estimating total project costs for residential, commercial, industrial public, agricultural, and military buildings for the Santa Rosa area is six percent. Thus, a factor of 1.06 can be applied to each of the capital and O&M cost ranges in the tables below where a non-local figure is used. A detailed cost estimate for compliance measures is beyond the scope of this staff report.

The cost information provided in the NRCS FOTG is a national dataset to assist local NRCS Districts in setting cost shares for implementing conservation practices. Cost estimates are provided at the county level and the data used for this analysis are specific to Northern California as described in their Fiscal Year 2014 Payment Schedule. The FOTG represents the NRCS estimate of costs to implement such practices.

The costs included in the CDFG Manual are described as upslope erosion inventory and sediment control guidance. The numbers are based on estimates provided by Pacific Watershed Associates, a consulting firm specializing in erosion control work. Actual costs can vary considerably depending on operator skill and experience, equipment types, local site conditions, and regional location.

12.2.1 Potential Costs for Treatment Plant Upgrades at Existing WWTFs

12.2.1.1 Disinfection Improvements

All municipal wastewater treatment facilities within the Russian River Watershed are required to comply with effluent disinfection requirements contained in waste discharge requirements. No new capital costs are anticipated as a result of implementing the proposed Action Plan for WWTFs that are in compliance with effluent limitations for bacteria and disinfection requirements in their waste discharge permits. Permitted wastewater treatment facilities will incur increased costs associated with additional effluent and receiving water bacteria monitoring to demonstrate compliance with the proposed Action Plan. In particular, those facilities that discharge treated and disinfected effluent to a holding pond prior to discharge to a surface water, will be required to conduct a reasonable potential analysis during the process of renewing their NPDES permit to demonstrate that discharges of treated wastewater from holding ponds are not causing or contributing to an exceedance of the bacteria water quality objectives of the Russian River and its tributaries. The reasonable potential analysis may include an investigation to determine the concentrations of *E. coli*, total coliform bacteria, or other fecal indicator discharged from the holding pond, the sources of these contaminants (i.e., whether the sources are humans, domestic animals, or other), and whether the microbial contaminants discharged from the holding ponds pose a public health threat or impair the REC-1 beneficial use. The cost to conduct a reasonable potential analysis to assess compliance with the bacterial water quality objectives will vary depending on the scope of the investigation but may be expected to be in the hundreds of thousands of dollars for a detailed investigation involving microbial source tracking techniques.

In cases where a municipal wastewater treatment facility does not consistently meet bacteria effluent limitations in its waste discharge permit or cannot demonstrate that discharges from wastewater holding ponds are in compliance with wasteload allocations (WLAs), the municipality or special district may have to improve the reliability or upgrade its existing treatment facilities. It is anticipated that treatment systems consistent with disinfected tertiary treated water, as defined in title 22 of the California Code of Regulations, are the minimum acceptable processes that are capable of ensuring compliance with effluent limitations for bacteria, excluding consideration of the potential for bacterial regrowth in holding ponds. The costs for complying with effluent limitations for bacteria through improvements in wastewater disinfection systems include capital costs and cost for routine operations and maintenance and are presented in Table 12.1.

Table 12.1: Estimated Cost Range for Centralized Wastewater Treatment Compliance Measures Advanced Treatment and Disinfection

Compliance Measures	Capital Costs	Annual O&M Costs	Cost Source
Membrane Bioreactors	\$7.00-\$20.00 / gpd capacity	\$1.00-\$2.00 /gallons treated	USEPA ¹ , GWRMN
Chlorine Disinfection	1-2.5 mgd = \$1.1 to \$1.3 million 10-20 mgd = \$3.1 to \$4 million 100-175 mgd = \$14.3 to \$1.3 million	1-2.5 mgd = \$49K to \$76K 10-20 mgd = \$158K to \$380K 100-175 mgd = \$660K to \$1.3 million	USEPA ¹
Dechlorination	\$6,500 to \$383,000	\$9,900 to \$17,500 \$0.10 to \$10.00/1,000 gallons treated	USEPA ¹
Ultraviolet Light Disinfection	Lamps 1-5 mgd =\$400-\$1,375 5-10 mgd = \$345-\$595 19-100 mgd = \$275-\$590 Systems MGD (Design Flow) = \$300,000 MGD = \$250,000 10 MGD = \$1,000,000 100 MGD = \$7,000,000	\$19,200 MGD (Design Flow) = \$50,000 1.0 MGD = \$36,500 10 MGD = \$182,000 100 MGD = \$365,000	USEPA ¹

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Compliance Measures	Capital Costs	Annual O&M Costs	Cost Source
Ozone Disinfection	<p>Oxygen gas /compressor= \$245K</p> <p>Contact vessel (500 gpm)= \$4,000 - \$5,000</p> <p><u>Destruct unit:</u></p> <p>Small (around 30 cfm)= \$800</p> <p>Large (around 120)= \$1,000-1,200</p> <p>Non-component costs= \$35,000</p> <p>Engineering=\$12,000-15,000</p> <p>Contingencies= 30%</p>	<p>Labor= \$12,000</p> <p>Power= 90 kW</p> <p>Other (filter replacements, compressor oil, spare dielectric, etc.)= \$6,500</p>	USEPA ¹
Reverse Osmosis	\$776k to \$81 million / 1.0 to 200 mgd	USEPA ¹	
Wetland Treatment Systems	<p>\$155,000 to \$260,00 /100,000 gpd</p> <p>\$359,000 to \$1,015,009 /acre of wetland treatment system</p> <p>Operations and maintenance costs</p>	<p>\$5,00 to \$8,323 /acre per year</p> <p>\$0.45 to \$1.36 /1,000 gallons over 10 to 30 year timeframe</p>	FRTR, USEPA ³
Advanced Ecologically Engineered Systems	<p>40K gpd = \$985K to \$1.2 million</p> <p>80K gpd = \$1.5 to \$1.9 million</p> <p>1 million gpd = \$8.5 to \$10.5 million</p>		USEPA ¹

gpm – gallons per minute / mgd – million gallons per day / gpd – gallons per day/ cy – cubic yard / ft² – square foot / lb. – pound / ft- feet

OWTS – Onsite Wastewater Treatment System

SWRCB 1 – State Water Resources Control Board Onsite Wastewater Treatment System Policy Final SED June 19, 2012

FRTR – Federal Remediation Technologies Roundtable

GWRTAC – Groundwater Remediation Technologies Analysis Center, Technology Overview Report TO-97-03

[U.S. EPA 1 – US Environmental Protection Agency Technology Fact Sheets](http://water.epa.gov/scitech/wastetech/mtbfact.cfm)
(<http://water.epa.gov/scitech/wastetech/mtbfact.cfm>)

U.S. EPA 2 – US Environmental Protection Agency Technologies and Cost for Removal of Arsenic from Drinking Water

U.S. EPA 3 – US Environmental Protection Agency Technology Fact Sheet Free Surface Water Wetland & Constructed Wetland Treatment of Municipal Wastewaters

[GWRMN- Groundwater Remediation and Management for Nitrate Report – Addressing Nitrate in California's Drinking Water.](https://ucanr.edu/sites/groundwaternitrate/files/138956.pdf)
(<https://ucanr.edu/sites/groundwaternitrate/files/138956.pdf>)

12.2.1.2 Expansion of Collection, Treatment, and Disposal or Recycled Water Systems

To accommodate new connections, WWTFs may need to evaluate whether flow from new customers will require expansion of its wastewater collection, treatment and disposal systems. Wastewater collection costs are generally the largest component of costs for expansion of the complete system, but the cost of land purchase is often significant when land suitable for waste management functions is scarce and expensive. Cost estimates for expanding the wastewater collection system for new connections are highly variable depending on terrain and other site constraints, method of collection, and design flow. As part of a 2007 assessment by the City of Los Altos Hills in Santa Clara County, for example, it was estimated that a proposed extension of an existing municipal sewer line to 40 nearby residences would cost approximately \$1.5 million or \$37,500 per residence (Moody Sewer Extension), and another proposed extension to 57 residences would cost approximately \$1.01 million or \$17,720 per residence (Robleda Sewer Extension). In Sonoma County, the Sonoma County Water Agency (Sonoma Water) is developing a project for Larkfield Estates that would extend and make sewer service available to property owners that were impacted by a destructive wildfire in 2017. The affected parcels are located within an existing municipal sewer boundary but are currently served by individual OWTS. Sonoma Water estimated that construction costs for the sewer connections, including service laterals to the property

line, will cost between \$50,000 to \$55,000 per parcel. Connection fees for individual property owners, which would be due upon connection, would cost \$12,023 and the annual service charge is expected to be approximately \$900. These cost estimates for Larkfield Estates are based on extension of sewer to an area within an existing sewer district and reflect costs for a construction project that poses few technical challenges. Sewer extension to residential areas where there are technical challenges to traditional construction practices and options will likely cost considerably more.

Unit costs for expansion of baseline capacity for treatment unit processes to accommodate additional flow from new customers outside an established service area are highly variable and dependent on many factors and estimating the cost for such an expansion would require a project level evaluation beyond the scope of this staff report. Consequently, estimating the cost for possible construction costs for WWTF expansion scenarios would be speculative and inaccurate. The average operation and maintenance costs for wastewater treatment are generally lower for a facility that increases design volume. This is a result of an economy of scale for secondary and tertiary wastewater treatment systems.

In cases where a municipality or special district chooses to comply with Action Plan by expanding effluent storage so that the need to discharge to surface water is eliminated, the capital cost may include costs for land acquisition, permitting, pond excavation and earthwork, pond liner, pumping and pumping appurtenances, and electrical systems. The total cost of construction or expansion of effluent storage will vary greatly depending on site constraints, land availability, and level of public support. Two recent examples illustrate the range of costs: In 1999, the Russian River County Sanitation District (Guerneville, CA) evaluated a project to construct a 5.7 million gallon equalization basin to increase wastewater treatment capacity at its Guerneville Treatment Plant. Although the project was never completed, the estimated cost of the expansion was \$1.5 million. More recently, the Sonoma Valley County Sanitation District (Sonoma, CA) is proposing to construct a 37-million gallon recycled water storage reservoir to increase recycled water, reduce its discharge to Schell Slough and San Pablo Bay, and provide recycled water for irrigation purposes. Construction of the reservoir is expected to cost approximately \$2.3 million. Where discharge to a pond is designed to use percolation to groundwater as the method of disposal, costs associated with ongoing operation and maintenance, as well as groundwater monitoring will also apply.

To avoid Action Plan implementation requirements for storage pond discharges to surface waters, municipalities and special districts that treat municipal wastewater may also expand existing or implement new water recycling programs. Total capital costs will vary depending on site conditions, land acquisition requirements, and public support. As part of the 1999 WWTF evaluations, the Russian River County Sanitation District considered expansion of its treated wastewater disposal capacity. Among the alternatives evaluated was expansion of spray irrigation on the Burch Property, which is located adjacent to the Guerneville Treatment Plant and a portion of which is already

leased for spray irrigation of treated wastewater. This alternative was estimated to cost approximately \$4.0 million (including purchase of the Burch Property). Other alternatives for this project included extension of the pipelines and spray irrigation to Green Valley and to the Guerneville and Westside Road areas. These projects were estimated from \$6.5 to \$12 million and \$3 to \$12.5 million, respectively. Annual operation and maintenance costs for the Green Valley alternative was estimated from \$50,000 to \$350,000. Proper operation and maintenance include the cost of monitoring to ensure proper application. These projects were designed to use vegetative uptake as the primary mechanism for wastewater removal, depending on agronomic rates of wastewater application and may be considered typical for similar projects, for the purpose of this analysis.

12.2.2 Potential Cost for Sanitary Sewer Systems

Sanitary sewer systems greater than one mile in length within the Russian River Watershed are required under the existing General Permit for Sanitary Sewer Systems to be designed, operated, and maintained in such a way as to prevent or minimize sanitary sewer overflows. No new costs to prevent sanitary sewer overflows are anticipated as a result of the Action Plan. In the event that public entities which own sanitary sewer systems enact new ordinances or programs to require or promote private property owners to inspect their private sewer laterals, costs to develop the ordinances or programs will be incurred. The cost of developing and implementing a program will depend on the nature and complexity of the local program and are not estimated here.

12.2.3 Potential Costs for Individual and Decentralized Onsite Wastewater Treatment Systems

12.2.3.1 Individual OWTS Cost Considerations

As outlined in the Action Plan, certain existing, new, and replacement OWTS in the Russian River Watershed may be required to utilize supplemental treatment to achieve load allocations for fecal indicator bacteria. The necessary supplemental treatment components will vary depending on type and age of the existing OWTS, site conditions and constraints, the availability of and proximity to the individual OWTS to community sewer systems, and the availability of financial assistance to private property owners to fund OWTS upgrades. Table 12.2 presents cost estimates for new OWTS and for supplemental treatment components for new and replacement OWTS based upon available information from cited sources. The County of Sonoma estimates a large range of system types that may need to be installed given site constraints of each parcel; noting that, “some parcels could accommodate a code complaint system, some a substantially conforming system and others a septic tank and seepage pit (cesspool conversion). This results in a range of compliance costs. Going from least to most expensive, the cesspool conversion is estimated at \$15,000 and a code complaint system could range from \$50,000 for a standard system to \$100,000 for a mound system or drip system with treatment. Substantially conforming systems are somewhere

in between.”³³

Permit and design fees are an additional cost to construct an individual new or replacement OWTS and may add \$5,000 to \$15,000 to the capital and O&M costs, or more for complicated designs. Other site preparation costs, such as tree removal, are site specific, but can increase costs significantly.

In the absence of a TMDL, existing OWTS that do not meet requirements in the statewide Conditional Waiver of Waste Discharge Requirements or the conditions and requirements set forth in an approved LAMP may be required to submit a report of waste discharge, obtain waste discharge requirements, and pay an annual fee for their OWTS or provide to the North Coast Water Board information about the siting and design of their individual domestic waste disposal system. The cost of preparing a complete report of waste discharge will vary depending on whether the report will be prepared by the property owner or a qualified professional, how much information is available to characterize the discharge and site conditions, site conditions and constraints, and the proposed supplemental treatment. The cost for a general site evaluation to obtain local agency approvals for a new or replacement OWTS is approximately \$1,000. The cost for preparation of a report of waste discharge by a qualified professional could range from \$2,000 to \$6,000 (Ted Walker, personal communication). The cost of a site investigation performed by a qualified professional to prepare a report identifying the location and type of individual domestic wastewater disposal system is estimated to range from approximately \$1,000 to \$6,000, depending on the scope and complexity of the investigation. If the location and type of onsite OWTS are already known to the property owner, the cost to report this information is expected to be nominal. The application fee and first annual fee submitted to the North Coast Water Board for waste discharge requirements for a discharge with a threat to water quality and complexity rating of 3C, which is typical for low volume OWTS, is currently \$1,972.50 (Fiscal Year 2024- 2025) after the applicable 50 percent discount for domestic discharges with permitted flows less than 50,000 gallons per day.

³³ County of Sonoma, Comments on the Draft Staff Report and Draft Action Plan for the Russian River Pathogen Total Maximum Daily Load (Draft TMDL), May 8, 2025.

Table 12.2: Estimated Cost Range for Wastewater Treatment Compliance Measures Individual OWTS

Compliance Measures	Capital Costs	O&M Costs	Cost Source
Septic System for single home	Tank replacement: \$2,500 - \$4,500 Leachfield replacement: \$3,300 - \$7,400	\$44-\$400/yr	USEPA ¹ , EN ² , SWRCB ³
Septic System for single home	Whole new standard gravity OWTS: \$5,600-\$10,000	\$44-\$400/yr	USEPA ¹ , EN ² , SWRCB ³
Septic System for single home	With supplemental treatment: \$17,600 - \$45,000 ⁴	\$44-\$400/yr	USEPA ¹ , EN ² , SWRCB ³
Septic System for a Restaurant (approximately 200 meals per day)	Tank replacement: \$4,500 - \$13,800 Leachfield replacement: \$29,500 - \$66,000	\$44-\$400/yr	USEPA, EN, SWRCB
Septic System for a Restaurant (approximately 200 meals per day)	Whole new OWTS: \$34,000-\$80,000	\$44-\$400/yr	USEPA, EN, SWRCB
Septic System for a Restaurant (approximately 200 meals per day)	With supplemental treatment: \$104,000 - \$151,000	\$44-\$400/yr	USEPA, EN, SWRCB
Septic System for a School (Approximately 700 students)	Tank replacement: \$4,500 - \$13,000 Leachfield replacement: \$50,000 - \$200,000	\$44-\$400/yr	USEPA, EN, SWRCB

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Compliance Measures	Capital Costs	O&M Costs	Cost Source
Septic System for a School (Approximately 700 students)	Whole new OWTS \$55,600-\$212,000	\$44-\$400/yr	USEPA, EN, SWRCB
Septic System for a School (Approximately 700 students)	With supplemental treatment: \$104,000 - \$151,000	\$44-\$400/yr	USEPA, EN, SWRCB
Aerobic Pretreatment	500–1,500 gallon per day = \$2,500 to \$9,000	\$350/yr	USEPA
Chlorine Disinfection	\$325 - \$4,200 /unit	Tablets \$69-\$280 (45lb. pail)	USEPA
UV Disinfection	\$2,500 – 4,700/unit	Lamp Replacement: \$40-\$80 Power: 200-300 kWh/yr	USEPA Levernze ⁵
Control Panels	\$1,500 - \$3,000 /unit	-0-	USEPA
Septic Tank Effluent Screen	\$70 - \$300 per unit, not including installation	Minimal	USEPA

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Compliance Measures	Capital Costs	O&M Costs	Cost Source
Sand/Gravel Filters	<p>Range: \$4,000 - \$15,000</p> <p>1,500-gallon single compartment septic/pump tank @ \$0.57/gallon: \$850</p> <p>ISF complete equipment package</p> <p>(includes dual simplex panel, pump</p> <p>pkg., tank risers, lids, liner, lateral kit, orifice shields, etc.): \$3,200</p> <p>Non-component costs: \$750</p> <p>Engineering (soil evaluation, siting, design, and construction): \$2,000</p>	<p>Labor @ \$65/hr. (2 hrs./yr.)= \$130/yr</p> <p>Power @10 cents/kWh</p> <p>Sludge disposal=\$25/yr</p>	USEPA, EN
Low Pressure Pipe System	\$1,500 - \$5,000	<p>Distribution line and filter flushing: \$0</p> <p>Power: Variable depending on pumping rate, volume per dose pumped, and pump wattage.</p>	USEPA, EN

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Compliance Measures	Capital Costs	O&M Costs	Cost Source
Pressure Systems	\$4,000 - \$6,500	Distribution line and filter flushing: \$0 Power: Variable depending on pumping rate, volume per dose pumped, and pump wattage.	USEPA, EN
Mound Systems	\$12,000 to \$20,000	\$100/yr	USEPA, EN
Granular Activated Carbon Absorption	\$0.80 - \$6.30 /1,000 gallons treated	Carbon \$0.50 to \$1.20 /lb	USEPA
Replace/Upgrade Sewer laterals	Burst Pipe: \$40-\$80 per linear foot Sliplining: \$80-\$170 per linear foot Cured In Place Pipe: \$25-\$65 per linear foot Modified Cross Section: \$18-\$50 per linear foot	Overlaps with Capital Costs	USEPA
Composting Toilets	Household of four: \$1,200 - \$6,000 Seasonal Usage: \$700 - \$1,500 Large Capacity/ Public Facility: \$20,000	Electric (fan): 120 Wh/day Leachate disposal: variable Bulking agents: variable Compost Disposal: variable	USEPA

Compliance Measures	Capital Costs	O&M Costs	Cost Source
Incinerating Toilet	Electric: \$2,300 - \$2,700 Propane: \$2,550	Electric: \$2,748/yr Propane: \$383.60/yr	

¹ [U.S. EPA 1 – US Environmental Protection Agency Technology Fact Sheets](http://water.epa.gov/scitech/wastetech/mtbfact.cfm) (<http://water.epa.gov/scitech/wastetech/mtbfact.cfm>), [Decentralized Wastewater Systems Technology Fact Sheets](https://www.epa.gov/septic/decentralized-wastewater-systems-technology-fact-sheets) (<https://www.epa.gov/septic/decentralized-wastewater-systems-technology-fact-sheets>), [Water Efficiency Technology Fact Sheets](https://www.epa.gov/septic/water-efficiency-technology-fact-sheets) (<https://www.epa.gov/septic/water-efficiency-technology-fact-sheets>)

² [EN- Eco-Nomic Septic System design Page](https://eco-nomic.com/) (<https://eco-nomic.com/>)

³ SWRCB 1 – State Water Resources Control Board Onsite Wastewater Treatment System Policy Final Substitute Environmental Document June 19, 2012

⁴ Total costs for OWTS with supplemental treatment components and pressure-distributed effluent dispersal systems to mitigate for difficult sites can be considerably higher than this cost range.

⁵ [Leverenz, Harold, J. Darby, and G. Tchobanoglous, 2006. Evaluation of Disinfection Units for Onsite Wastewater Treatment Systems.](https://www.semanticscholar.org/paper/Evaluation-of-Disinfection-Units-for-Onsite-Systems-Leverenz-Darby/1482b5f8e8f290e903b8abed25d9bf60fbb21739) (<https://www.semanticscholar.org/paper/Evaluation-of-Disinfection-Units-for-Onsite-Systems-Leverenz-Darby/1482b5f8e8f290e903b8abed25d9bf60fbb21739>)

12.2.3.2 OWTS Upgrades in the APMP

The County of Sonoma conducted a cost analysis to assess the impact of potential OWTS upgrades and replacements that could be expected as a result of Action Plan implementation. The County estimates that 1,589 County parcels within the geographic area of the Advanced Protection Management Plan (APMP) will require upgrades to their OWTS to comply with the APMP. The County estimates that the total cumulative cost of implementing the APMP to County residents affected by the APMP is between \$24 million and \$160 million.³⁴

12.2.3.3 Community Cost Considerations

The County of Sonoma conducted a cost analysis to assess the impact of potential OWTS upgrades and replacements that could be expected as a result of Action Plan

³⁴ County of Sonoma, Comments on the Draft Staff Report and Draft Action Plan for the Russian River Pathogen Total Maximum Daily Load (Draft TMDL), May 8, 2025.

implementation. The County estimates that 2,100 County residents within the proposed geographic area of the Advanced Protection Management Plan (APMP) will require upgrades to their OWTS and another 1,400 residents will need to construct a new replacement OWTS to comply with the proposed APMP. The cumulative costs to affected OWTS owners is estimated by the County to be between \$31.5 million and \$42 million for OWTS owners who must upgrade and between \$49 million and \$70 million for construction of new replacement OWTS. The County also estimates a cumulative cost between \$870,000 and \$1.74 million for the 8,700 County residents now required by the APMP to inspect their OWTS once every five years. The County estimates that the total cumulative cost of implementing the APMP to County residents affected by the APMP is between \$81 million and \$114 million.

12.2.3.4 Decentralized OWTS Cost Considerations

An alternative for some small communities, where neither individual OWTS nor connection to an existing centralized municipal sewer system work well, is the establishment of a decentralized onsite waste treatment and disposal system. There is a range of available collection, treatment, and effluent dispersal technologies for a community-owned decentralized OWTS that may be used individually or in combination. Cost estimates for individual property owners to connect to a community-owned decentralized OWTS via a local sewer system (not including connection fees or other related costs) are presented in Table 12.3. Table 12.4 presents estimates for the cost of operating a decentralized OWTS, based on common technologies for waste flows ranging from 5,000 to 50,000 gpd.

Table 12.3: Estimated Cost Range for Wastewater Treatment Compliance Measures Decentralized OWTS – Cost to Property Owner

Compliance Measures	Capital Costs for building sewer and connection to sewer main	Annual O&M Costs	Cost Source
Private Laterals	\$20-\$30/ft (excluding surface restoration) \$50-\$100/ft (for paved streets)	Electricity: \$0 O&M: \$0	CCCSD ¹
Gravity Sewer Systems	Materials and Installation: \$1,800 - \$2,700	Electricity: \$0 O&M: \$16 - \$24	WERF ²

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Compliance Measures	Capital Costs for building sewer and connection to sewer main	Annual O&M Costs	Cost Source
Pressure Sewer Systems	Materials and Installation: \$4,800 - \$7,200	Electricity: \$44 - \$66 O&M: \$120 - \$240	WERF
Effluent (STEP) Sewer Systems	Materials and Installation: \$3,000 - \$5,000	Electricity: \$24 - \$36 O&M: \$56 - \$84	WERF

¹ [Central Contra Costa County Sanitary District \(CCCSO\) website](https://www.centrsan.org/)
(<https://www.centrsan.org/>)

² Water Environment Research Foundation (WERF). Performance & Cost of Decentralized Unit Processes. Final Report, 2010.

Table 12.4: Estimated Cost Range for Wastewater Treatment Compliance Measures Decentralized OWTS – Cost to Wastewater Utility

Compliance Measures	Cost Factors	Wastewater Volume 5,000 gpd (or 20 homes)	Wastewater Volume 10,000 gpd (or 40 homes)	Wastewater Volume 50,000 gpd (or 200 homes)
Gravity Sewers	Materials and Installation	\$210,000-\$315,000	\$419,000-\$629,000	\$2,182,000-\$3,273,000
	Annual O&M	\$6,400-\$9,600	\$12,800-\$19,200	\$65,000-\$97,000
Pressure Sewers	Materials and Installation	\$33,000-\$49,000	\$65,000-\$98,000	\$344,000-\$516,000
	Annual O&M	\$6,400-\$9,600	\$13,000-\$19,000	\$56,000-\$84,000

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Compliance Measures	Cost Factors	Wastewater Volume 5,000 gpd (or 20 homes)	Wastewater Volume 10,000 gpd (or 40 homes)	Wastewater Volume 50,000 gpd (or 200 homes)
Effluent Sewers	Materials and Installation	\$32,000-\$48,000	\$65,000-\$97,000	\$340,000-\$510,000
	Annual O&M	\$6,000-\$9,000	\$12,000-\$18,000	\$61,000-\$91,000
Extended Aeration	Materials and Installation	\$100,000-\$150,000	\$148,000-\$223,000	\$410,000-\$616,000
	Annual Electrical	\$900-\$1,400	\$1,800-\$2,700	\$9,000-\$14,000
	Annual O&M	\$5,300-\$8,000	\$9,000-\$13,000	\$34,000-\$51,000
Fixed-growth Media Filter	Materials and Installation	\$30,000-\$46,000	\$98,000-\$147,000	\$287,000-\$431,000
	Annual Electrical	\$350-\$500	\$900-\$1,400	\$4,600-\$6,900
	Annual O&M	\$4,100-\$6,000	\$7,300-\$11,000	\$30,000-\$44,000
Wastewater Lagoons	Materials and Installation	\$314,000-\$471,000	\$628,000-\$942,000	\$3,141,000-\$4,711,000
	Annual Electrical	-0-	-0-	-0-
	Annual O&M	\$2,400-\$3,500	\$4,700-\$7,100	\$24,000-\$35,000
Chlorine Disinfection	Materials and Installation	\$3,100-\$5,400	\$3,100-\$5,400	\$3,100-\$5,400
	Annual Electrical	\$40-\$50	\$50-\$80	\$3,100-\$4,700
	Annual O&M	\$900-\$1,400	\$1,700-\$2,500	\$7,900-\$12,000

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Compliance Measures	Cost Factors	Wastewater Volume	Wastewater Volume	Wastewater Volume
		5,000 gpd (or 20 homes)	10,000 gpd (or 40 homes)	50,000 gpd (or 200 homes)
UV Disinfection	Materials and Installation	\$1,700-\$2,500	\$2,300-\$3,400	\$5,200-\$7,800
	Annual Electrical	\$14-\$20	\$28-\$40	\$130-\$190
	Annual O&M	\$480-\$720	\$700-\$1,100	\$2,600-\$3,900
Gravity Distribution	Materials and Installation	\$54,000-\$81,000	\$105,000-\$158,000	\$517,000-\$776,000
	Annual Electrical	\$80-\$120	\$160-\$230	\$750-\$1,100
	Annual O&M	\$2,300-\$3,400	\$4,400-\$6,600	\$21,000-\$31,500
Drip Distribution	Materials and Installation	\$37,000-\$56,000	\$85,000-\$127,000	\$329,000-\$494,000
	Annual Electrical	\$240-\$360	\$480-\$720	\$2,400-\$3,600
	Annual O&M	\$3,300-\$5,000	\$6,900-\$10,000	\$31,000-\$47,000
Spray Distribution	Materials and Installation	\$138,000-\$206,000	\$265,000-\$397,000	\$1,260,000-1,890,000
	Annual Electrical	\$240-\$360	\$460-\$690	\$2,300-\$3,500
	Annual O&M	\$2,200-\$3,400	\$4,300-\$6,500	\$21,000-\$31,000

¹ Water Environment Research Foundation (WERF). Performance & Cost of Decentralized Unit Processes. Final Report, 2010.

12.3.2.5 Local Oversight Agency Costs

As described in Chapter 6 (Source Analysis), Section 6.4.7 (Onsite Waste Treatment Systems), effective pathogen removal in OWTS is dependent on proper siting and installation of the OWTS components, proper maintenance, and operation of the system

within design specifications. Local agencies have been performing OWTS design review and approval for decades. According to the well and septic fees adopted by Sonoma County for the 2015/2016 fiscal year, inspections and field clearance reports range from \$400-\$1,100 per inspection/plan check. For existing OWTS requiring certification, the cost of a qualified contractor to perform the inspection and generate a report could range from \$350 to \$1,500.

As a general rule, the local agencies that issue a building permit are often the same entities that oversee the installation and construction of most of the OWTS, as well. In many cases, local agencies have worked with their respective North Coast Water Boards to integrate the necessary OWTS-related requirements into the building permit process, allowing one permitting and inspection agency to oversee both programs. Estimating the cost associated complying with the OWTS-related requirements of a building permit, is difficult and speculative, given the combined requirements.

Tier 2 of the Basin Plan's OWTS Policy is written to allow variability in local programs while retaining comparable standards to maintain the function of OWTS for the purpose of protecting the environment and human health through institutional controls and management. This is achieved by requiring North Coast Water Board approval of a Local Agency Management Plan (LAMP) developed under Tier 2 of the Basin Plan's OWTS Policy. Conceptually, Tier 2 Programs (approved LAMPs) will include varying degrees of change to the local programs and practices currently in place. An OWTS managed under an approved LAMP may be allowed a variety of technological designs for both the wastewater treatment and effluent dispersal system. The selection of the technology would be made to accommodate site constraints, in order to ensure that the design provides adequate protection given the site's slope, groundwater level, soil conditions, topographic location, and other natural barriers to effective treatment.

There may be additional cost to the local agencies for developing and administering a local agency management program (LAMP). Additional costs will depend on the extent to which the existing programs and practices require upgrading to meet the goals and requirements of the Basin Plan's OWTS policy. It is expected that some or all of any such additional costs will be passed on to the owners of OWTS in the form of permit fees.

Tier 3 of the Basin Plan's OWTS Policy applies to new and replacement OWTS that are near waterbodies listed as impaired/polluted for pathogens or nitrogen on the CWA 303(d) list and where it is likely that operating OWTS will be determined to be a contributing source of the impairment. Tier 3 may also apply to existing OWTS when addressed by a TMDL program of implementation or special provision in an approved LAMP. Tier 3 OWTS are regulated in accordance with an Advanced Protection Management Program (APMP) when a TMDL Implementation Plan (Action Plan) addressing the impairment(s) has been adopted by the North Coast Water Board. The cost to a local agency for implementing requirements in an adopted Action Plan will depend on the extent to which the local agency assumes responsibility for

implementation actions for existing OWTS.

Tier 4 of the Basin Plan's OWTS Policy requires that OWTS owners replace their failing OWTS (e.g. collapsed septic tank, overflowing leachfield) with a new component that will operate correctly and in compliance with conditions and requirements of the OWTS Policy. Replacement components (e.g. septic tank or drainfield) may have to be upgraded consistent with the Action Plan and the repair policy of the local agency. (See Tables 12.2 and 12.3 for costs associated with individual OWTS)

12.2.4 Potential Costs of Addressing Homeless and Farmworker Encampments, and Recreational Water Use

12.2.4.1 Homeless Encampments and Illegal Camping

In accordance with a Memorandum of Understanding (MOU), Sonoma County, the Sonoma County Community Development Commission and the North Coast Water Board will implement a Joint Protocol to address water quality impacts associated to homeless encampments. It is anticipated that for the control of waste discharges from homeless and farmworker encampments the signatories to the MOU will employ a combination of non-structural and structural BMPs. Non-structural BMPs include community outreach and public information to reduce the homeless population within the Russian River Watershed, thereby reducing the need for the formation of encampments. Many of these efforts are voluntary and are already in development or underway in both Mendocino County and Sonoma County. Cost estimates for these initiatives are not considered as part of this staff report. Structural BMPs could include construction of permanent restroom facilities or installation of temporary mobile restroom facilities that are accessible to homeless individuals.

Cost estimates for the construction of public restroom facilities is presented in Table 12.5 and are based on nationwide case studies in conjunction with a local project in the community Guerneville in Sonoma County. These costs also apply to the construction of public restroom facilities at recreational beaches and trailheads in close proximity to the Russian River and its tributaries. Other costs associated with the operation of public toilets include costs for cleaning, maintenance, security, insurance, and other operating costs such as repair costs for graffiti and vandalism. Annual cleaning and maintenance costs for one popular, low-maintenance restroom model, the Portland Loo, which must connect to public sewer, run approximately \$21,000 per station. Costs may be considerably higher for other models depending on restroom type, location, level of use, and desired level of cleanliness. For models where a daily attendant is required, annual costs per station may be as high as \$100,000.

12.2.4.2 Recreational Water Use

In accordance with a Memorandum of Understanding, Sonoma County, the Sonoma County CDC, and the North Coast Water Board will work with local entities and private parties along the Russian River to address water quality impacts relative to recreational

water uses, and to promote the installation and location of sanitary facilities along the Russian River for use by recreational water users. It is anticipated that increasing the availability and access to restroom facilities at places of significant recreational use will result in a significant reduction in pathogen waste entering surface waters from recreational water use.

Table 12.5 provides estimates of the cost for construction of restroom facilities. In addition, cities, counties, and special districts may limit the availability of public parking near places of recreational water use, so as to accommodate only as many recreational water users as the facilities can safely support. Estimating costs for these site-specific measures are difficult to determine with the existing baseline of parking and trespassing enforcement during the peak tourism season. Additionally, minor cost may be incurred for posting additional signage informing recreators of such facility limits.

Table 12.5: Estimated Cost for Construction of Public Restroom Facilities

Location/Manufacturer	(1) Room	(2) Room	(4) Room	(6) Room	Source
Salt Lake City 1700 South River Park	N/A	N/A	158,264	N/A	1
Roseburg, OR ROMTEC, Inc.	82,571	N/A	149,293	204,523	1
Spokane, WA CXT Concrete Buildings	78,614	N/A	199,370	127,030	1
LeGrange, KY Hunter Knepshield Co.	93,702	N/A	181,266	222,047	1
Reno, NV Restroom Facilities Ltd	148,460	N/A	351,483	491,646	1
Reno, NV Public Restroom Co.	117,281	N/A	205,111	247,378	1
Portland, OR Portland Loo	156,000	N/A	N/A	N/A	1

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Location/Manufacturer	(1) Room	(2) Room	(4) Room	(6) Room	Source
Salt Lake City American Ready Kontainer	N/A	N/A	217,750	N/A	1
Guerneville, CA	N/A	250,000	N/A	N/A	
Durham, NC	N/A	165- 200,000	N/A	N/A	2
Range	\$78- 156,000	\$165- 250,000	\$150- 351,000	\$127- 492,000	

N/A – Not Available

¹ Staff report to City Council, Salt Lake City, “Cost of Building Public Restrooms.”(Jan 15, 2013)

² “Going Public: An Assessment of Restroom Facilities in City of Durham Parks” (Jan 15, 2014)

12.2.5 Potential Costs to Control Urban Storm Water Runoff

12.2.5.1 Local Agency Program Costs

As described in Chapter 6 (Source Analysis) Section 6.3.2 (Storm Water), urban storm water runoff and non-storm water runoff from MS4s³⁵ located in urban areas within the Russian River Watershed are regulated under conditions in the Phase I MS4 Permit for the County of Sonoma, City of Cloverdale, City of Cotati, City of Healdsburg, City of Rohnert Park, City of Santa Rosa, City of Sebastopol, Sonoma County Water Agency, City of Ukiah, and the Town of Windsor. Under terms of the Phase I MS4 Permit, permittees are required to develop and implement a Storm Water Management Plan and Monitoring Program that identifies tasks and programs to reduce the discharge of pollutants in storm water to the maximum extent practicable in a manner designed to achieve compliance with water quality standards and objectives. The Storm Water Management Plan and Monitoring Program includes ongoing costs for operations and maintenance, inspections, enforcement, staff training, public education and outreach, illicit connections and discharges response and abatement, and effectiveness

³⁵ Municipal Separate Storm Sewer System (MS4) is a conveyance or system of conveyances owned by a public entity and designed for collecting and conveying storm water, including roads, drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains.

monitoring. The costs for implementing the Storm Water Management Plan and Monitoring Program are baseline program costs and will be incurred by MS4 Permittees with or without additional, incremental costs associated with a specific program to control fecal indicator bacteria.

The Program of Implementation for the control of urban storm water and non-storm water runoff requires the MS4 Permittees to develop and implement BMPs to reduce the levels of pathogens in storm water discharged to surface waters. It is anticipated that MS4 Permittees will develop specific structural and/or nonstructural BMPs to control the sources of bacteria within the MS4 boundary. Potential control measures are unknown at this time. However, in the California Regional Water Quality Control Board, San Francisco Bay Region's *Pathogens in the Napa River Watershed Total Maximum Daily Load*, it was estimated that additional pathogen-specific measures for Napa County would result in a two to 15 percent increase to the annual MS4 program budget based on information for a similar MS4 program in Marin County. Using this estimate, staff estimates a range of incremental costs of implementing MS4 bacteria-control measures between a two percent annual increase (minimum) and a 15 percent annual increase (maximum). As an example of potential added costs for two MS4 Permittees in the Russian River Watershed, the cost calculations for the City of Santa Rosa and the County of Sonoma are shown in Table 12.6. Staff expects that MS4 Permittees that are already addressing fecal indicator bacteria issues would fall at the low end of incremental cost increases.

Other structural controls, including exclusionary structures to discourage uncontrolled public access and the formation of homeless encampments are also potential costs for MS4s or other entities where limiting public access is a feasible implementation action. The cost for exclusionary fencing for bridge abutments for MS4 Permittees is expected to be similar to costs estimates for Caltrans discussed in section 12.2.5.2. Potential costs for purchasing and installing exclusionary or safety fencing for operators of transportation corridors are likely much higher, depending on the type and length of fence needed.

Table 12.6: Estimated Cost Range for Incremental Costs for Bacteria Control Measures Municipal Separate Storm Sewer Systems (MS4s) Hydrologic Subarea Crosswalk

	Annual Program Cost	2% Incremental Cost Increase associated with Bacteria Control Program	15% Incremental Cost Increase associated with Bacteria Control Program
Santa Rosa (FY 13/14) ¹	\$1,983,913	\$39,678	\$297,587

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Santa Rosa (FY 14/15, est.) ¹	\$2,251,609	\$45,032	\$337,741
Sonoma County (FY 13/14) ²	\$775,949	\$15,519	\$116,392

¹ City of Santa Rosa, December 2014. City of Santa Rosa's 2013-2014 Annual Report of Compliance with Order No. R1-2009-0050

² County of Sonoma, December 2014. NPDES Phase I Annual Report: July 1, 2013 – June 30, 2014, Term 3, Year Five

12.2.5.2 Costs for Storm Water Controls for Caltrans

In the North Coast Region (Caltrans District 4), BMPs installed to comply with Caltrans' statewide NPDES Permit conditions currently are focused on activities to prevent and minimize erosion and sediment discharges from Caltrans right-of-way. Effective erosion control will reduce the migration of pollutants, including human pathogens and fecal indicator bacteria, to surface waters.

Proactive bridge design is a cost-effective method to prevent the creation of tempting encampment sites for homeless persons. For retrofitting existing bridge underpasses, security fencing and other exclusionary structures are effective BMP to discourage the formation of homeless encampments under bridges within the Caltrans right-of-way. As an example of potential costs, in 2014, the City of Santa Rosa installed exclusion structures designed to exclude access to flat areas at the base of old bridge abutments that have been used for camping at three road crossings within the Russian River Watershed. The cost estimate for the project was \$38,960, plus \$1,170 for inspection of the three sites. In Pennsylvania, the Pennsylvania Department of Transportation spent an average of \$24,000 per location to fences bridges and highway ramps to deter homeless. Based on available information, the cost estimate per location for exclusionary fencing is from \$13,000 to \$24,000, depending on site conditions.

12.2.5.3 General Storm Water Compliance Measures Costs

Structural controls for nonpoint sources divert, store, treat, and/or infiltrate storm water to prevent the discharge of waste material to the river with storm water runoff. Structural controls for point sources can be implemented to treat waste before discharge and/or prevent the direct discharge of waste into a waterbody, as highlighted in Table 12.7.

**Table 12.7: Estimated Costs of Reasonably Foreseeable Compliance Measures
Associated with Storm Water Control**

Reasonably Foreseeable Compliance Measure	Practice Name	Range of Practice Costs	NRCS Practice Code or Source
Sediment/Bacteria Controls	Fiber roll / Straw Wattle	\$1.20- 20.00/Lft	Home Depot/ Caltrans 2013
Sediment/Bacteria Controls	Sand Filters	\$6,000 -\$18,500 /acre	U.S. EPA
Bioretention	Green Roofs, Rain Gardens, vegetated strips, and bioswales	\$500-\$7,000/per unit	U.S. EPA

12.2.6 Potential Costs for Owners of Non-Dairy Livestock and Farm Animals

Activities associated with raising, feeding, and maintaining non-dairy livestock and farm animals occur throughout the North Coast Region both on private and public lands. Best management practices are recommended to prevent the migration of animal waste to surface waters. Estimates of potential cost to the grazing community are derived from NRCS Fiscal Year 2013 Payment Schedule, as depicted in Table 12.8.

**Table 12.8 Estimated Cost Range for Incremental Costs for Bacteria Control
Measures Owners of Non-dairy Livestock and Farm Animals**

Reasonably Foreseeable Compliance Measure	Practice Name	Range of Practice Costs	NRCS Practice Code or Source
Use Exclusion	Forage exclusion	\$0.64- \$1.32/ft	#472
Vegetated filter strips	Filter strip	\$210- \$448/acre	#393

Reasonably Foreseeable Compliance Measure	Practice Name	Range of Practice Costs	NRCS Practice Code or Source
Stream buffer areas/Field borders	Field Borders: Riparian tree & shrub establishment; Non-native or native seedbed preparation	\$211-\$1,617/acre	#386
Fencing	NA	\$3-\$12/ft	CDFW Coho Recovery Plan

Owners of non-dairy livestock and farm animals who fail to implement these or substantially similar best management practices within two years after the effective date of the Action Plan will be in violation of the fecal waste discharge prohibition. The Executive Officer may require of individual non-dairy livestock operations the development and implementation of a ranch management plan. The cost for preparing a ranch management plan will vary depending whether the plan will be prepared by the property owner or a qualified professional, the size of the operation, how much information is available to characterize the discharge and site conditions, and site conditions and constraints.

12.2.7 Potential Costs for Pet Waste Management Programs

A successful pet waste management program is dependent of the participation and cooperation of individual pet owners. The cost of a public education program depends on the type of materials produced and the method of distribution. Implementation of a pet waste management program is an existing program under the MS4 permit for the County of Sonoma, City of Cloverdale, City of Cotati, City of Healdsburg, City of Rohnert Park, City of Santa Rosa, City of Sebastopol, Sonoma County Water Agency, City of Ukiah, and the Town of Windsor. No new costs are anticipated to continue implementing this program beyond the installation of new trash receptacles and pet waste bag dispensers. The cost of a bag dispenser is approximately \$60 (Washington State Department of Ecology).

12.2.8 Potential Costs for Dairies

The structural BMPs to reduce and prevent discharges of animal waste associated with the operation of cow dairies are similar to practices identified in section 12.2.6 for non-dairy livestock and farm animals. Cost estimates for bacteria control measures for these BMPs are presented in Table 12.8. Where the structural BMP involves the construction of a new manure storage pond or enlargement of an existing manure storage pond,

costs depend on the required design storm and the resulting required pond volume. Average national installation costs for livestock ponds is 2.2 cents per gallon for ponds with a capacity less than 1 million gallons, 1.8 cents per gallon for capacities from 1 million to 3 million gallons, and 1.5 cents per gallon for capacities greater than 3 million gallons (USDA)³⁶. Increasing capacity in existing ponds by raising the levels of pond berms would cost considerably less.

12.2.9 Potential Costs for Biosolids Application

Current options for managing wastewater biosolids include both beneficial reuse technologies (such as land application, landfilling with biogas recovery, and energy recovery through incineration) and non-reuse options, including landfilling. While implementing some type of beneficial reuse is the preferred method for managing wastewater biosolids, this is not always practical. For example, land acquisition constraints or poor material quality may limit beneficial reuse options. Composting is one of several methods for treating biosolids to create a marketable end product that is easy to handle, store, and use.

Recycling biosolids through land application serves several purposes. It improves soil properties, such as texture and water holding capacity, which make conditions more favorable for root growth and increases the drought tolerance of vegetation. Biosolids application also supplies nutrients essential for plant growth, including nitrogen and phosphorous, as well as some essential micronutrients such as nickel, zinc, and copper. Biosolids can also serve as an alternative or substitute for expensive chemical fertilizers.

Implementation of BMPs to prevent the migration of biosolids, and associated fecal pathogens, from land application areas is an existing requirement of the State Water Board's Water Quality Order No. 2004-0012-DWQ, General Waste Discharge Requirements for the Discharge of Biosolids for use as a Soil Amendment in Agricultural, Silvicultural, Horticultural, and Land Reclamation Activities (Biosolids General Order) and a common requirement in individual WDRs or Waivers of WDRs that authorize land application of biosolids. The Action Plan requires that each

³⁶ [USDA Natural Resources Conservation Service \(Rhode Island\). Comprehensive Nutrient Management Plans \(CNMP\): Costs Associated with Development and Implementation of Comprehensive Nutrient Management Plans - Part I—Nutrient Management, Land Treatment, Manure and Wastewater Handling and Storage, and Recordkeeping.](https://www.nrcs.usda.gov/sites/default/files/2022-10/cnmp_full_report.pdf) (https://www.nrcs.usda.gov/sites/default/files/2022-10/cnmp_full_report.pdf)

discharger that land applies biosolids comply with its applicable permit. No new costs are anticipated as a result of this Program of Implementation.

12.2.10 Potential Costs for Public Outreach and Education Programs

Public education and community outreach are integral parts of any public program. Public education provides information to the public about where, when, why, and how a program will be implemented. If provided early and continued through the life a program, public education can also help create and maintain public support for a program and to ultimately meet the goals of the program.

Creating and implementing a successful education and outreach program requires a significant long-term financial commitment. The cost for implementing a public education and community outreach program depends on the scope of the public information effort. As an example, the Texas Water Development Board estimates in its *Best Management Practices for Municipal Water Users*³⁷ guide, that the costs for a public utility for administration and materials to implement a comprehensive water conservation program would range in cost from \$0.25 per customer per year to several dollars per year, depending on the budget and size of the public utility. The Sonoma County Water Agency estimates that the costs to implement the public outreach and education components of its water programs range from \$100,000 to \$500,000 per year.

12.3 SOURCES OF FUNDING

Potential sources of funding include monies from private and public sources. Public financing includes, but is not limited to: grant funds, as described below; single-purpose appropriations from federal, state, and/or local legislative bodies; and bond indebtedness and loans from government institutions. Funding sources change over time.

12.3.1 Summary of Pertinent State Funding Programs

There are several potential sources of public financing through grant and loan funding programs administered, at least in part, by the North Coast Water Board and the State Water Board. The Division of Financial Assistance (DFA) administers the implementation of the State Water Board financial assistance programs that include loan and grant funding for project planning, construction of municipal sewage and water

³⁷ [Texas Water Development Board. *Best Management Practices for Municipal Water Users*. November 2013.](http://www.twdb.texas.gov/conservation/BMPs/Mun/doc/MunMiniGuide.pdf?d=1530657069210)
(<http://www.twdb.texas.gov/conservation/BMPs/Mun/doc/MunMiniGuide.pdf?d=1530657069210>)

recycling facilities, remediation for underground storage tank releases, watershed protection projects, and nonpoint source pollution control projects.

The resources available through these programs vary over time depending upon federal and state budgets and ballot propositions approved by voters. State funding programs pertinent to the proposed Action Plan are summarized and described below. Additional information can be found on the [State Water Resources Control Board webpage](http://www.waterboards.ca.gov/water_issues/programs/grants_loans/) (http://www.waterboards.ca.gov/water_issues/programs/grants_loans/).

12.3.1.1 Clean Water State Revolving Fund

The Federal Water Pollution Control Act (Clean Water Act or CWA), as amended in 1987, provides for establishment of a Clean Water State Revolving Fund (CWSRF) program. The program is funded by federal grants, State funds, and Revenue Bonds. The purpose of the CWSRF program is to implement the CWA and various State laws by providing financial assistance for the construction of facilities or implementation of measures necessary to address water quality problems and to prevent pollution of the waters of the State, including federal waters.

In 2014, California voters passed the Water Quality, Supply, and Infrastructure Improvement Act of 2014 (Proposition 1; Prop 1), which authorized \$7.545 billion in general obligation bonds for water projects including surface and groundwater storage, ecosystem and watershed protection and restoration, and drinking water protection. The State Water Board administers Proposition 1 for five programs: Small Community Wastewater, Water Recycling, Drinking Water, Storm Water, and Groundwater Sustainability. For small community wastewater projects, Proposition 1 allocates \$260 million to the CWSRF Small Community Grant (SCG) Fund. The State Water Board has an annual SCG appropriation of \$8 million dollars, which is administered consistent with the CWSRF Intended Use Plan (IUP), and the CWSRF Policy. Administering these funds as a part of the CWSRF Program allows grant funds to be easily leveraged with low-interest financing available through the CWSRF Program. CWSRF applications are accepted on a continuous basis, and eligible projects are funded as applications are completed and approved.

In addition to capital projects, up to 15 percent of the funds available from Prop 1 is allocated to a multi-disciplinary technical assistance (TA) program. The Prop 1 TA Funding Plan (Plan) was adopted by the State Water Board on November 4, 2015. The Plan outlines the general process to administer Prop 1 TA funds. The TA efforts are focused on helping small disadvantaged communities develop, fund, and implement capital improvement projects. This is a multi-disciplinary approach, intended to address small disadvantaged communities' drinking water, wastewater, groundwater quality, and storm water needs under one program.

Including the currently authorized and forecasted future revenue bond sales, the CWSRF's estimated cumulative uncommitted cash through June 30, 2023, available for financing new projects is approximately \$711 million.

Additional information can be found on the [State Water Resources Control Board webpage](http://www.waterboards.ca.gov/water_issues/programs/grants_loans/srf/) (http://www.waterboards.ca.gov/water_issues/programs/grants_loans/srf/)

12.3.1.2 Integrated Regional Water Management Grants

Proposition 1 also authorized \$510 million to Integrated Regional Water Management (IRWM) funding, with funding allocated to hydrologic region-based Funding Areas. The Proposition 1 IRWM Grant Program, administered by the California Department of Water Resources (DWR), is designed to provide funding for projects that help meet the long-term water needs of the state, with particular attention to communities that are economically disadvantaged. The IRWM program is a collaborative effort to manage all aspects of water resources in a region. IRWM crosses jurisdictional, watershed, and political boundaries; involves multiple agencies, stakeholders, individuals, and groups; and attempts to address the issues and differing perspectives of all the entities involved through mutually beneficial solutions. In the North Coast Region, the North Coast Regional Partnership, a coalition of local and Tribal governments, water and wastewater service providers, non-governmental organizations, watershed groups, resource conservation districts, and interested stakeholders from Tribes and the North Coast counties, has been instrumental in obtaining IRWM project implementation funding for communities, with \$53 million of that funding over the last 10 years substantially contributing towards drinking water and water quality improvement projects in disadvantaged communities.

DWR has a number of IRWM grant program funding opportunities. Current IRWM grant programs include: planning, implementation, and storm water flood management. The IRWM Grant Programs are managed within DWR's Division of IRWM by the Financial Assistance Branch with assistance from the Regional Planning Branch and regional offices. Additional information can be found on the [State Department of Water Resources webpage](https://water.ca.gov/Work-With-Us/Grants-And-Loans/IRWM-Grant-Programs) (<https://water.ca.gov/Work-With-Us/Grants-And-Loans/IRWM-Grant-Programs>).

The North Coast Resource Partnership

The North Coast Resource Partnership (NCRP) is a long term, innovative and successful collaboration among local governments, watershed groups, Northern California Tribes, and other interested stakeholders that identifies, evaluates, and selects for funding water quality projects, which include projects for water and wastewater infrastructure, water recycling, storm water capture, and groundwater management. The NCRP region covers over 19,000 square miles – 12% of the California landscape – and includes the Tribal lands and the counties of Del Norte, Humboldt, Trinity, Siskiyou, Modoc, Mendocino and Sonoma.

Since 2004, the partnership has engaged in collaborative, integrated planning and project implementation, investing over \$67 million of local, state, and federal funding in hundreds of projects that benefit the North Coast Region's communities and

watersheds. The NCRP has been active in securing funding for failing water and wastewater infrastructure, and for projects that promote community health and safety.

Additional information can be found on the [NCRP webpage](http://northcoastresourcepartnership.org/) (<http://northcoastresourcepartnership.org/>).

12.3.1.3 Emergency Solutions Grants Program

The Emergency Solutions Grants program (ESG) provides funds for a variety of activities to address homelessness as authorized under the federal HEARTH Act of 2009 and State program requirements. The State of California Department of Housing and Community Development (HCD) administers the ESG program with funding received from the U.S. Department of Housing and Urban Development (HUD).

The federal ESG program provides grant funding to 1) engage homeless individuals and families living on the street; (2) rapidly re-house homeless individuals and families (2) help operate and provide essential services in emergency shelters for homeless individuals and families; (4) prevent individuals and families from becoming homeless.

Additional information can be found on the [HCD webpage](https://www.hudexchange.info/programs/esg/) (<https://www.hudexchange.info/programs/esg/>).

12.3.1.4 Clean Beaches Initiative Grant Program

The Clean Beaches Initiative (CBI) Grant Program provides funding for projects that restore and protect the water quality and the environment of coastal waters, estuaries, bays, and near shore waters. The CBI Grant Program was initiated in response to the poor water quality and significant exceedances of bacterial indicators revealed by Assembly Bill (AB) 411 (Stats. 1997, Ch. 765) monitoring at California's beaches. Scientific studies have shown that water with high bacteria levels can cause infections rashes, and gastrointestinal and respiratory illnesses.

The CBI Grant Program has provided about \$100 million from voter-approved bonds for approximately 100 projects since it was started under the 2001 Budget Act. Typical projects include the construction of disinfecting facilities, diversions that prevent polluted storm water from reaching the beach, and scientific research that will enable early notification of unhealthy swimming conditions. Round 2 Implementation includes \$90 million that will become available in the Summer 2019. According to the CBI Grant Program webpage, less than \$10 million is currently available for funding eligible projects.

Additional information about the CBI Grant Program can be found on the [State Water Board website](https://www.waterboards.ca.gov/water_issues/programs/beaches/cbi_projects/) (https://www.waterboards.ca.gov/water_issues/programs/beaches/cbi_projects/).

12.2.1.5 Cleanup & Abatement Account

The State Water Board's Cleanup and Abatement Account (CAA) was created by Water Code Sections 13440-13443 to provide grants for the cleanup or abatement of a condition of pollution when there are no viable responsible parties available to undertake the work. The CAA is supported by court judgments and administrative civil liabilities assessed by the State Water Board and the North Coast Water Boards. Eligible entities include:

- Public agencies, including North Coast Water Boards.
- Tribal government on the California Tribal Consultation List maintained by the Native American Heritage Commission and is a disadvantaged community (DAC).
- Not-for-profit organizations serving a DAC; or
- Community water systems serving a DAC.

Available funding varies for this program.

CAA Cleanup or Abatement Projects

(https://www.waterboards.ca.gov/water_issues/programs/grants_loans/cleanup_and_abatement.html)

12.3.2 Summary of Pertinent Federal Funding Programs

Several federal agencies, including but not limited to the U.S. EPA, NOAA Fisheries, U.S. Fish and Wildlife Service, and U.S. Department of Agriculture (USDA) Natural Resources Conservation Service also provide grants and other funding opportunities. Table 12.9 presented below provides a summary of the pertinent federal funding programs. Not all of the programs are currently available, but they are listed for educational purposes and in the case that they become available in the future.

The U.S. EPA provides access through its webpage to a [catalog of federal funding opportunities](https://www.epa.gov/grants/find-current-funding-opportunities) (<https://www.epa.gov/grants/find-current-funding-opportunities>)

12.3.2.1 (USDA) Natural Resources Conservation Service

The United States Department of Agriculture Rural Development has more than 40 programs to support investments in infrastructure, housing, and economic and community development projects throughout rural California. USDA's loan and grant programs work in partnership with state and local sources to help build stronger rural communities. Eligible applicants include: public agencies, special districts, nonprofit corporations and federally recognized tribes. Funding available in the Water and Environmental (WEP) programs include water and wastewater loan and grant, emergency community water assistance grants, Native American grants and Special Evaluation Assistance for Rural Communities and Households (SEARCH) grants. WEP also provides funding to organizations that provide technical assistance and training to rural communities in relation to their water and waste activities. Some examples of

eligible projects include: water, waste treatment and disposal, and constructed wetlands.

Additional information can be found on the [USDA webpage](https://www.rd.usda.gov/) (<https://www.rd.usda.gov/>)

12.3.3 Summary of Pertinent Private Funding Programs

In addition to the range of government entities that offer financial resources to advance environmental projects, there are a number of private funding programs that can be used to finance public infrastructure projects. Private funding organizations often provide funds through non-profit corporations.

12.3.3.1 (IBank) Infrastructure State Revolving Fund Program

The California Infrastructure and Economic Development Bank (IBank) provides funding to finance public infrastructure and private development that promote a healthy climate for jobs, contribute to a strong economy and improve the quality of life in California communities. The Infrastructure State Revolving Fund (ISRF) program provides financing to public agencies and non-profit corporations, sponsored by public agencies, for a wide variety of infrastructure and economic development projects (excluding housing). ISRF funding is available in amounts ranging from \$50,000 to \$25 million with loan terms for the useful life of the project up to a maximum of 30 years. Some examples of eligible projects include: water, sewage, flood control, waste disposal, streets, highways, public transit, public safety, educational, cultural, social, parks and recreation facilities, ports and goods movement.

Additional information can be found on the [IBank webpage](http://www.ibank.ca.gov/about-us/) (<http://www.ibank.ca.gov/about-us/>)

Table 12.9: Summary of Federal Funding Programs

Funding Program	Programs Description	2019 Funding
Agency : U.S. Department of Agriculture		
Sustainable Agriculture Research and Education (https://www.sare.org/Grants)	<p>The Sustainable Agriculture Research and Education (SARE) program of the U.S. Department of Agriculture National Institute of Food and Agriculture (NIFA) works to advance farming systems that are productive, profitable, environmentally sound and good for communities through a regional grants program. SARE funds research and extension activities to reduce the use of chemical pesticides, fertilizers, and toxic materials in agricultural production; to improve management of on-farm resources to enhance productivity, profitability, and competitiveness; to promote crop, livestock, and enterprise diversification and to facilitate the research of agricultural production systems in areas that possess various soil, climatic, and physical characteristics; to study farms that are managed using farm practices that optimize on-farm resources and conservation practices; and to promote partnerships among farmers, nonprofit organizations, agribusiness, and public and private research and extension institutions. Click on program name and check the link in the Primary Internet box for more information about grant opportunities and program results.</p> <p>SARE Grants (https://www.sare.org/Grants)</p> <p>SARE Professional Development Program for States and Protectorates (https://western.sare.org/about/state-pdp-coordinators/)</p>	\$22.7 million

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Funding Program	Programs Description	2019 Funding
Environmental Quality Incentives Program (https://www.nrcs.usda.gov/programs-initiatives/eqip-environmental-quality-incentives)	<p>The USDA Natural Resources Conservation Service's Environmental Quality Incentives Program (EQIP) was established to provide a voluntary conservation program for agricultural producers to address significant natural resource needs and objectives. Through a competitive process, EQIP offers financial assistance contracts with a maximum term of ten years, to help implement eligible conservation practices. Persons or legal entities, who are owners of land under agricultural production or who are engaged in livestock or agricultural production on eligible land, including private non-industrial forest land, or Indian Tribes may participate in EQIP. Conservation practices implemented through EQIP are subject to NRCS technical standards adapted for local conditions. NRCS or Technical Service Providers (TSPs) help applications develop a plan of operations which identifies practices needed to address natural resource concerns and support the EQIP contract. EQIP-related programs include Conservation Innovation Grants (CIG), Resource Conservation Partnership Program (RCPP), and the National Water Quality Initiative (NWQI).</p> <p>Environmental Quality Incentives Program (https://www.nrcs.usda.gov/programs-initiatives/eqip-environmental-quality-incentives)</p>	\$981.7 million Estimate (Cost Share)

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Funding Program	Programs Description	2019 Funding
National Integrated Water Quality Program (NIWQP) (https://www.nrcs.usda.gov/pr ograms-initiatives/natio nal-water-quality-initiative)	The National Integrated Water Quality Program (NIWQP) provides funding for research, education, and extension projects aimed at improving water quality in agricultural and rural watersheds. The NIWQP has identified eight "themes" that are being promoted in research, education and extension. The eight themes are (1) Animal manure and waste management (2) Drinking water and human health (3) Environmental restoration (4) Nutrient and pesticide management (5) Pollution assessment and prevention (6) Watershed management (7) Water conservation and agricultural water management (8) Water policy and economics. Awards are made in four program areas - National Projects, Regional Coordination Projects, Extension Education Projects, and Integrated Research, Education and Extension Projects. Please note that funding is only available to universities.	Not currently available
Agency: U.S. Department of Housing and Urban Development		
Community Development Block Grants/Entitlement Grants (https://www.hudexchange.info/programs/cdbg/)	The objective of this program is to develop viable urban communities, by providing decent housing and a suitable living environment, and by expanding economic opportunities, principally for persons of low and moderate income. Recipients may undertake a wide range of activities directed toward neighborhood revitalization, economic development and provision of improved community facilities and services. Community Development Block Grant Programs (https://www.hudexchange.info/programs/cdbg/)	\$1.95 billion (est.)
Agency: U.S. Environmental Protection Agency		

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Funding Program	Programs Description	2019 Funding
Source Reduction Assistance Grant Program (https://www.epa.gov/p2/source-reduction-assistance-grants)	<p>The Source Reduction Assistance Grant Program provides grants and cooperative agreements to fund pollution prevention (source reduction and resource conservation) activities. Specifically, the Agency is interested in funding projects that help reduce hazardous substances, pollutants, or contaminants entering waste streams or otherwise released into the environment (including fugitive emissions) prior to recycling, treatment, disposal or energy recovery activities.</p> <p>FY 2018 and FY 2019 Request for Proposals for the Source Reduction Assistance Grant Program (https://www.epa.gov/p2/fy-2018-and-fy-2019-request-proposals-source-reduction-assistance-grant-program)</p>	<p>\$2.0 million (est.)</p>
Clean Water State Revolving Fund (https://www.epa.gov/cwsrf)	<p>The EPA's Clean Water State Revolving Fund (CWSRF) program provides a permanent source of low-cost financing for a wide range of water quality infrastructure projects. These projects include traditional wastewater treatment and collection, nonpoint source pollution controls, and estuary management. Funds to capitalize the program are provided annually through federal grants and state matching funds (equal to 20 percent of federal grants). Monies are loaned to assistance recipients at below-market rates. In addition, states also have the ability to customize loan terms to benefit small and disadvantaged communities. Loan repayments are recycled back into the programs to fund additional projects. Since its inception, the CWSRF has provided over \$95.4 billion in assistance to eligible borrowers, including communities of all sizes, farmers, small businesses, and nonprofit organizations. More information on the CWSRF program can be obtained at</p> <p>Clean Water State Revolving Fund (https://www.epa.gov/cwsrf)</p>	<p>\$1.1 billion (est.)</p> <p>Estimated 70 million in Grants for California</p>

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Funding Program	Programs Description	2019 Funding
Nonpoint Source Implementation Grants (319 Program) (https://www.epa.gov/nps/319-grant-program-states-and-territories)	<p>Through its 319 program, U.S. EPA provides formula grants to the states, territories and tribes to implement nonpoint source programs and projects and programs in accordance with section 319 of the Clean Water Act (CWA). Nonpoint source pollution projects can be used for a wide range of activities including agriculture, forestry, construction, and urban challenges. When set as priorities within a state's Nonpoint source management program, projects may also be used to protect source water areas and high quality waters. Examples of previously funded projects include installation of best management practices (BMPs) for animal waste; design and implementation of BMP systems for stream, lake, and estuary watersheds; and basin-wide landowner education programs. Most states provide opportunities for 3rd parties to apply for funds under a state request for proposal.</p> <p>Nonpoint Source Pollution (NPS) Control Program (https://www.waterboards.ca.gov/water_issues/programs/nps/319grants.html)</p>	

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Funding Program	Programs Description	2019 Funding
Urban Waters Small Grants (https://www.epa.gov/urbanwaterspartners/urban-waters-small-grants)	<p>EPA's Urban Waters Program protects and restores America's urban waterways. EPA's funding priority is to achieve the goals and commitments established in the Agency's Urban Waters Strategic Framework (www2.epa.gov/urbanwaters/urban-waters-strategic-framework). This program has an emphasis on engaging communities with environmental justice concerns. The objective of the Urban Waters Small Grants is to fund projects that will foster a comprehensive understanding of local urban water issues, identify and address these issues at the local level, and educate and empower the community. In particular, the Urban Waters Small Grants seek to help restore and protect urban water quality and revitalize adjacent neighborhoods by engaging communities in activities that increase their connection to, understanding of, and stewardship of local urban waterways.</p>	
Pollution Prevention Grant Program (https://www.epa.gov/p2/grant-programs-pollution-prevention)	<p>The Pollution Prevention Grant Program provides grants and cooperative agreements to state agencies, instrumentalities of a state and federally recognized tribes to implement pollution prevention projects that provide technical assistance to businesses. The program requires applicants to work towards reducing pollution, conserving energy and water, and saving dollars through P2 efforts; as identified in EPA's Strategic Plan under Goal 4: Ensuring Safety of Chemicals and Preventing Pollution, Objective 4.2: Promote Pollution Prevention.</p> <p>Grant Programs for Pollution Prevention (https://www.epa.gov/p2/grant-programs-pollution-prevention)</p>	

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed

Funding Program	Programs Description	2019 Funding
Five-Star Restoration Program (https://www.epa.gov/wetlands/five-star-wetland-and-urban-waters-restoration-grants)	<p>The U.S. EPA supports the Five-Star Restoration Program by providing funds to the National Fish and Wildlife Foundation and its partners, the National Association of Counties, NOAA's Community-based Restoration Program and the Wildlife Habitat Council. These groups then make subgrants to support community-based wetland and riparian restoration projects. Competitive projects will have a strong on-the-ground habitat restoration component that provides long-term ecological, educational, and/or socioeconomic benefits to the people and their community. Preference will be given to projects that are part of a larger watershed or community stewardship effort and include a description of long-term management activities. Projects must involve contributions from multiple and diverse partners, including citizen volunteer organizations, corporations, private landowners, local conservation organizations, youth groups, charitable foundations, and other federal, state, and tribal agencies and local governments. Each project would ideally involve at least five partners who are expected to contribute funding, land, technical assistance, workforce support, or other in-kind services that are equivalent to the federal contribution.</p> <p>Grants Reporting and Tracking System (GRTS) (https://www.epa.gov/nps/grants-reporting-and-tracking-system-grts)</p>	

References

- [U.S. Environmental Protection Agency \(USEPA\) Technology Fact Sheets](https://www.epa.gov/septic/wastewater-technology-fact-sheets)
 (https://www.epa.gov/septic/wastewater-technology-fact-sheets)
- [Federal Remediation Technologies Roundtable Screening Matrix and Reference Guide \(FRTR\)](https://frtr.gov/matrix/) (https://frtr.gov/matrix/);

- SWRCB 1 – State Water Resources Control Board Onsite Wastewater Treatment System Policy Final Substitute Environmental Document June 19, 2012
- [U.S. EPA 1 – US Environmental Protection Agency Technology Fact Sheets](https://www.epa.gov/septic/wastewater-technology-fact-sheets) (https://www.epa.gov/septic/wastewater-technology-fact-sheets)
- [Leverenz, Harold, J. Darby, and G. Tchobanoglous, 2006. Evaluation of Disinfection Units for Onsite Wastewater Treatment Systems](https://www.semanticscholar.org/paper/Evaluation-of-Disinfection-Units-for-Onsite-Systems-Leverenz-Darby/1482b5fbe8f290e903b8abed25d9bf60fbb21739) (https://www.semanticscholar.org/paper/Evaluation-of-Disinfection-Units-for-Onsite-Systems-Leverenz-Darby/1482b5fbe8f290e903b8abed25d9bf60fbb21739)
- [Central Contra Costa County Sanitary District \(CCCSD\) website](https://www.centalsan.org/) (https://www.centalsan.org/)
- Water Environment Research Foundation (WERF). Performance & Cost of Decentralized Unit Processes. Final Report, 2010.
- Staff report to City Council, Salt Lake City, “Cost of Building Public Restrooms.”(Jan 15, 2013)
- “Going Public: An Assessment of Restroom Facilities in City of Durham Parks” (Jan 15, 2014)
- City of Santa Rosa, December 2014. City of Santa Rosa’s 2013-2014 Annual Report of Compliance with Order No. R1-2009-0050
- County of Sonoma, December 2014. NPDES Phase I Annual Report: July 1, 2013 – June 30, 2014, Term 3, Year Five
- State Water Board Onsite Wastewater Treatment System Policy Final Substitute Environmental Document, June 19, 2012
- [New Jersey Agricultural Experiment Station: Rutgers Cooperative Research & Extension Jan. 2005. Fact Sheet: Onsite Wastewater Treatment Systems: Alternative Technologies](https://njaes.rutgers.edu/pubs/publication.php?pid=FS530) (https://njaes.rutgers.edu/pubs/publication.php?pid=FS530)

CHAPTER 13

ANTIDegradation ANALYSIS

13.1 OVERVIEW

This chapter analyzes whether approval of the amendment would be consistent with the federal and state antidegradation policies.

13.2 STATE AND FEDERAL ANTIDegradation POLICIES

The federal antidegradation policy, described in 40 CFR section 131.12, requires that existing instream designated uses and the level of water quality necessary to protect the existing uses be maintained and protected. Where, however, the quality of the water exceeds levels necessary to support propagation of fish, shellfish, and wildlife, and recreation in and out of the water, that quality must be maintained and protected unless the state finds that:

1. Such activity is necessary to accommodate important economic or social development in the area in which the waters are located;
2. Water quality is adequate to protect existing beneficial uses fully; and
3. The highest statutory and regulatory requirements for all new and existing point source discharges and all cost-effective and reasonable best management practices for nonpoint source control are achieved.

In addition, the federal antidegradation policy requires that where high quality waters constitute an outstanding National resource that water quality shall be maintained and protected.

The state antidegradation policy incorporates the federal Antidegradation Policy.³⁸ (The state Antidegradation Policy applies to high quality waters.³⁹ The state policy establishes several conditions that must be met before the quality of high quality waters may be lowered by waste discharges. ("Statement of Policy With Respect to Maintaining High Quality Waters in California", State Water Board Resolution No. 68-16; See also

³⁸ See State Water Board Order No. WQ 2001-16, fn 83).

³⁹ Baseline water quality for the purposes of the antidegradation analysis is the best quality of water measured since 1968, considering the state antidegradation policy, or 1975, considering the federal antidegradation policy, unless a subsequent lowering of water quality was allowed consistent with state and federal antidegradation policies.

Basin Plan pages 3-2.00 to 3-3.00). The state must determine that lowering the quality of high quality waters:

1. Will be consistent with the maximum benefit to the people of the state,
2. Will not unreasonably affect present and anticipated beneficial uses of such water, and
3. Will not result in water quality less than that prescribed (e.g., by water quality objectives).

In addition, before any degradation of water quality is permitted, it must be shown that the discharge will be required to meet waste discharge requirements that result in best practicable treatment or control of the discharge necessary to assure that:

1. Pollution or nuisance will not occur;
2. The highest water quality consistent with maximum benefit to the people of the State is maintained.

13.3 APPLICABILITY TO THE RUSSIAN RIVER WATERSHED PATHOGEN INDICATOR TMDL ACTION PLAN AND WASTE DISCHARGE PROHIBITION

The Action Plan is based in part on the principles contained in the state and federal antidegradation policies. High concentrations of fecal indicator bacteria in ambient waters infer the presence of human and animal fecal waste and associated disease-causing microorganisms that pose a risk to human health. The water quality of the Russian River does not support the recreational beneficial use.⁴⁰ The Action Plan is designed to improve water quality conditions and protect uses of water for recreational activities such as wading, swimming, fishing and rafting. The Action Plan is expected to result in an improvement in water quality compared to existing conditions and will promote attainment of water quality standards and protection of beneficial uses pursuant to the schedule established in the Action Plan. While not a specific component of an antidegradation analysis or required for compliance with state or federal antidegradation requirements, the Action Plan incorporates monitoring requirements to provide feedback on whether the actions that parties must implement are effective in improving water quality and avoiding further degradation. Both individual and comprehensive monitoring programs will help determine areas where site-specific management measures and further monitoring are necessary to achieve water quality goals.

It is important to note that the proposed Action Plan includes a prohibition of the discharge of fecal waste materials that cause or contribute to an exceedance of bacteria water quality objectives not authorized by action of the Regional or State Water Board. The Action Plan identifies a wide range of factors affecting the fate and transport of pathogens and the appropriate choice of compliance measures that will help attain water quality standards. The Action Plan also allows measures tailored to a particular site and includes iterative planning based on monitoring feedback (e.g., advanced protection management plan for OWTS, sanitary sewer management plans, etc.).

While the Action Plan directs the North Coast Water Board staff to incorporate pathogen protection measures into its point source and nonpoint source permitting actions, it does not itself authorize or permit any activity that will discharge waste into high quality waters. An antidegradation analysis is appropriate at the time of permit development, with the proper findings made by the North Coast Water Board prior to adoption, including findings that where any lowering of water quality is authorized that the discharges will ensure water quality objectives are not exceeded, are to the maximum benefit to the people of the state, and are subject to best practicable treatment and control methods.

The proposed Action Plan complies with antidegradation policies by ensuring the protection of contact recreation use, and by implementing a program to achieve bacteria source reduction and to reach attainment of water quality objectives if discharges are to occur. The waste load allocations and load allocations are set at a level that are expected to improve conditions in the Russian River Watershed. Additionally, the prohibition of the discharge of fecal waste materials that cause or contribute to an exceedance of bacteria water quality objectives will help to ensure the attainment of standards. This amendment is consistent with the State Antidegradation Policy (State Water Board Resolution No. 68-16), and the federal Antidegradation Policy (40 CFR § 131.12), in that it does not allow degradation of water quality but requires restoration of water quality and attainment of water quality standards.

CHAPTER 14

PUBLIC PARTICIPATION SUMMARY

This chapter describes the opportunities for the public to participate in the development of the Russian River Watershed Pathogen TMDL and Program of Implementation. Consistent with the California Code of Regulations, title 23, sections 3778-80, and California Water Code section 189.7, the North Coast Water Board consulted with stakeholders in the region, federally recognized California Native American tribes and non-federally recognized Native American tribes on the contact list maintained by the Native American Heritage Commission, and other potentially affected parties about the proposed action, and considered and addressed all comments received.

In January 2015, the North Coast Water Board held a California Environmental Quality Act (CEQA) public scoping meeting. A draft of the Action Plan, staff report, and substitute environmental documentation were available for public review on August 21, 2015. The public comment period closed on October 8, 2015, allowing a 48-day review and comment period. On September 22, 23, and 24, 2015, the Regional Water Board held three staff led workshops on the development of the TMDL and Action Plan. A public hearing was postponed until public comments received could be fully addressed. On August 7, 2017, an updated Action Plan and staff report were released for public review. These documents represented a revision of the proposed project based on public comments received in 2015. The proposed amendment to revise the existing Basin Plan language regarding OWTS requirements for the Russian River Watershed, pending Action Plan adoption, was also released for public review. The public comment period closed on September 29, 2017, allowing for a 52-day review and comment period. On August 17, 2017, the North Coast Water Board held a public workshop at a regularly scheduled Board meeting on the development of the TMDL and Action Plan.

On May 9, 2019, the Action Plan and staff report were released for a third public review, that addressed the public comments received in 2017 and accounted for the new statewide water quality objective for bacteria adopted by the State Water Board on August 7, 2018. A 45-day public comment and review period was provided. On June 13, 2019, the Regional Water Board held a public staff-led workshop on the development of the TMDL and Action Plan. On August 14, 2019, a public hearing was conducted to consider adoption of the proposed Action Plan, including the substitute environmental documents and the comments received during the Basin Plan amendment process and staff's written responses.

In 2020, prior to submitting the Action Plan and supporting documents to the State Water Board for its consideration, Regional Water Board staff reanalyzed Russian River fecal indicator bacteria and microbial source tracking data resulting in some new and altered findings related to geographic scope of the advanced protection management program (APMP) for OWTS. The Technical Report, 2021 Revised staff report, and the Revised Action Plan were the subject of an additional 54-day public review followed by

a public workshop during the August 19, 2021, North Coast Water Board meeting. On December 2, 2021, a public hearing was conducted and the Board adopted the revised Action Plan, including the revised staff report and supporting documents that constitute substitute environmental documentation. The State Water Board provided a 45-day public review period for the staff report and Action Plan in January 2022. Between 2022 and 2025, prior to submitting the Action Plan and supporting documents to the State Water Board for its consideration, North Coast Water Board staff reanalyzed and revised the program of implementation for OWTS resulting in the 2025 revised draft Staff Report and draft Action Plan which underwent an additional 45-day public comment period from March 24, 2025 to May 8, 2025. During that public comment period, on April 1, 2025, the North Coast Water Board held a public workshop to review changes and receive public input. On August 14 or 15, 2025, a public hearing is scheduled to consider adoption of the proposed Action Plan, including the substitute environmental documents, the comments received during the Basin Plan amendment process and staff's written responses.14.1 Stakeholder and Public Outreach

North Coast Water Board staff has held numerous meetings to update and inform key stakeholders and the public throughout the Russian River Watershed TMDL assessment and Action Plan development process. The outreach meetings related to this project have included both public meetings and meetings targeted to small groups of individuals and local agency representatives who were identified by North Coast Water Board staff as key stakeholders in the Russian River Watershed. A list of the stakeholder and public meetings held through 2024 regarding the Pathogen TMDL and Action Plan is presented in Table 14.1. Meetings before the North Coast Water Board are identified in **bold**.

Table 14.1: Stakeholder and Public Meetings for the Russian River Watershed Pathogen TMDL and Action Plan

Subject	Date	Participants
Update on Regulatory and TMDL Efforts	January 27, 2011	North Coast Water Board meeting, all interested stakeholders
Early TMDL Implementation and Monitoring	November 3, 2011	North Coast Water Board meeting, all interested stakeholders
Update on Russian River Watershed TMDL	August 23, 2012	North Coast Water Board meeting, all interested stakeholders
Monte Rio Community Forum	October 20, 2012	Public Meeting in Monte Rio
Public Outreach	May 28, 2013	Fitch Mountain Neighborhood Association Sonoma County Supervisor Mike McGuire
Implementation Plan Outreach	August 21, 2013	Sonoma County Community Development Agency
Russian River Biological Opinion, Fish Habitat and Water Rights Project and Pathogen TMDL	August 22, 2013	North Coast Water Board meeting, all interested stakeholders
Update on Russian River Watershed TMDL	March 13, 2014	North Coast Water Board meeting, all interested stakeholders
Implementation Brainstorming Session 1	May 20, 2014	Sonoma County Water Coalition Russian Riverkeepers Green Valley Watershed Committee
Implementation Brainstorming Session 2	June 5, 2014	Sonoma County Continuum of Care

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed Pathogen TMDL

Subject	Date	Participants
Implementation Brainstorming Session 3	June 5, 2014	<p>Sonoma County Water Agency</p> <p>Sonoma County Permit and Resource Management Department (PRMD)</p> <p>Sonoma County Community Development Agency</p> <p>Board Members Bill Massey and David Noren</p>
Implementation Brainstorming Session 4	July 1, 2014	<p>Sonoma County Water Agency</p> <p>Sonoma County PRMD</p> <p>City of Santa Rosa</p> <p>City of Sebastopol</p> <p>City of Cotati</p> <p>City of Rohnert Park</p> <p>Town of Windsor</p> <p>City of Ukiah</p> <p>Sonoma County Agricultural Commissioner</p>
Implementation Brainstorming Session 5	July 3, 2014	<p>Sonoma County Department of Health Services</p>
Implementation Brainstorming Session 6	July 9, 2014	<p>Sonoma Resource Conservation District</p> <p>Gold Ridge Resource Conservation District</p> <p>Mendocino Resource Conservation District</p> <p>Sonoma County Agricultural Commissioner</p>

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed Pathogen TMDL

Subject	Date	Participants
Implementation Plan Update	August 15, 2014	<p>Summer Home Park</p> <p>Monte Rio</p> <p>Villa Grande</p> <p>Russian River Redevelopment Oversight Committee (Fitch Mountain)</p> <p>Sonoma County Supervisor Efren Carrillo</p> <p>Sonoma County Water Agency</p> <p>Sonoma County PRMD</p> <p>Board Members Bill Massey and David Noren</p>
Implementation Plan Outreach	August 28, 2014	Public Meeting in Santa Rosa
Stakeholder Outreach Meeting	January 9, 2015	North Bay Association of Realtors in Santa Rosa
Russian River Watershed Pathogen TMDL Technical Group Meeting	January 30, 2015	<p>Representatives from the Communities of: Guerneville</p> <p>Occidental</p> <p>Monte Rio</p> <p>Villa Grande</p> <p>Fitch Mountain</p> <p>Northwood Property Owners</p>

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed Pathogen TMDL

Subject	Date	Participants
Public Workshops on draft TMDL and Action Plan	September 22, 2015	Staff-led workshop, Lower River stakeholders
	September 23, 2015	Staff-led workshop, Upper River stakeholders
	September 24, 2015	Staff-led workshop, Middle River stakeholders
North Coast Water Board Information Item	November 19, 2015	North Coast Water Board meeting, all interested stakeholders
North Coast Water Board Information Item	August 11, 2016	North Coast Water Board meeting, all interested stakeholders
Fitch Mountain Community Meeting	November 19, 2016	Fitch Mountain Community
North Coast Water Board Public Workshop	December 15, 2016	North Coast Water Board meeting, all interested stakeholders
Program of Implementation Update for Lower Russian River OWTS Owners Group	January 20, 2017	Sonoma County PRMD, Sonoma County Supervisors Lynda Hopkins and James Gore, North Coast Water Board Member David Noren, private individuals residing in lower Russian River area
Program of Implementation Update for LUAP Subcommittee	March 16, 2017	Sonoma County PRMD, Sonoma County LUAP subcommittee members
Program of Implementation Update for Lower Russian River OWTS Owners Group	May 20, 2017	Sonoma County PRMD, Sonoma County Supervisors Lynda Hopkins and James Gore, private individuals residing in lower Russian River area

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed Pathogen TMDL

Subject	Date	Participants
Program of Implementation Update for Lower Russian River OWTS Owners Group	June 5, 2017	Sonoma County PRMD, Sonoma County Supervisor Lynda Hopkins, private individuals residing in lower Russian River area
Program of Implementation Update for Lower Russian River OWTS Owners Group	June 21, 2017	Sonoma County PRMD, Sonoma County Supervisor Lynda Hopkins, private individuals residing in lower Russian River area
Revisions to Program of Implementation	May 5, 2018	Lower Russian River stakeholders
Revisions to Sonoma County OWTS Manual and APMP Requirements	May 14, 2018	Sonoma County Supervisor Lynda Hopkins
Executive Officer's Report article on status of TMDL project	July 11, 2018	North Coast Water Board, all interested stakeholders
Monte Rio Tour	July 17, 2018	Sonoma County Supervisor Lynda Hopkins, Sonoma County Water Agency, CAG Members
Sonoma County OWTS Manual and APMP Requirements	August 15, 2018	Sonoma County Supervisor Lynda Hopkins, Sonoma County Supervisor James Gore, Permit Sonoma, North Coast Water Board Member David Noren
Sonoma County OWTS Manual Community Workshop (Monte Rio)	September 29, 2018	Permit Sonoma, Interested Public
Sonoma County OWTS Manual Community Workshop (Healdsburg)	October 10, 2018	Permit Sonoma, Interested Public
Sonoma County OWTS Manual Community Workshop (Santa Rosa)	October 11, 2018	Permit Sonoma, Interested Public

Staff Report
for the Action Plan for Pathogens in the Russian River Watershed Pathogen TMDL

Subject	Date	Participants
Sonoma County OWTS Manual Community Workshop (Guerneville)	October 17, 2018	Permit Sonoma, Interested Public
Sonoma County OWTS Manual and APMP Requirements	October 26, 2018	Sonoma County Supervisor Lynda Hopkins, Permit Sonoma
Executive Officer's Report article on status of TMDL project	November 14, 2018 and December 4, 2024	North Coast Water Board, all interested stakeholders
Community Advisory Group (CAG) Meetings	June 2018 – Present, approximately monthly	North Coast Water Board, Permit Sonoma, Sonoma County, Sonoma County Water Agency representatives ⁴¹ from Monte Rio, Northwood, Villa Grande, and Camp Meeker
Interagency Meeting	October 2018 – October 2021, approximately quarterly	North Coast Water Board, Permit Sonoma, Sonoma County, Sonoma County Water Agency
Interagency Meeting	October 2021 – December 2024, approximately monthly	North Coast Water Board, Permit Sonoma, Sonoma County, Sonoma County Water Agency

In addition to the meetings listed in Table 14.1, a public workshop and hearing before the North Coast Water Board were held in 2019 resulting in the Board's adoption of the Action Plan for the Russian River Pathogen TMDL as an amendment to the Basin Plan. A reanalysis of fecal indicator bacteria and microbial source tracking data conducted by North Coast Water Board staff in 2020, was the basis for a 2021 Update, including revisions to the TMDL Action Plan adopted by the North Coast Water Board in 2019. Updates to the 2019 TMDL Staff Report and Action Plan triggered a public workshop

⁴¹ Some representatives include individuals from the OWTS Residents of the Russian River, a committee that submitted a comment letter on the draft Staff Report and Action Plan

and hearing before the North Coast Water Board in 2021 to consider re-adoption of the TMDL Action Plan, including updates. The North Coast Water Board adopted the 2021 Action Plan on December 2, 2021. In January 2022, North Coast Water Board staff initiated a process for the State Water Board to consider approval of the amendments adopted by the North Coast Water Board by posting the 2021 Action Plan package for public review. Through discussion and coordination with State Water Board staff, North Coast Water Board staff decided to revise the Action Plan's onsite wastewater treatment systems (OWTS) program of implementation prior to bringing the item before the State Water Board for consideration. The draft 2025 revised Staff Report and Action Plan were posted for public review and comment on March 24, 2025, which closed on May 8, 2025. A public workshop was held over the draft Staff Report and Action Plan on April 1, 2025 and the proposed Staff Report and Action Plan will be considered for adoption by the North Coast Water Board at a public meeting in August, 2025.

14.1.1 Community and interagency groups

Owners of OWTS within the boundaries of the APMP may be required to implement corrective actions when their OWTS are not in compliance with the minimum standards set forth in the TMDL Action Plan. In some cases, upgrades to individual OWTS to meet the APMP minimum standards may be infeasible or cost prohibitive. To foster community-based solutions to area-wide wastewater treatment and disposal challenges, North Coast Water Board staff, in coordination the Sonoma County Water Agency, representatives of Sonoma County's 5th Supervisory District, Permit Sonoma, the Gold Ridge Resource Conservation District (RCD), and the Sonoma RCD formed an Interagency Committee to guide a pilot project that would explore community alternatives, public funding options for local projects, and to encourage community engagement for a community solution. This Interagency Committee meets monthly, or more frequently as needed.

To facilitate community involvement, build consensus on potential solutions, and secure funding for the planning, development and implementation of sustainable solutions to address the failing septic systems located in disadvantaged Russian River communities, the Interagency Committee encouraged the formation of a Community Advisory Group (CAG). In January 2018, the Sonoma County Board of Supervisors provided notice of the need for the formation of a CAG and requested that members of the lower Russian River communities of Monte Rio, Northwood, Villa Grande, and Camp Meeker whom were interested in participating in the CAG submit a letter of interest. The Interagency Committee selected 12 applicants from an applicant pool of 23 applicants. The first monthly meeting of the CAG occurred in June 2018.

The CAG has continued to meet on a roughly monthly basis to inform TMDL implementation and is anticipated to continue to meet at that frequency at least until the completion of the Monte Rio/Villa Grande Wastewater Solutions Pilot Project and Feasibility Study in 2025, and likely beyond. That study assesses various possible solutions for wastewater treatment and disposal in those communities. The CAG also

hosted three public meetings to conduct outreach and receive feedback on drafts of that Study in 2024.

14.1.2 Russian River Watershed TMDL Webpage

In addition to holding public meetings, North Coast Water Board staff has maintained a webpage on the North Coast Regional Water Quality Control Board's website where the latest, up-to-date information on the Russian River TMDL development process can be found. The webpage also includes a map of the watershed, a description of the current Clean Water Act Section 303(d) listing, project documents, quality assurance plans, technical memoranda, and board presentations. The website also includes the public comment letters received on both the [2015 draft Staff Report and Action Plan and the 2017 draft Staff Report and Action Plan](#) (http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/russian_river/)

14.2 PRESENTATIONS TO THE NORTH COAST WATER BOARD

Periodically, North Coast Water Board staff has presented updates and status reports to the North Coast Water Board and interested members of the public on the Russian River Watershed Pathogen TMDL. The presentations were opportunities for the public and Board members to hear status updates and background information regarding progress and emerging issues related to the TMDL development process. At each of these meetings, the public also had the opportunity to give comment before the Board. All such comments are part of the public record. Table 14.1 includes in **bold** a list of the presentations given to the North Coast Water Board. Text preceding table 14.1 provides additional information regarding public participation since 2018.

14.3 PRESENTATIONS TO COUNTY SUPERVISORS

In order to keep local agencies informed of the details of the Russian River Watershed TMDL, North Coast Water Board staff met with County Supervisors from Sonoma County and Mendocino County. A list of these presentations is available in Table 14.2. North Coast Water Board staff also met with Sonoma County supervisors, administration staff, legal counsel, and staff from the Sonoma County Community Development Commission to develop a Memorandum of Understanding (MOU) between the agencies that would establish the roles and responsibilities of the parties with respect to the parties' joint efforts to implement the Action Plan for the Russian River Watershed Pathogen TMDL. These coordination meetings occurred on March 17, 2016 and August 9, 2016. The MOU was signed by the Sonoma County Administrative Officer and the North Coast Water Board Executive Officer and made final on December 13, 2016.

Table 14.2: Presentations to County Supervisors

Subject	Date	Venue
---------	------	-------

Russian River TMDL	January 22, 2015	Sonoma County Board Supervisors Efren Carrillo and James Gore
Russian River TMDL	February 6, 2015	Sonoma County Board Supervisor Shirlee Zane
Russian River TMDL	February 9, 2015	Sonoma County Board Supervisor David Babbitt
Russian River TMDL	February 18, 2015	Sonoma County Board Supervisor Susan Gorin
Russian River TMDL	April 6, 2015	Sonoma County Board Supervisors Efren Carrillo and James Gore

14.4 PEER REVIEW

Prior to development of the Public Review Draft of the Russian River Watershed TMDL Staff Report, a peer- review draft report was reviewed by the following two professors as part of a formal state-mandated peer-review process:

- Dr. Nicholas J. Ashbolt, Alberta Innovates Translational Research Chair in Water, School of Public Health, at the University of Alberta, Canada;
- Dr. Patricia A. Holden, Professor of Bren School, Director of UCSB Natural Reserve System at the University of California, Santa Barbara

14.5 PUBLIC REVIEW DRAFTS

A draft Staff Report and the Action Plan were posted and available for public review and comment beginning on August 21, 2015 with the public review period closing on October 8, 2015. Numerous, detailed comments were submitted requiring consideration and revision to the Program of Implementation. Revisions to the 2015 Staff Report were also required as a result of public comment, but the basic tenets of the technical analysis remained the same. Due to the extent of public comments, the item scheduled for the November 19, 2015 Board Meeting was changed from an adoption hearing to an Information Item.

Staff reviewed public comments received in 2015 and revised the Staff Report and Action Plan, accordingly. A revised Draft Staff Report and Action Plan was prepared and made available in August 2017 for a 45-day public review period. An adoption hearing was scheduled to be held before the North Coast Water Board at its December 12-13, 2017 meeting, but was postponed as a result of the wildfires in October 2017 and in order to accommodate changes to the statewide bacteria objectives. In January

2018, the State Water Board posted for public review statewide bacteria objectives to supersede Basin Plan bacteria objectives to protect REC-1. The adoption hearing was held in August 2018, at which time the State Water Board adopted statewide bacteria objectives. North Coast Water Board staff postponed bringing the Russian River Pathogen TMDL and Action Plan to the North Coast Water Board for adoption until the State Water Board acted on the statewide objective.

Following the August 2018 adoption of statewide bacteria objectives, staff made revisions to the TMDL staff report and Action Plan to account for the new statewide objectives. The statewide bacteria objective specified a six-week rolling method for calculating compliance with the geometric mean, which differed from the static calculation method used to assess data in the Russian River. Staff recompiled all of the ambient water quality data collected in the Russian River Watershed and conducted a reassessment to bring the conclusions of the TMDL up to date with respect to the new statewide objective. Since 2018, North Coast Water Board staff have posted the TMDL Action Plan materials for public review and comment three more times, once in 2019, again in 2021, and most recently in early 2022. This 2025 revise package was posted for 45 days of public review and comment from March 24 through May 8, 2025 prior to bringing this item before the North Coast Water Board for consideration.

Throughout the Basin Plan amendment process, there are opportunities for public participation and comment, including at the CEQA scoping meetings, North Coast Water Board workshops, North Coast Water Board adoption hearing, and the State Water Board approval process. Interested parties are advised to check the North Coast Water Board website for announcements regarding North Coast Water Board meetings, updates to the Russian River Watershed TMDL project, and to sign up for the Russian River TMDL email subscription list.

CHAPTER 15

NINE KEY ELEMENTS

15.1 OVERVIEW

The California Nonpoint Source Grant Program allocates Clean Water Act section 319(h) funding from the U.S. EPA to support projects that implement watershed plans to address water quality problems in surface water and groundwater resulting from nonpoint source pollution. Before receiving 319 grants for projects, the project proponent/grantee must demonstrate that a watershed plan is in place and includes the U.S. EPA's nine key elements. The purpose of this chapter is to explicitly explain how the nine key elements are included in this TMDL and described in this Staff Report.

In California, wide ranges of plans are used to comply with the nine key elements, often in combination with each other. Examples of other plans include bacteria load reduction plans, erosion control plans, local watershed plans, coordinated resource management plans, comprehensive conservation and management plans, and Regional Water Quality Control Plans (Basin Plans). Applicants that need assistance may work with their North Coast Water Boards to verify that the combination of plans has the nine elements. More information about the nine key elements can be found in U.S. EPA's "Handbook for Developing Watershed Plans to Restore and Protect Our Waters" (U.S. EPA 2008).

The following describes how the nine key elements are included in this TMDL Staff Report.

Element 1: Identification of Causes & Sources

Element 1 includes the identification of causes of impairment and pollutant sources or groups of similar sources that need to be controlled to achieve needed load reductions, and any other goals identified in the watershed plan. Sources that need to be controlled should be identified geographically along with estimates of the extent to which they are present in the watershed.

Chapter 6 (Source Analysis) describes the geographic distribution of pathogenic indicator bacteria by type (i.e., human, grazer, and bird) and by land cover (i.e., forest, shrubland, agriculture, developed sewer, developed non-sewered) throughout the watershed. Chapter 6 also identifies individual nonpoint sources, including onsite wastewater treatment systems, recreation, runoff from homeless encampments, recycled water discharges from landscape irrigation, pet waste, livestock waste, and runoff from dairies and land application of manure.

Element 2: Load Reductions Expected From Management Measures

An estimate of the load reductions expected from management measures. Estimates for loading reductions should be provided at the same level as that required in the scale and scope component in Element 1.

Chapter 7 (TMDL Calculations and Allocations) describes the point source waste load allocations and nonpoint source load allocations that will attain water quality standards. These allocations are expressed as concentrations of *E. coli* and enterococci bacteria in surface waters and in discharges. Chapter 7 also provides estimates of the reductions that will be needed to achieve the concentration-based load allocations at numerous locations in the watershed. These load reductions are expected to be attained upon the completion of the management measures, which are also known as implementation actions, described in Chapter 9. Calculations pointing to percent load reductions needed by source category are referenced in Chapter 6 as Butkus 2013b and 2014c.

Element 3: Description of Nonpoint Source Management Measures

Element 3 includes the nonpoint source management measures that will need to be implemented to achieve the load reductions in Element 2, and a description of the critical areas in which those measures will be needed to implement this plan. Management measures are groups or categories of cost-effective management practices that are implemented to achieve comprehensive goals.

Chapter 9 (Implementation) describes the nonpoint source management measures that satisfy Element 3. The management measures are better known as implementation actions. They are specific to each type of source of pathogenic indicator bacteria. Within the source category, the management measures/implementation actions are specific to individual facilities and/or areas which are critical for achieving the TMDL and water quality standards.

Element 4: Technical and Financial Assistance Needed, Costs, Sources of Funding, and Implementation Authority

Element 4 includes an estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement the watershed plan. Available federal, state, local, and private funds and resources should be considered and shortfalls between needs and actuals should be identified.

Chapter 12 estimates the costs for implementing the management measures, for both point and nonpoint sources. Chapter 12 also identifies potential sources of funding from public and private sources. Chapter 1 describes the North Coast Water Board's authority to require the implementation of management measures.

Technical assistance will be necessary for many responsible parties as they implement the required management measures. The amount will vary depending on their technical capability and knowledge. Some responsible parties will be able to fully implement on their own, while others will need assistance with funding, project design, permitting, implementation, monitoring, reporting, and maintenance. There are several entities throughout the watershed and across the state that can help provide technical assistance, including:

- Sonoma Resource Conservation District
- Gold Ridge Resource Conservation District
- Mendocino County Resource Conservation District
- University of California Cooperative Extension
- Sonoma County Permit and Resource Management Department
- Mendocino County Planning and Building Services
- Natural Resource Conservation Service's District Conservationists

Element 5: Information and Education

Element 5 includes an information and education component used to enhance public understanding of the project and encourage the public's early and continued participation in selecting, designing, and implementing the nonpoint source management measures that will be implemented.

Chapter 14 (Public Participation Summary) describes the meetings held and efforts made to update, inform, and solicit input from key stakeholders and the public throughout the TMDL development process, including the public review process. In addition, the North Coast Water Board is collaborating with the Russian River Watershed Association to establish a Russian River Regional Monitoring Program through which substantial education and outreach will occur.

Information on individual implementation projects (e.g., grant-funded projects on an individual property) may require additional outreach and education to neighbors and the public. Such project-specific information should be included in a project-specific plan. Russian River Watershed

Element 6: Schedule

Element 6 includes a schedule for implementing the nonpoint source management measures that are identified in the plan and are reasonably expeditious.

9 (Implementation) describes specific compliance dates for required management measures/implementation actions.

Element 7: Interim Measureable Milestones

Element 7 includes interim measurable milestones for determining whether nonpoint source management measures or other control actions are being implemented.

Chapter 9 (Implementation) describes the steps necessary to fully implement appropriate controls for each of the source areas of concern. Milestones are given as deadlines, deliverables, and concentration trends.

Element 8: Benchmarks for Tracking Progress

Element 8 includes criteria or benchmarks that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made toward attaining water quality standards. Interim benchmarks can be direct measurements (e.g., *E. coli* concentrations) or indirect indicators of load reductions (e.g., number of beach caution postings). This element also includes how plans will be revised if interim targets are not met.

Chapter 5 (Numeric Targets) and Chapter 8 (Linkage Analysis) describe the targets or benchmarks proposed to measure protection of beneficial uses and their linkage to the existing water quality objective. Chapter 10 (Watershed Monitoring) describes the procedures for attainment and non-attainment of the target concentrations/loading capacities.

Element 9: Monitoring

Element 9 includes a monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the benchmarks established in Element 8. Watershed-scale monitoring can be used to measure the effects of multiple programs, projects, and trends over time. Instream monitoring does not have to be conducted for individual management practices unless that type of monitoring is relevant and appropriate.

Chapter 10 (Watershed Monitoring) describes requirements and responsible parties for monitoring, assessment, and adaptive management. It also provides an umbrella stewardship approach for cooperation and collaboration in regards to monitoring: the Russian River Regional Monitoring Program.

15.2 SUMMARY

This TMDL Staff Report contains all of the nine key elements of a watershed plan that are needed to qualify for 319(h) nonpoint source grants. Additional, project-level detail may be required to supplement the broader management measures described in this Staff Report. Bacteria load reduction plans, erosion control plans, watershed plans, and other planning documents may be useful when identifying the nine key elements and requesting grants for funding.

CHAPTER 16

REFERENCES

Anderson, J.R. Hardy, E.E., Roach, J.T. and R.E. Witmer. 1976. A Land Use and Land Cover Classification System for use with Remote Sensor Data. Geological Survey Professional Paper 964. U.S. Geological Survey, Washington, DC.

Anderson, S.A., Turner, S.J., and G.D. Lewis. 1997. enterococci in the New Zealand environment: implications for water quality monitoring. *Water Science and Technology* 35(11–12): 325–31.

Applied Survey Research 2005. 2005 Mendocino County Homeless Census and Survey. Applied Survey Research, Watsonville, CA.

Applied Survey Research 2013. 2013 Sonoma County Homeless Census and Survey Comprehensive Report. Applied Survey Research, Watsonville, CA.

BAE Urban Economics 2013. Final Report: 2013 Napa County Farmworker Housing Needs Assessment. Submitted to Napa County Housing and Intergovernmental Affairs. March 29, 2013.

Basu, S., Page, J., and Wei, I.W. 2007. UV Disinfection of Treated Wastewater Effluent: Influent of Color, Reactivation, and Regrowth of Coliform Bacteria. *Environmental Engineer: Applied Research and Practice*. Vol. 4, Fall 2007.

Benito, C.A. 2005. The Economic Impact of Equestrian Activities in Sonoma County. Sonoma State University, School of Business and Economics. Prepared for the Sonoma County Horse Council, Santa Rosa, CA.

Bernhard, A.E., and Field, K.G. 2000a. Identification of nonpoint sources of fecal pollution in coastal waters by using host-specific 16S ribosomal DNA genetic markers from fecal anaerobes. *Applied and Environmental Microbiology* 66(4): 1587–1594.

Bernhard, A.E., and Field, K.G. 2000b. A PCR assay to discriminate human and ruminant feces on the basis of host differences in *Bacteroides*-*Prevotella* genes encoding 16S rRNA. *Applied and Environmental Microbiology* 66(10): 4571–4574.

Boehm, A.B., Soller, J.A. and O.C. Shanks. 2015. Human-Associated Fecal Quantitative Polymerase Chain Reaction Measurements and Simulated Risk of Gastrointestinal Illness in

Recreational Waters Contaminated with Raw Sewage. *Environmental Science & Technology Letters* 2:270–275.

Budnick, G.E., Howard, R.T., and D.R. Mayo. 1996. Evaluation of Enterolert for enumeration of enterococci in recreational waters. *Applied and Environmental Microbiology* 62(10): 3881–3884.

Butkus, S. 2013a. Assessment of Fecal Indicator Bacteria Concentrations measured Draining from Areas with Different Land Covers. Memorandum to the Russian River TMDL File dated January 18, 2013. North Coast Regional Water Quality Control Board, Santa Rosa, CA.

Butkus, S. 2013b. Evaluation of the Averaging Period for Application of Fecal Indicator Bacteria Water Quality Criteria. Memorandum dated July 25, 2013 to the File: Russian River Pathogen TMDL Development and Planning, North Coast Water Quality Control Board. Santa Rosa, CA.

Butkus, S. 2013c. Evaluation of Fecal Coliform Bacteria Concentrations Measured in the Russian River Watershed Indicator Bacteria Water Quality Criteria. Memorandum dated July 25, 2013 to the File: Russian River Pathogen TMDL Development and Planning, North Coast Water Quality Control Board. Santa Rosa, CA.

Butkus, S. 2013d. Fecal Indicator Bacteria Concentration Reductions needed to meet Water Quality Criteria. Memorandum to the Russian River TMDL File dated November 7, 2013. North Coast Regional Water Quality Control Board, Santa Rosa, CA.

Butkus, S. 2014a. Summary and review of report titled “Russian River Human Impact Study – PhyloChip Microbial Community Analysis”. Memorandum dated June 5, 2014 to the File: Russian River Pathogen TMDL Development and Planning, North Coast Water Quality Control Board. Santa Rosa, CA.

Butkus, S. 2014b. Effect of Russian River Dry Season Stream Flow Management on *E. coli* Bacteria Concentrations. Memorandum to the Russian River TMDL File dated June 4, 2014. North Coast Regional Water Quality Control Board, Santa Rosa, CA.

Butkus, S., 2014c. *E. coli* Bacteria Concentration Reductions Needed to Meet Water Quality Criteria for Different Land Cover Areas. Memorandum to the Russian River TMDL File dated June 4, 2014. North Coast Regional Water Quality Control Board, Santa Rosa, CA.

Cabelli, V.J., Dufour, A.P., McCabe, L.J., Levin, M.A. 1982. Swimming Associated Gastroenteritis and Water Quality. *American Journal of Epidemiology* 115 (4). 606-616 as cited in U.S. EPA 2012. Recreational Water Quality Criteria. Publication No. EPA 820-F-12-058. U.S. Environmental Protection Agency, Washington, DC. As reported in (U.S. EPA 2012).

Cabelli, V.J., Dufour, A.P., McCabe, L.J., Levin, M.A. 1983. A Marine Recreational Water Quality Criterion consistent with Indicator Concepts and Risk Analysis. *Journal Water Pollution Control Federation* 55 (10). 1306-1314. As reported in (U.S. EPA 2012).

Casanovas-Massana, A., and Blanch, A. R. 2012. Determination of fecal contamination origin in reclaimed water open-air ponds using biochemical fingerprinting of enterococci and fecal coliforms. *Environmental Science and Pollution Research*. Published online DOI 10.1007/s11356-012-1197-1. Springer-Verlag Berlin Heidelberg.

California Department of Housing and Community Development (CDHCD) 2014. Mobile Homes and RV Parks Listing. Data downloaded January 2014 from <https://ssw1.hcd.ca.gov/ParksListing/faces/parkslist/mp.jsp>.

California Department of Health Services (CDHS) 2006. Draft Guidance for Fresh Water Beaches. Last Update: May 8, 2006. Initial Draft: November 1997. CDHS Division of Drinking Water and Environmental Management. Sacramento, CA

California Department of Health Services (CDHS) 1999. Drinking Water Source Assessment and Protection (DWSAP) Program. Division of Drinking Water and Environmental Management. Carpinteria, CA.

California Department of Health Services (CDHS) 2007. Treatment Technology Report for Recycled Water. Division of Drinking Water and Environmental Management. Carpinteria, CA.

City of Santa Rosa 2013. Santa Rosa Non-Stormwater Discharge Best Management Practices (BMP) Plan for NPDES MS4 Permit Order No. R1-2009-0050. City of Santa Rosa Utilities Department, CA

Corbett, S.J., Rubin, G.L., Curry, G.K., Kleinbaum, D.G. and the Sydney Beach Users Study Advisory Group. 1993. The Health Effects of Swimming at Sydney Beaches. *American Journal of Public Health* 83(12): 1701-1706.

County of Sonoma. 2025. *Comments on the Draft Staff Report and Draft Action for the Russian River Total Maximum Daily Load*.

Devriese, L.A., Vancanneyt, M., Descheemaeker, P., Baele, M., Van Landuyt, H.W., Gordts, B., Butaye, P. Swings, J. and F. Hasesbrouck. 2002. Differentiation and identification of enterococci *durans*, *E. hirae* and *E. villorum*. *Journal of Applied Microbiology* 92: 821-827.

Dubinsky, E.A., Esmaili, L., Hulls, J.R., Cao, Y., Griffith, J.F. and G.L. Andersen. 2012. Application of Phylogenetic Microarray Analysis to Discriminate Sources of Fecal Pollution. *Environmental Science and Technology* 46:4340–4347.

Dubinsky, E., and G. Andersen. 2014. Russian River Human Impact Study PhyloChip Microbial Community Analysis. Final Report dated May 1, 2014. Lawrence Berkeley National Laboratory, Berkeley, CA.

- Dubinsky E.A., Butkus S.R. and G.L. Andersen. 2016. Microbial source tracking in impaired watersheds using PhyloChip and machine-learning classification. *Water Research* 105:56-64.
- Dufour, A.P. 1983. Health Effects Criteria for Fresh Recreational Waters. Publication No. EPA-600/1-84-004. U.S. Environmental Protection Agency, Cincinnati, OH.
- Favero, M.S. 1985. Microbiological indicators of health risks associated with swimming. *American Journal of Public Health* 75(9): 1051–3.
- Ferguson, D.M., Moore, D.F., Getrich, M.A. and M.H. Zhouwandai. 2005. Enumeration and speciation of enterococci found in marine and intertidal sediments and coastal water in southern California. *Journal of Applied Microbiology* 99(3):598-608.
- Ferguson, D., Griffith, J., Cao, Y., Othmann, L., Manajsan, M. and Andre Sonksen. 2011. Assessing natural sources and regrowth of enterococci in urban runoff impacting coastal beaches in San Diego. Great Lakes Beach Association Conference. September 2011, Michigan City, IN.
- Ferguson, D.M., Griffith, J.F., McGee, C.D., Weisberg, S.B., and C. Hagedorn. 2013. Comparison of enterococci Species Diversity in Marine Water and Wastewater Using Enterolert and EPA Method 1600. *Journal of Environmental and Public Health*, Volume 2013, Article ID 848049. <http://dx.doi.org/10.1155/2013/848049>
- Fewtrell, L. and D. Kay. 2015. Recreational Water and Infection: A Review of Recent Findings. *Current Environmental Health Report* 2:85–94
- Fisher, K. and C. Phillips. 2003. The ecology, epidemiology and virulence of enterococci. *Microbiology* 155, 1749–1757
- Fry, J., Xian, G., Jin, S., Dewitz, J., Homer, C., Yang, L., Barnes, C., Herold, N., and J. Wickham. 2011. Completion of the 2006 National Land Cover Database for the Conterminous United States. *Photogrammetric Engineering & Remote Sensing* Vol. 77(9):858-864.
- Griffith, J.F., Layton, B.A., Boehm, A.B., Holden, P.A., Jay, J.A., Hagedorn, C., McGee, C.D., and S. B. Weisberg. 2013. The California Microbial Source Identification Manual: A Tiered Approach to Identifying Fecal Pollution Sources to Beaches. Technical Report 804. Southern California Coastal Water Research Project, Costa Mesa, CA.
- Hansen, D.L., Clark, J.J., Ishii, S., Sadowsky, M.J. and R.E. Hicks. 2008. Sources and Sinks of *Escherichia coli* in Benthic and Pelagic Fish. *Journal of Great Lakes Research* 34:228-234.
- Hartel, P.G., Rodgers, K., Fisher, J.A., McDonald, J.L., Gentit, L.C., Otero, E., Rivera-Torres, Y., Bryant, T.L., and S.H. Jones. 2005. Proceedings of the 2005 Georgia Water

Resources Conference, held April 25-27, 2005, at The University of Georgia. Kathryn J. Hatcher, editor, Institute Ecology, The University of Georgia, Athens, Georgia.

Hartel, P.G., Jones, S. and E. Otero. 2006. Field-testing Targeted Sampling and enterococci faecalis to Identify Human Fecal Contamination in Three National Estuarine Research Reserves. Report Submitted to The NOAA/UNH Cooperative Institute for Coastal and Estuarine Environmental Technology. NOAA Grant Number NA03NOS4190195.

Hazen, T.C., Dubinsky, E.A.; DeSantis, T.Z.; Andersen, G.L., Piceno, Y.M., Singh, N, Jansson, J.K.; Probst, A., Borglin, S.E., Fortney, J.L., Stringfellow, W.T.; Bill, M., Conrad, M. E., Tom, L.M., Chavarria, K.L., Alusi, T.R., Lamendella, R., Joyner, D.C.; Spier, C., Baelum, J., Auer, M.; Zemla, M. ., Chakraborty, R., Sonnenthal, E.L., D'Haeseleer, P., Holman, H. Y. N., Osman, S., Lu, Z. M, Van Nostrand, J.D., Deng, Y., Zhou, J.Z., and O.U. Mason. 2010. Deep-Sea Oil Plume Enriches Indigenous Oil-Degrading Bacteria. *Science* 2010, 330 (6001), 204–208.

Howard, J. 2010. Sensitive Freshwater Mussel Surveys in the Pacific Southwest Region: Assessment of Conservation Status. Prepared for USDA Forest Service, Pacific Southwest Region. The Nature Conservancy.

IDEXX. 2001. Colilert® and Enterolert® Test Pack Procedures IDEXX Laboratories, Inc., Westbrook, Maine.

Layton, A., McKay, L., Williams, D., Garrett, V., Gentry, R., and G. Sayler 2006. Development of Bacteroides 16S rRNA Gene TaqMan-Based Real-Time PCR Assays for Estimation of Total, Human, and Bovine Fecal Pollution in Water. *Applied and Environmental Microbiology* 72(6): 4214–4224.

Lim, S. and V. Olivieri. 1982. Sources of Microorganisms in Urban Runoff. Johns Hopkins School of Public Health and Hygiene. Jones Falls Urban Runoff Project. Baltimore, MD. As reported in (Schueler 2000).

Linegar, T. 2013. Sonoma County Agricultural Crop Report – 2012. Office of the Agricultural Commissioner, County of Sonoma, Santa Rosa, CA.

Marks, R. 2001. Cesspools of Shame – How Factory Farm Lagoons and Sprayfields threaten Environmental and Public Health. Natural Resources Defense Council and the Clean Water Network. Washington, DC.

Mattison K, Shukla A , Cook A, Pollari F, Friendship R, Kelton D, Bidawid S, Farber JM. Human norovirus in swine and cattle. *Emerg Infect Dis* 2007; 13(8):1184-1188.

McAllister, T.A. and E. Topp. 2012. Role of Livestock in microbial contamination of water: Commonly the blame, but not always the source. *Animal Frontiers* 2(2):17-27.

- Molina, M. 2007. Evaluation of Selected DNA-based Technology in Impaired Watersheds Impacted by Fecal Contamination from Diverse Sources. Publication No. EPA/600/R-07/123. U.S. Environmental Protection Agency, Athens, GA.
- Morse, C. 2012. Mendocino County Agricultural Crop Report – 2012. Office of the Agricultural Commissioner, County of Mendocino, Ukiah, CA.
- National Resources Conservation Service (NRCS). 2007. Chapter 7 - Hydrologic Soil Groups. Part 630 Hydrology National Engineering Handbook. 210-VI-NEH. U.S. Department of Agriculture. Washington, DC.
- National Resources Conservation Service (NRCS). 2013. Soil Survey Geographic Database (SSURGO). U. S. Department of Agriculture. Washington, DC. Available at <http://websoilsurvey.nrcs.usda.gov/>
- Niemi, R.M., Ollinkangas, T., Paulin, L., Svec, P., Vandamme, P., Karkman, A., Kosina, M., and K. Lindström. 2012. *enterococci rivorum* sp. nov., from water of pristine brooks. International Journal of Systematic and Evolutionary Microbiology 62(9):2169-73.
- North Coast Regional Water Quality Control Board (NCRWQCB). 1967. Water Quality Control Policy for the Klamath River in California. State of California. The Resources Agency. March 1967.
- North Coast Regional Water Quality Control Board (NCRWQCB). 1971a. Interim Water Quality Control Policy for the Klamath River Basin. State of California. The Resources Agency. June 1971.
- North Coast Regional Water Quality Control Board (NCRWQCB). 1971b. Interim Water Quality Control Policy for the North Coastal Basin. State of California. The Resources Agency. June 1971.
- North Coast Regional Water Quality Control Board (NCRWQCB). 1975. Water Quality Control Policy for the North Coastal Basin. State of California. State Water Resources Control Board. April 1975
- North Coast Regional Water Quality Control Board (NCRWQCB) 2011. Water Quality Control Plan for the North Coast Region. NCRWQCB, Santa Rosa, CA.
- North Coast Regional Water Quality Control Board (NCRWQCB) 2012. Russian River Pathogen TMDL: 2011-2012 Monitoring Report. NCRWQCB, Santa Rosa, CA. May 2012.
- North Coast Regional Water Quality Control Board (NCRWQCB) 2013a. Russian River Pathogen TMDL: Onsite Wastewater Treatment System Impact Study Report. NCRWQCB, Santa Rosa, CA. July 2013.

North Coast Regional Water Quality Control Board (NCRWQCB) 2013b. Russian River Pathogen TMDL: Beach Recreation Impact Study Report. NCRWQCB, Santa Rosa, CA. November 2013.

North Coast Regional Water Quality Control Board (NCRWQCB) 2013c. Upper Russian River Fecal Indicator Bacteria Monitoring Report. NCRWQCB, Santa Rosa, CA. November 2013.

Ode, P. and K. Schiff. 2009. Recommendations for the Development and Maintenance of a Reference Conditional Management Program (RCMP) to Support Biological Assessment of California's Wadeable Streams. Final Technical Report. California Water Boards. Surface Water Ambient Monitoring Program.

Palencia, L. and E. Archibald. 2013. Sonoma County Water Agency Watershed Sanitary Survey. Second Update. Final Report. November 2013.

Pitt, R. 1998. "Epidemiology and Stormwater Management." In Stormwater Quality Management. CRC/Lewis Publishers. New York, NY. As reported in (Schueler 2000).

Roberts, G.S. 2012. When Bacteria call the Storm Drain "Home". Stormwater Journal for Surface Water Quality Professionals. May 2012. Santa Barbara, CA.

Schueler, T. 2000. Microbes in Urban Watersheds: Concentrations, Sources, & Pathways: The Practice of Watershed Protection. Center for Watershed Protection, Ellicott City, MD. *Watershed Protection Techniques* 3(1): 554-565.

Sercu, B. Van De Werfhorst, L.C., Murray, L.S. and P.A. Holden. 2010. Cultivation-independent analysis of bacteria in IDEXX Quanti-1 Tray/2000 fecal indicator assays. *Applied Environmental Microbiology*, doi:10.1128/AEM.01113-10, American Society for Microbiology.

Seyfried, P.L., Tobin, R.S., Brown, N.E., and P.F. Ness, P.F. 1985a. A prospective study of swimming-related illness: I. Swimming-associated health risk. *American Journal of Public Health* 75:1068-1070.

Seyfried, P.L., Tobin, R.S., Brown, N.E., and P.F. Ness. 1985b. A prospective study of swimming-related illness: II. Morbidity and the microbiological quality of water. *American Journal of Public Health* 75:1071-1075.

Shanks, O.C., White, K., Kelty, C.A., Sivaganesan, M., Blannon, J., Meckes, M., Varma, M., and R.A. Haugland. 2010a. Performance of PCR-based assays targeting Bacteroidales genetic markers of human fecal pollution in sewage and fecal samples. *Environmental Science and Technology* 44(16):6281-6288.

Shanks, O.C., White, K., Kelty, C.A., Hayes, S., Sivaganesan, Jenkins, M., Varma, M., and R.A. Haugland. 2010b. Performance Assessment PCR-Based Assays Targeting

Bacteroidales Genetic Markers of Bovine Fecal Pollution. *Applied and Environmental Microbiology* 76(5): 1359–1366

Soller, J.A., Bartrand, T., Ashbolt, N.J., Ravenscroft, J., Wade, T., 2010. Estimating the primary aetiologic agents in recreational freshwaters impacted by human sources of faecal contamination. *Water Research* 44 (16), 4736e4747.

Sonoma County Department of Health Services (SCDHS). 2014. Fresh Water Quality Sampling: Russian River Beaches and Spring Lake Lagoon. Data downloaded on November 14, 2014 from <http://www.sonoma-county.org/health/services/pdf/russianriver2014.pdf>.

Stoddard, J.L., D.P. Larsen, C.P. Hawkins, R.K. Johnson, and R.H. Norris. 2006. Setting Expectations for the Ecological Condition of Streams: The Concept of Reference Condition. *Ecological Applications* 16(4), 2006, pp. 1267-1276.

Trial, W. et al. 1993. Bacterial Source Tracking: Studies in an Urban Seattle Watershed. *Puget Sound Notes* 30:1-3. As reported in (Schueler 2000)

Tyler, J. 2013. Personal Communication from James Tyler, Supervising Environmental Health Specialist with the County of Sonoma Department of Health Services to Steve Butkus (North Coast Water Board Staff) on October 4, 2013.

U.S. Census Bureau (2010) Annual Estimates of the Resident Population. April 1, 2010. Available at <http://www.census.gov/2010census/popmap/ipmtext.php?fl=06>

U.S. Census Bureau (2013). Annual Estimates of the Resident Population. July 1, 2013. Available at <http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk>

U.S. Department of Health, Education, and Welfare (U.S. DHEW). 1972. Manual of Septic-Tank Practice. Rockville, MD.

U.S. Environmental Protection Agency (U.S. EPA) 1976. Quality Criteria for Water. U.S. EPA, Washington, DC.

U.S. Environmental Protection Agency (U.S. EPA) 1986. Ambient Water Quality Criteria for Bacteria – 1986. Publication No. EPA440/5-84-002. U.S. EPA, Washington, DC.

U.S. Environmental Protection Agency (U.S. EPA) 1999. Protocol for Developing Nutrient TMDLs. Publication No. EPA 841-B-99-007. Office of Water (4503F). U.S. EPA, Washington, DC.

U.S. Environmental Protection Agency (U.S. EPA) 2001a. Protocol for Developing Pathogen TMDLs. Publication No. EPA 841-R-00-002. Office of Water (4503F). U.S. EPA, Washington, DC.

U.S. Environmental Protection Agency (U.S. EPA) 2001b. EPA Requirements for Quality Assurance Project Plans. Publication No. EPA/240/B-01/003. U.S. EPA, Washington DC.

U.S. Environmental Protection Agency (U.S. EPA) 2002a. Method 1600: enterococci in Water by Membrane Filtration Using membrane-enterococci Indoxyl- β -D-Glucoside Agar (mEI). Publication No. EPA 821-R-02-022. U.S. EPA, Washington, D.C.

U.S. Environmental Protection Agency (U.S. EPA) 2002b. Method 1603: Escherichia coli (*E. coli*) in Water by Membrane Filtration Using Modified Membrane-Thermotolerant Escherichia coli Agar (Modified mTEC). Publication No. EPA 821-R-02-023. U.S. EPA, Washington, D.C.

U.S. Environmental Protection Agency (U.S. EPA) 2002c. Guidance for Quality Assurance Project Plans EPA QA/G-5. Publication No. EPA/240/R-02/09. U.S. EPA, Washington, D.C.

U.S. Environmental Protection Agency (U.S. EPA). 2008. Handbook for Developing Watershed Plans to Restore and Protect Our Waters. Publication No. EPA 841-B*08-002. U.S. EPA. Washington, D.C.

U.S. Environmental Protection Agency (U.S. EPA). 2009. Review of zoonotic pathogens in ambient water. Publication No. EPA 822-R-09-002. USEPA, Washington, D.C.

U.S. Environmental Protection Agency (U.S. EPA) 2010. Report on 2009 National Epidemiologic and Environmental Assessment of Recreational Water Epidemiology Studies. Publication No. EPA-600-R-10-168. U.S. EPA, Washington, DC.

U.S. Environmental Protection Agency (U.S. EPA) 2012. Recreational Water Quality Criteria. Publication No. EPA 820-F-12-058. U.S. EPA, Washington, DC.

U.S. Food and Drug Administration (U.S. FDA) 2011. Guide for the Control of Molluscan Shellfish. National Shellfish Sanitation Program. U.S. FDA, College Park, MD.

van der Wel, B. 1995. "Dog Pollution." *The Magazine of the Hydrological Society of South Australia* 2(1)1. As reported in (Schueler 2000).

Wade, T.J., Pai, N., Eisenberg, J.N.S. and J.M. Colford, Jr. Do U.S. Environmental Protection Agency Water Quality Guidelines for Recreational Waters Prevent Gastrointestinal Illness? A Systematic Review and Meta-analysis. *Environmental Health Perspectives* 111(8):1102-1109.

Wexler, H.M. 2007. Bacteroides: the Good, the Bad, and the Nitty-Gritty. *Clinical Microbiology Reviews* 20(4):593-621.

Wheeler, A.L., Hartel, P.G., Godfrey, D.G., Hill, J.L., and W.I. Segars. 2002. Potential of enterococci faecalis as a Human Fecal Indicator for Microbial Source Tracking. *J. Environ. Qual.* 31:1286–1293.

Wilhelm, S., S. Schiff, and J. Cherry. 1994. Biogeochemical Evolution of Domestic Wastewater in Septic Systems: 1. Conceptual model." *Groundwater* 32: 905-916.

Yakub, G.P., Castric, D.A., Stadterman-Knauer, K.L., , Tobin, M.J., Blazina, M., Heineman, T.N., Yee, G.Y. and L. Frazier. 2002. Evaluation of Colilert and Enterolert Defined Substrate Methodology for Wastewater Applications. *Water Environment Research* Vol. 74, No. 2 (Mar. - Apr., 2002), pp. 131-135.

Zhang, Z., and B.E. Johnson. 2010. HEC-HMS Development in Support of Russian River Watershed Assessment. Publication No. ERDC/EL TN-10-3. U.S. Army Corps of Engineers. Army Engineer Research and Development Center, Vicksburg, MS.