Appendix B

Staff Report

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Pathogens in the Napa River Watershed Total Maximum Daily Load (TMDL)

Staff Report

California Regional Water Quality Control Board San Francisco Bay Region

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This report is available in electronic format at:
http://www.waterboards.ca.gov/sanfranciscobay/napariverpathogentmdl.htm

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1. INTRODUCTION

1.1 Overview

This staff report provides the technical background and basis for a proposed amendment to the *Water Quality Control Plan, San Francisco Bay Region* (Basin Plan) (Water Board, 1995). The report presents results of staff analysis of pathogen impairment and sources, recommended pathogen load allocations, and a plan to implement the allocations. If adopted, the Basin Plan amendment would: 1) establish a pathogen Total Maximum Daily Load (TMDL) in the Napa River watershed pursuant to Section 303(d) of the Clean Water Act, and 2) establish an implementation strategy to achieve and support the TMDL. If adopted, portions of Basin Plan Chapter 4 (implementation plan) will be revised.

1.2 Compliance with the California Environmental Quality Act (CEQA)

This staff report meets the requirements of the California Environmental Quality Act (CEQA) for adopting Basin Plan amendments. CEQA authorizes the California Resources Agency Secretary to exempt a state agency's regulatory program from preparing an Environmental Impact Report or Negative Declaration if certain conditions are met. The Resources Agency has certified the basin planning process to be "functionally equivalent" to the CEQA process. Therefore, this report is a functional equivalent document and fulfills CEQA environmental documentation requirements.

1.3 Description of TMDL Process

The federal Clean Water Act requires states to identify impaired waters and the pollutants causing impairments. This list of water bodies is often referred to as the "303(d) list", referencing the identification requirement in section 303(d) of the Clean Water Act).. In California, it is the State Board that adopts this list of impaired water bodies, with input from the regions and stakeholders. The Clean Water Act also requires states to establish Total Maximum Daily Loads (TMDLs) for the listed pollutants in those impaired waters, which is the responsibility of the Regional Water Boards. TMDLs are essentially water body-specific cleanup or restoration plans that target the pollutants causing impairment. Essential components of TMDLs include: numeric target(s) that define the desired condition or "restored" condition of the waterbody; the maximum amount of pollutant(s) or stressor(s) the waterbody can tolerate while meeting these targets; identification of the sources of the pollutant(s) reaching the waterbody; and allocations of pollutant loads or load reduction responsibility to these sources.

The Napa River is listed as impaired for pathogens, as well as sediments and nutrients . The Napa River lies within the jurisdiction of the California Regional Water Quality Control Board, San Francisco Bay Region (Water Board), and therefore the Water Board is responsible for developing a TMDL to address the impairment of the Napa River by pathogens. This report describes the water quality problem causing the impairment, pollution sources and actions needed to restore or cleanup the water body. This TMDL addresses water quality in all tributaries of the Napa River and serves as a comprehensive water quality attainment strategy for the watershed. This report provides the technical and scientific basis for the Basin Plan amendment.

TMDLs are established via Board-approved amendments to our Basin Plan, and these amendments must also include plans to implement the TMDLs. As required, the proposed amendment and this staff report contain a detailed implementation plan, identify responsible parties and schedules for actions, and describe monitoring to track the actions and attainment of water quality standards. Additional studies may be prescribed to confirm key assumptions made while developing the TMDL, resolve any uncertainties remaining when the TMDL is adopted, and establish a process for revising the TMDL, as necessary, in the future.

1.4 Next Steps

The Water Board will hold two public hearings, a testimony hearing and an adoption hearing, for this TMDL. The first, a testimony hearing, is scheduled for April 12, 2006. This hearing will provide an opportunity for interested parties to hear and comment on the proposed Basin Plan amendment and associated staff report, which includes an implementation plan. In addition, Water Board members will be able to ask questions of staff and stakeholders. At the second hearing, which is the adoption hearing, the Water Board will be asked to consider comments received, consequent staff responses, and any proposed revisions, and to begin the process of establishing the TMDL by adopting the proposed Basin Plan amendment. The adoption hearing is anticipated to be held on June 14, 2006. After adoption by the Water Board, the TMDL will be sent to the State Water Board, the California Office of Administrative Law, and U.S. EPA for approval.

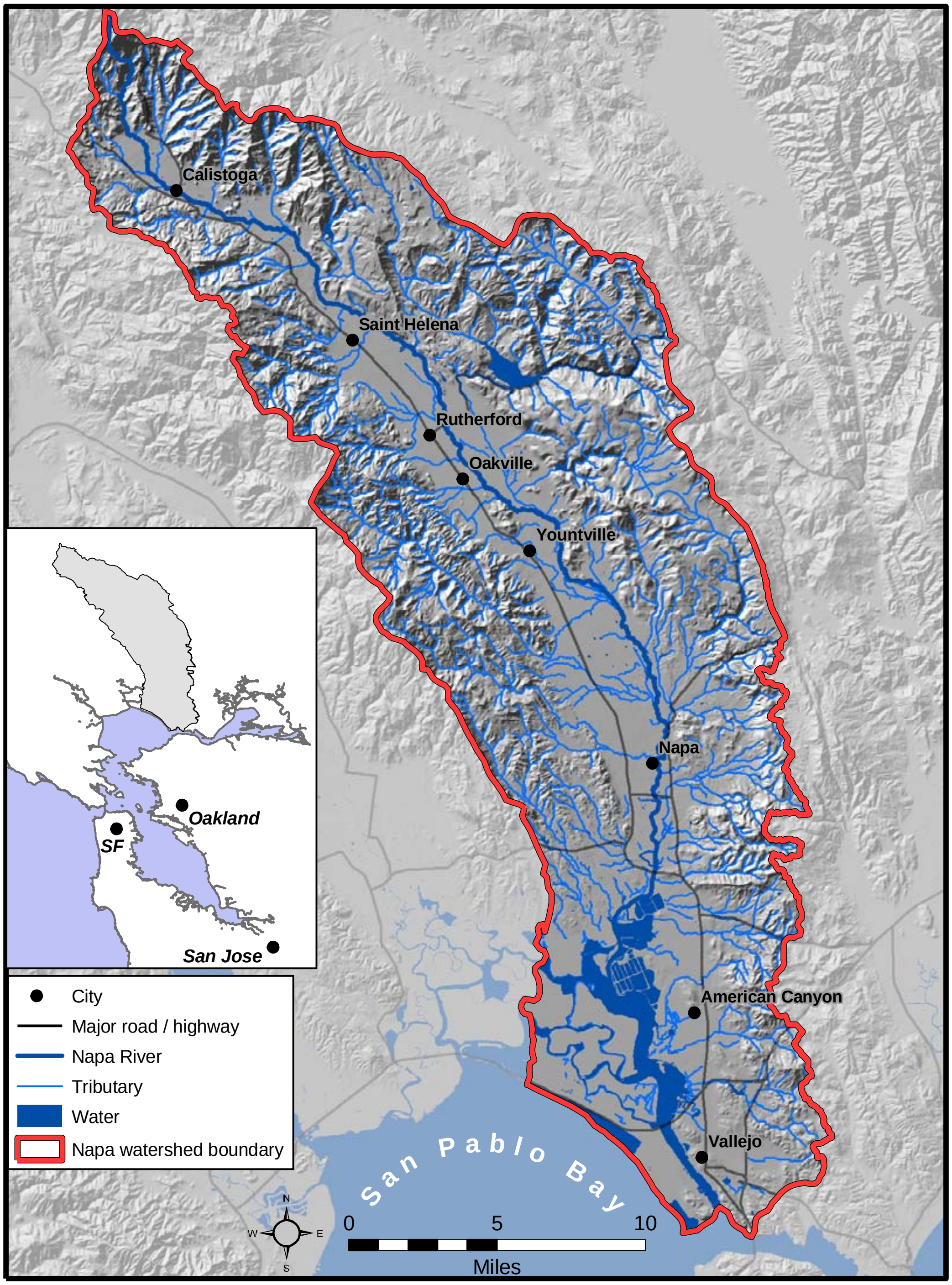
2. WATERSHED DESCRIPTION

The Napa River watershed is located in the California Coast Ranges north of San Pablo Bay (Figure 1), covering an area of approximately 426 square miles (1,103 km^2). The main stem of the Napa River flows approximately 55 miles in a southeasterly direction though the Napa Valley before discharging to San Pablo Bay. Numerous tributaries enter the main stem from the mountains that rise abruptly on both sides of the valley.

Average annual rainfall ranges from 25 to 38 inches in the Napa Valley. Precipitation tends to be somewhat higher in the Mayacanas mountains to the west of the valley, and lower in the eastern mountains. The large majority of rainfall occurs from November through April, with heaviest rainfall occurring from December through February. This rainfall regime results in two distinct seasons in the watershed. During the winter wet season streamflow and pollutant loading are dominated by precipitation-driven surface runoff. In contrast, groundwater inflow or runoff from human activities are dominant during the dry summer months.

Major land cover types in the watershed are forest (35%), grassland/rangeland (23%), and agriculture (19%). Approximately two-thirds of agricultural land is in vineyards (13% of total area). Developed land—residential, industrial, or commercial—accounts for approximately 8% of the watershed (Association of Bay Area Governments, 2000).

Figure 1.
Location of the Napa River Watershed



3. PROBLEM DEFINITION

Elevated levels of fecal coliform bacteria have been observed in the Napa River since the 1960s. These bacteria indicate the presence of fecal contamination and attendant health risk to recreational users of the river from water-borne pathogens. Fecal contamination is the primary mechanism for the spread of water-born illness (American Public Health Association, 1998; U.S. EPA, 2001, 2002).

Recent monitoring programs (see Sections 3.3 and 3.4) confirm elevated fecal coliform and *Escherichia coli* (*E. coli*) levels in the river and its tributaries. The following sections discuss the use of pathogen indicator bacteria in water quality monitoring and regulation, relevant water quality standards, historic bacterial monitoring in the watershed, and current bacterial water quality studies.

3.1 Use of Fecal Bacteria as Indicators of Pathogens

More than 100 types of pathogenic microorganisms may be found in water polluted by fecal matter and can cause outbreaks of waterborne disease (Havelaar, 1993). Techniques currently available for direct monitoring of specific pathogens in water have several shortcomings that preclude their use in routine water quality monitoring. Some common disease-causing viruses (Hepatitis A virus, Rotaviruses, and Norwalk virus) cannot as-yet be detected practically; techniques for the recovery and identification of human enteric viruses (viruses affecting the intestines) often have limited sensitivity, are time consuming, and expensive (U.S. EPA, 2001).

Due to these difficulties, indicator organisms—principally bacteria—are commonly used to assess microbial water quality for recreational use waters. Indicator bacteria colonize the intestinal tracts of warm-blooded animals (including humans) and are routinely shed in animal feces. These organisms are not necessarily pathogenic, but are abundant in wastes from warm-blooded animals and are easily detected in the environment. The detection of these organisms indicates that the environment is contaminated with fecal waste and that pathogenic organisms may be present.

Commonly used bacterial indicators of fecal contamination include total coliforms, fecal coliforms, *E. coli*, and fecal enterococci. Total coliforms include several genera of bacteria commonly found in the intestines of warm-blooded animals. However, many types of coliform bacteria grow naturally in the environment—that is, outside the bodies of warm-blooded animals. Fecal coliforms are a subset of total coliform and are more specific to wastes from warm-blooded animals, but not necessarily to humans. *E. coli* are a subset of fecal coliforms, and are thought to be more closely related to the presence of human pathogens than fecal coliforms (U.S. EPA, 2002). Fecal enterococci represent a different bacterial group from the coliforms, and are also regarded to be good indicators of fecal contamination, especially in salt water (U.S. EPA, 2002).

Although fecal bacteria have historically been the indicator organisms of choice, they have three primary shortcomings: 1) the presence of these indicators does not necessarily mean that human pathogens are present—only that they may be present; 2) bacterial indicators may not have the same levels of survival in the environment as the pathogens for which they are intended to serve as sentinels; and 3) these indicators are not human-specific, and therefore do not fully assess the health risk from human enteric viruses and other human-specific pathogens. The third limitation is of less importance than might be assumed, since fecal contamination from a wide range of non-human species—both domesticated and wild—often carry human pathogens (U.S. EPA, 2002). Despite these shortcomings[1], no practical alternative to the use of fecal indicator bacteria is currently available. The Napa River Pathogen TMDL uses fecal coliforms, *E. coli*, and fecal enterococci as pathogen indicators. Use of these indicators is consistent with state water quality criteria and with federal guidance (U.S. EPA, 2002). If in the future better indicator organisms are identified and new standards are put into place for these organisms, this TMDL will be modified accordingly.

Microbial Source Tracking (MST) methods have recently been used to help identify nonpoint sources responsible for the fecal pollution of water systems. These methods involve examining the DNA or antibiotic resistance properties of fecal indicator bacteria to determine if the bacteria originated from humans, domesticated animals, or wildlife. Microbial source tracking was not employed in this TMDL for the following reasons:

- This approach is very expensive and time-consuming
- Results are often imprecise and equivocal (Stoeckel et al., 2004)
- Since both human and non-human fecal contamination is known to pose human health risks (Atwill, 1995; U.S. EPA, 2001) identification of a pathogen source as non-human does not eliminate the need to control the source

A more detailed discussion of MST is presented in the Tomales Bay Pathogen TMDL Final Project Report (Water Board, 2005).

[1] An important additional limitation that applies to ambient sampling for any type of microorganism—including both indicator bacteria and actual pathogenic organisms—is that reported sample values are subject to error resulting from limitations in sampling and analytical methods, and should therefore be regarded as approximations. Sources of error can include non-uniform distribution of target organisms in the water being sampled, differential survival of organisms during sample storage and in the test media, clumping of multiple organisms in the test media (with the result that several organisms are counted as just one), and statistical limitations of the testing procedure. Sampling and analytical procedures are designed to minimize these errors, but even in the best of situations the precision of laboratory analysis for bacteria is low relative to chemical analyses. In many cases the true value for a single sample may range from one-third to three times the reported value (American Public Health Association, 1998). This uncertainty can be considerably reduced through repeated sampling and use of geometric means or medians, rather than single-sample values.

3.2 Water Quality Standards

Under CWA authority, the Water Board has established water quality standards for the Napa River and its tributaries. Water quality standards consist of: a) beneficial uses[2] for the waterbody, b) water quality objectives[3] (numeric or narrative) to protect those beneficial uses, and c) the Antidegradation Policy, which requires the continued maintenance of existing high-quality waters. The Water Board's Basin Plan specifies beneficial uses for waterbodies in the Region and the objectives and implementation measures necessary to protect those beneficial uses. The beneficial uses of the Napa River and its tributaries impaired by high levels of pathogens (Table 1) are water contact recreation (REC-1) and non-contact water recreation (REC-2). The purpose of this TMDL is to protect and restore these beneficial uses by reducing the levels of pathogens in this watershed. Water quality objectives for REC-1 use are more stringent than those for REC-2, since REC-1 can involve water ingestion. Since both beneficial uses occur throughout the entire Napa River drainage basin, this TMDL will be driven by the more rigorous REC-1 requirements.

Table 1
Beneficial Uses of the Napa River Watershed
Potentially Impaired by Pathogens

Designated Beneficial Use	Description (as defined in Basin Plan)
Water Contact Recreation (REC-1)	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, whitewater activities, fishing, and uses of natural hot springs.
Non-contact Water Recreation (REC-2)	Uses of water for recreational activities involving proximity to water, but not normally involving contact with water where water ingestion is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, bathing, tide pool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.

Table 2 lists the Water Board's Basin Plan numerical water quality objectives for fecal and total coliforms for contact recreation (REC-1). The Basin Plan also cites U.S. EPA bacteriological criteria "to supplement objectives for recreational waters" (Water Board, 1995). The U.S. EPA criteria are presented in Table 3.

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[2] Synonymous with "designated uses" as used in the CWA.
[3] Synonymous with "water quality criteria" as used in the CWA.

The percentile criteria in Table 3 were originally expressed as single sample maximums (U.S. EPA, 1986). The 75th percentile value was applied as a single sample maximum at designated beaches, the 82nd at moderately used areas, the 90th at lightly used areas, and the 95th at infrequently used areas. Reconsideration of the epidemiological data on which these criteria are based, and of the statistical implications of these data, led U.S. EPA to revise the single sample maximum interpretation to a percentile-based interpretation (U.S. EPA, 2002, 2003). While the Basin Plan citation still reflects the old U.S. EPA interpretation, Table 3 is based on the newer interpretation.

Table 2
Water Quality Objectives For Coliform Bacteria[a]

Beneficial Use	Fecal Coliform (MPN[4]/100 mL)	Total Coliform (MPN/100 mL)
Water Contact Recreation (REC 1)	Log mean[b]<200 90th percentile<400	Median< 240 No sample> 10,000
Non-contact Water Recreation (REC 2)	Mean<2000 90th percentile<4000	N/A

[a]Based on a minimum of five consecutive samples equally spaced over a 30-day period.
[b]"Log mean" is in this case synonymous with geometric mean, the latter being the preferred term.

Table 3
U.S. EPA Recommended Water Quality Criteria for Bacteria in Fresh-Contact Recreational Waters

	Enterococci (CFU[a]/100 mL)	*E. Coli* (CFU/100 mL)
Steady State (all areas):	33	126
Percentiles[b]:		
75th	61	235
82nd	89	298
90th	108	406
95th	151	576

[a]Colony forming unit (CFU)[5].
[b]U.S. EPA does not specify a minimum number of samples upon which to base percentile calculations.

[4] MPN (Most Probable Number) is used here as a unit of measure, equivalent for practical data interpretation and regulatory purposes to CFU, described in the following footnote. The term MPN also describes a laboratory method consisting of a multi-phase laboratory assay followed by a statistical estimate of the number of organisms present.

[5] Throughout the remainder of this document, bacterial counts are expressed as colony forming units (CFU). The term MPN in Table 2 is used in order to be consistent with Basin Plan language. For practical data interpretation and regulatory purposes, MPN and CFU can be considered equivalent *when used as units of measurement*, both referring to the estimated number of viable bacteria in the sample (U.S. EPA, 2001).

It is noteworthy that U.S. EPA does not specify criteria for total coliforms in contact recreational waters. As discussed in Section 3.1 above, total coliform bacteria can reproduce in the environment outside the bodies of warm-blooded animals, and are therefore a poor indicator for pathogens in ambient water samples. The use of total coliform as indicators in fresh recreational waters is generally considered obsolete. However, total coliforms are still frequently used to monitor disinfection efficiency in wastewater treatment facilities.

3.3 Summary of Past Bacteriological Water Quality Studies in the Napa River

Beginning in the 1960s, a number of water quality studies have found excessive bacteria densities in the Napa River. Most of these studies focused on the main stem of the river. This TMDL applies to both the main stem and all tributaries within the drainage basin. Current monitoring, described later in this report, addresses both main stem and tributaries.

A 1969 study conducted by the California State Department of Public Health (1969) documented bacterial problems along the main stem of the Napa River. Thirty-nine main stem sites ranging from Kimball Reservoir to the Solano County line were sampled on five successive weeks in the summer of 1969. Median fecal coliform values exceeded the Basin Plan objective of 200 CFU/100 mL at fifteen of these sites, with the highest median (2,300 CFU/100 mL) observed at First Street in Napa. While some of the sites with high bacteria levels were associated with wastewater discharges, many—including the First Street site—were not.

The Napa Sanitation District sampled fecal coliforms in the tidally influenced reaches of the Napa River in 1972 and 1973 (Napa Sanitation District, 1974). Five stations, ranging from Third Street to the Solano County line were sampled approximately monthly from August 1972 though July 1973. Dry season (April though October) geometric means ranged from 13 to 104 CFU/100 mL, all falling below the Water Board objective of 200 CFU/100 mL. Dry season 90th percentile values ranged from 43 CFU/100 mL to 460 CFU/100 mL. Only the highest of these—the 3rd Street station—exceeded the 90th percentile Basin Plan objective of 400 CFU/100 mL. Wet season (November though March) geometric means ranged from 387 to 1,189 CFU/100 mL, all exceeding the Water Board objective. All wet season 90th percentile values exceeded the Water Board objective, with many individual samples greater than 2,000 CFU/100 mL.

A study conducted by the University of California, Berkeley for the Water Board from 1984 and 1985 (Johnson, 1985) monitored *E. coli* levels at fifteen sites on the Napa River, ranging from Tubbs Lane to Trancas Street. Samples were collected approximately biweekly from May 1984 though April 1985. During the dry season (May through October 1984 and April 1985), geometric means exceeded the U.S. EPA criterion of 126 CFU/100 mL at three stations: Tubbs Lane, Dunaweal Lane, and Trancas Street. Wet season (November 1984 through March 1985) geometric means exceeded the criterion at all fifteen sampling stations.

The results presented above provide historical perspective on the pathogen problem in the Napa River watershed. Improvements in waste treatment and management practices have resulted in significantly improved water quality, as described in the following section.

3.4 Recent and Ongoing Bacterial Water Quality Studies in the Napa River

Two major monitoring efforts provide insights into the current pathogen levels in the Napa River system: An ongoing program implemented by the Napa County Department of Environmental Management initiated in December 2002 in response to a raw sewage spill in Napa; and a study developed specifically in support of the Napa River Pathogen TMDL, cooperatively conducted by the Water Board and the San Francisco Estuary Institute (SFEI), with laboratory support from U.S. EPA. The two complementary efforts have sufficient overlap in stations to allow each study to serve to verify data collected by the other.

The Napa County monitoring program consists of approximately biweekly sampling for fecal and total coliforms at seven stations on the lower Napa River from Oak Knoll Road, north of Napa, to Kennedy Park, upstream of the Highway 29 bridge (Figure 2). Results obtained to date (through September 2004) are summarized in Table 4. Fecal coliform results are grouped into dry and wet seasons for each of the two sampling years: wet season 2002–2003, dry season 2003, wet season 2003–2004, and dry season 2004. Only two geometric mean values exceed the Basin Plan fecal coliform objective of 200 CFU/100 mL: wet season 2002–03 and dry season 2004, both at China Point. In contrast, many dry season and most wet season 90^{th} percentile values exceed the Basin Plan fecal coliform objective of 400 CFU/100 mL. The difference between geometric mean and 90^{th} percentile results reflects high within-season variability in fecal coliform densities. The raw monitoring results (Appendix A) show periods of low bacteria counts interspersed with occasional high counts, which result in fairly low geometric means, but fairly high 90^{th} percentiles. This type of data pattern illustrates one reason for having both geometric mean and 90^{th} percentile objectives: the former is more sensitive to consistently elevated bacterial densities, while the latter is better suited to detecting periodic excursions. Combined, the geometric mean and 90^{th} percentile values indicate moderate, intermittent bacterial impairment of the lower Napa River.

No obvious spatial patterns appear in the Napa County data. This is not surprising, since all but one of the sampling stations are in tidal portions of the river, where rapid bi-directional water movement would be expected to obscure spatial differences. (The study was limited to mostly tidal portions of the river because the sewage spill that precipitated the study only had an influence on this portion of the river.) The lack of spatial patterns does, however, suggest the absence of large, discrete pathogen sources in this portion of the river.

The Water Board/SFEI study was more spatially intensive, but involved fewer sampling events than the Napa County program. Seven main-stem sampling stations were distributed from Tubbs Lane in Calistoga to Third Street in Napa, with sixteen additional tributary stations (Figure 3). Sampling was conducted in October 2002, January 2003, and July 2003. The January sampling began approximately one week following a major winter storm event, and was intended to represent stable-flow wet season conditions. The other two events were selected to represent typical dry season conditions. For most of the sites a single sample was collected during each event. However, for each event a subset of five sites was selected for a more intensive sampling. Intensive sampling consisted of five samples collected at weekly intervals, allowing calculation of geometric means. Selection of sites for intensive sampling was based on suspected bacterial contamination, or on high frequency of recreational use.

Results of the Water Board/SFEI study are summarized in Table 5 (raw data are presented in Appendix B). Exceedances of U.S. EPA recommended criteria (both the geometric mean value of 126 CFU/100 mL and the single-sample 90^{th} percentile value of 406 CFU/100 mL) occurred at several locations, during both wet and dry season sampling. Most exceedances were observed in the lower watershed, and most were in tributaries rather than the main stem. These results will be discussed in greater detail in the source assessment section of this report.

Figure 2
Sites Monitored by the Napa County Department of Environmental Management

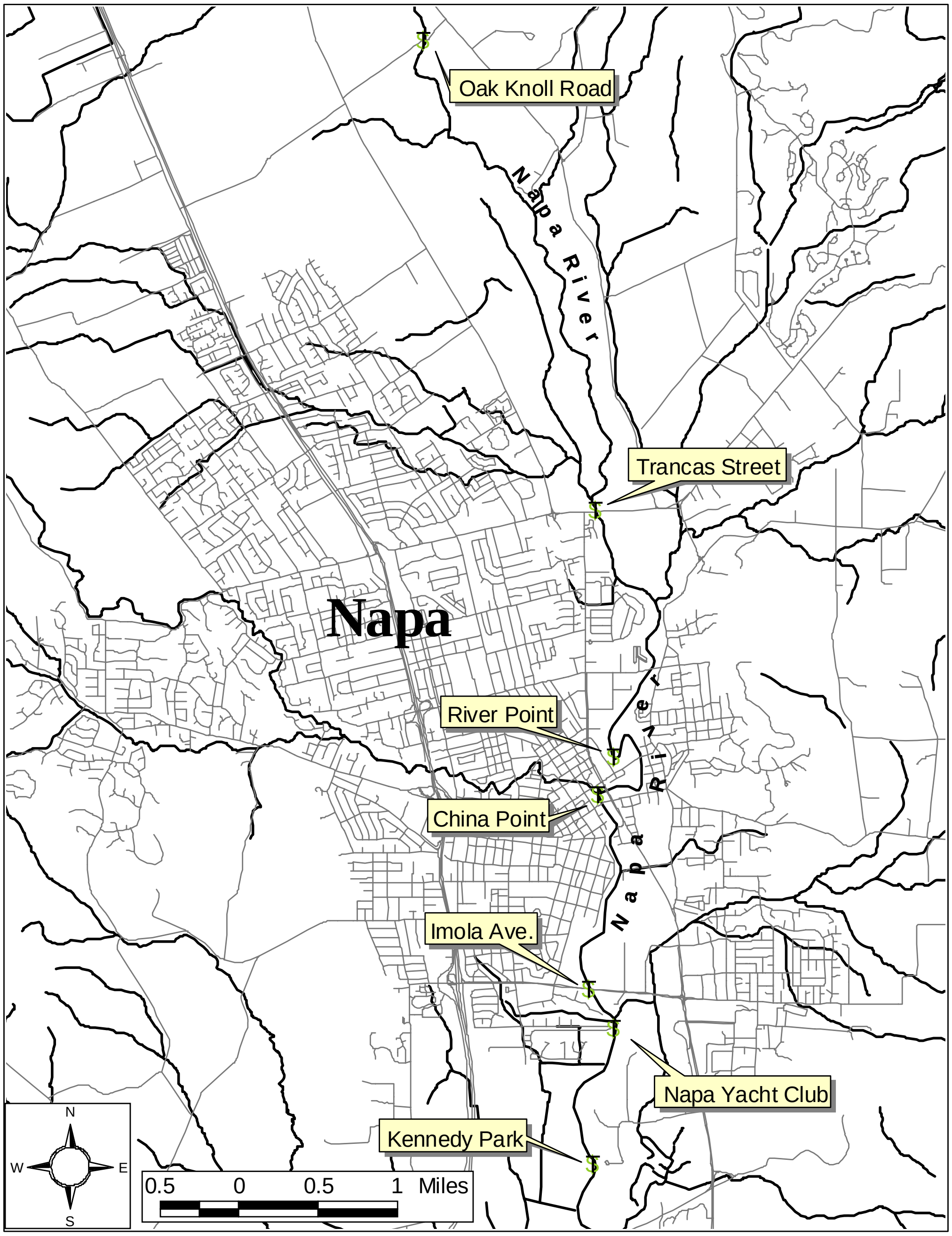

Table 4
Summary of Napa County Department of Environmental Management Fecal Coliform Data

Sample Station	Wet Season 2002–2003[a]			Dry Season 2003		
	Number of Samples	Geometric Mean	90th Percentile	Number of Samples	Geometric Mean	90th Percentile
		CFU/100 mL			CFU/100 mL	
Oak Knoll Road	10	106	*457*[b]	12	27	74
Trancas Street	10	69	305	10	45	110
River Point	10	104	*527*	13	59	205
China Point	10	*220*	*443*	13	157	283
Imola Avenue	10	155	*422*	13	148	298
Napa Yacht Club	4	31	79	13	105	242
Kennedy Park	10	126	*431*	13	169	325

Sample Station	Wet Season 2003–2004			Dry Season 2004		
	Number of Samples	Geometric Mean	90th Percentile	Number of Samples	Geometric Mean	90th Percentile
		CFU/100 mL			CFU/100 mL	
Oak Knoll Road	10	124	*665*	7	44	140
Trancas Street	11	172	*839*	8	105	*472*
River Point	11	195	*2,359*	5	134	*960*
China Point	10	192	*2,321*	5	*211*	*897*
Imola Avenue	11	115	*464*	6	84	142
Napa Yacht Club	11	129	*657*	8	60	*451*
Kennedy Park	11	87	275	8	140	*510*

[a]Wet season 2002–03 consisted of December 2002 through March 2003. Dry season 2003 consisted of April 2003 through October 2003. Wet season 2003–04 consisted of November 2003 through March 2004. Dry season 2004 consisted of April through September 2004.
[b]Exceedances of Basin Plan objectives are italicized.

Figure 3
Sites Monitored in the Water Board/SFEI Study

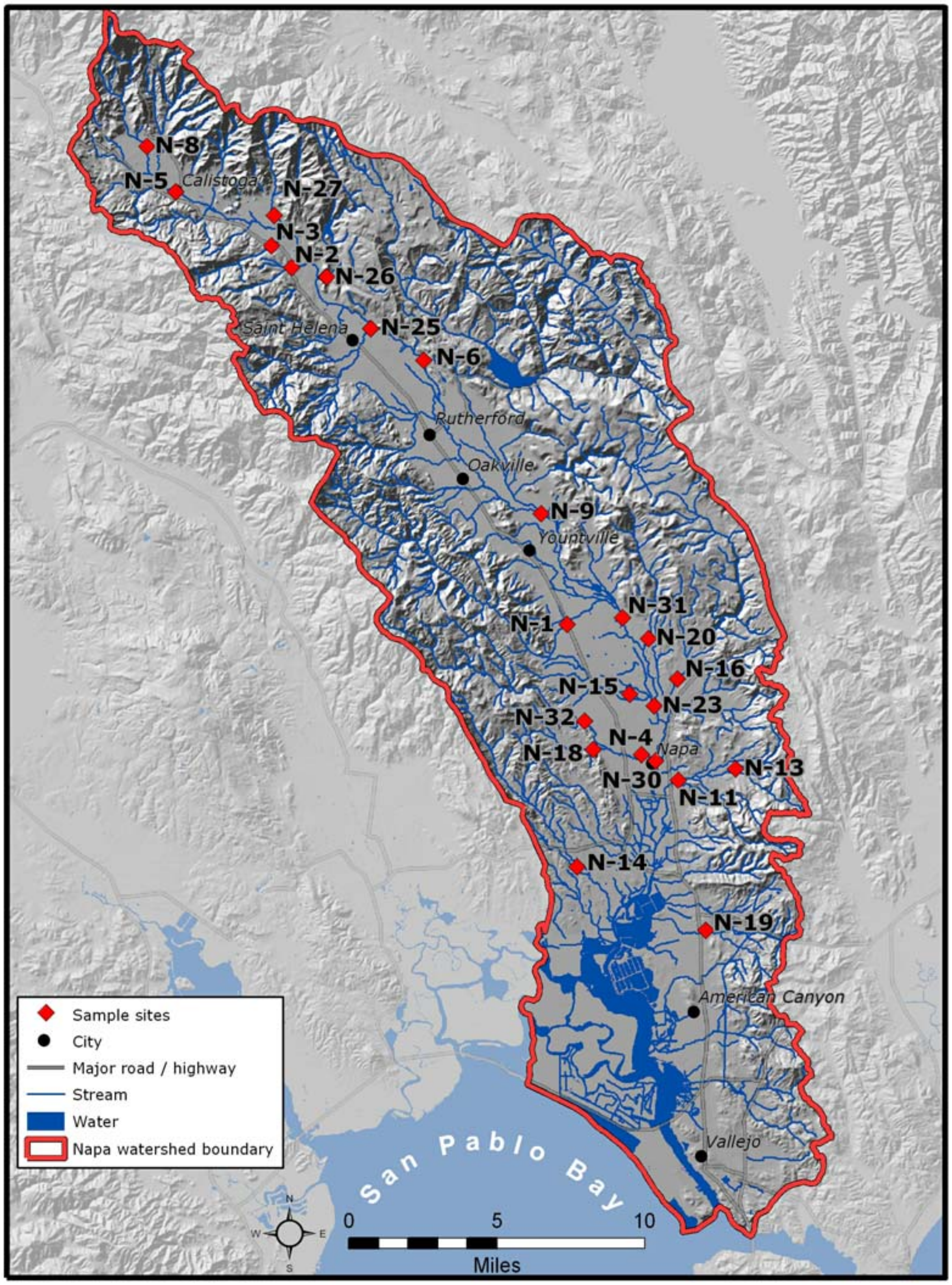

Table 5 *E. coli* Densities Observed in the Water Board/SFEI Study, October 2002–July 2003.				
		***E. coli*, CFU/100 ml**		
Station	**Location**	**Jan-03**	**Jul-03**	**Oct-02**
N-8	**Napa River at Tubbs Ln.**	74	20	[a]
N-5	**Napa River at Calistoga Community Center**	*530*[b]	**28**[c]	63
N-27	**Dutch Henry Creek at Larkmead Lane**	10		
N-3	**Ritchey Creek at State Park Campground**	130	63	98
N-2	**Mill Creek at State Park**	52	20	110
N-26	**Bell Canyon Creek at Silverado Tr.**	**44**	30	**51**
N-25	**Sulfur Creek at Starr Ave.**	*560*	10	10
N-6	**Napa River at Zinfandel Ln.**	84	**15**	10
N-9	**Napa River at Yountville Preserve**	97	**15**	10
N-1	**Dry Creek at Solano Ave.**	31	110	
N-31	**Napa River at Oak Knoll Ave.**	97	31	10
N-20	**Soda Creek at Silverado Tr.**	10		
N-15	**Salvador Channel at Summerbrook Cir.**	*430*	20	63
N-23	**Napa River at Trancas St.**	110	41	*1,100*
N-16	**Milliken Creek at Hedgeside Ave.**	52	150	74
N-30	**Napa River at 3rd St.**	**100**	**100**	***920***
N-32	**Redwood Creek at Redwood Rd.**		120	
N-18	**Browns Valley Creek at Browns Valley Rd.**	***790***	***1,200***	***1,600***
N-4	**Napa Creek at Jefferson St.**	***460***	110	***870***
N-13	**Murphy Creek at Coombsville Rd.**	**80**	*660*	***470***
N-11	**Tulocay Creek at Terrace Ct.**	330	41	
N-14	**Carneros Creek at Withers Rd.**	180	*460*	
N-19	**Fagan Creek at Kelly Rd.**	300	74	160

[a]Missing data points indicate that the sampling site was dry, except for the January Redwood Creek sample, where high flows prohibited safe sampling.
[b]Exceedances of U.S. EPA recommended *E. coli* criteria (126 CFU/100 mL for geometric means, and the 406 CFU/100 mL 90th percentile level for single samples) are in italics.
[c]Values in bold type represent geometric means of five weekly samples; non-bold values represent single samples.

A limited number of wet season fecal coliform samples were collected in American Canyon Creek by the American Canyon Training Center equestrian facility as part of this facility's conservation plan. Four samples were collected between January 2003 and February 2004. Two samples were below 200 CFU/100 mL, one was 3,700 CFU/100 mL, and one was greater than 160,000 CFU/100 mL. The high samples were collected within a day following major rainfall events, while the low samples were taken under relatively dry conditions. The sample site was downstream of several small, confined animal facilities (not including American Canyon Training Center, which drains into American Canyon Creek downstream of the sampling site), indicating that these facilities are a significant pathogen source during wet weather.

In sum, recent bacterial water quality studies in the Napa River watershed provide a consistent picture of widespread, but generally moderate and somewhat localized pathogen impairment. Data indicate that much of the watershed, including several major tributaries, meets bacterial Water Quality Objectives. However, Water Quality Objectives are exceeded at a number of locations in the watershed at all times of year.

4. NUMERIC TARGETS

In order to develop a TMDL, a desired or target condition must be established to provide measurable environmental management goals and a clear linkage to attaining the applicable water quality objectives. The numeric targets (desired future conditions for the Napa River watershed) proposed for this TMDL are as follows:

1. Geometric mean *E. coli* density[6] less than 126 CFU/100 mL[7]

2. 90th percentile *E. coli* density less than 409 CFU/100 mL

3. Geometric mean fecal coliform density less than 200 CFU/100 mL

4. 90th percentile fecal coliform density less than 409 CFU/100 mL

5. Median total coliform density less than 240 CFU/100 mL

6. No single total coliform sample to exceed 10,000 CFU/100 mL

7. Zero discharge of untreated or inadequately treated human waste to the Napa River and its tributaries or to groundwater with direct through flow to these surface waters

The bacterial density targets are based on U.S. EPA's *E. coli* criteria and on the Basin Plan's contact recreation water quality objectives for fecal coliform and total coliform bacteria. It should be noted, however, that the State Board is in the process of adopting statewide bacterial water quality objectives based on *E. coli* for freshwater, per EPA guidance. As a result of this action, anticipated in early 2007, the existing fecal and total coliform water quality objectives currently in the Basin Plan will likely be replaced by the new objectives. The fecal coliform and total coliform targets and allocations will sunset and no longer be effective upon the replacement of the total and fecal coliform water quality objectives in the Basin Plan with *E.coli*-based water quality objectives for contact recreation.

The last target, zero discharge of untreated human waste, is based on the knowledge that fecal bacteria are imperfect indicators of human pathogens. Since direct monitoring of human pathogens is not feasible (Section 3.1), and since human waste is the most serious potential source of these pathogens, a prohibition of raw or inadequately treated human waste discharge is proposed. (Septic tanks provide minimal primary treatment, but do not significantly reduce pathogen levels [Leverenz et al., 2002].) This target is consistent with the Basin Plan's region-wide prohibition against the discharge of raw or inadequately treated sewage.

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[6] "Density" refers to the number of bacteria in a given volume of water (U.S. EPA, 1986, 2002, 2003). The term is analogous to "concentration," which refers to the mass of chemical pollutant in a given volume of water. "Bacterial density" and "bacterial concentration" are sometimes used interchangeably.

[7] Based on a minimum of five consecutive samples collected at approximately equal intervals over a 30-day period.

These TMDL targets are consistent with water quality objectives or prohibitions included in the Basin Plan. The targets are proposed as the desired long-term conditions this TMDL seeks to achieve.

5. POLLUTANT SOURCE ASSESSMENT

Data collected in the Napa River watershed, as well as similar work conducted in the region, suggest a limited list of possible sources that may contribute significant pathogen loads to the system. Primary potential sources are described briefly below.

- **On-site sewage disposal systems (OSDSs; septic systems)** There are an estimated 9,000 OSDSs, or septic systems, in the Napa River watershed (Wang et al., 2004). The majority of soils in the watershed are classified as having severe restrictions for use as septic tank leach fields, due either to low permeability, slope, depth to bedrock, impermeable layers, or wetness (Lambert and Kashiwagi, 1978). Septic systems—especially older systems—located on these soils are especially prone to failure, and may release pathogens to adjacent surface waters even when system failure is not evident.

- **Sanitary sewer systems (sewer lines)** The cities of Napa, Calistoga, and St. Helena, and the town of Yountville are served by sanitary sewer lines. A major sewer line failure occurred a short distance north of Napa in 2002, resulting in high short-term loading to the river. Chronic minor leakage of main or lateral lines can produce a less dramatic effect, and can be difficult to distinguish from septic system failure in areas where sewer line service and septic systems are intermixed.

- **Municipal runoff** Approximately 8% of the watershed is occupied by residential or commercial development (ABAG, 1996). Urban runoff delivers pathogens to surface waters from domestic animal waste, trash, wildlife, failing septic systems, and in some cases human waste from homeless populations. Homeless encampments are readily observed at a number of locations along the Napa River, and may be an important source of waterborne pathogens. Illicit discharge of septic waste into stormwater conveyances can also create serious pathogen problems.

- **Grazing lands** Pasture/hayfield covers approximately 5% of the watershed, with an additional 22% in herbaceous grazing land (i.e., rangeland) cover (ABAG, 1996).

- **Confined animal facilities** Numerous, mostly small, animal facilities of various sorts can be found in the Congress Valley, Coombsville, and American Canyon areas in the lower part of the Napa watershed.

- **Wildlife** Most of the Napa River watershed remains undeveloped, providing habitat for abundant wildlife. Most warm-blooded animals are capable of carrying pathogen indicator bacteria as well as a wide range of actual human pathogens (U.S. EPA, 2001).

Wildlife have been identified as significant pathogen sources in other TMDLs in California, but generally in locations where there are concentrated populations of wildlife (Central Coast Water Board, 2002; Water Board, 2005).

- **Municipal wastewater treatment facility discharge.** Six municipal wastewater treatment facilities are permitted to discharge treated municipal wastewater to the Napa River under the National Pollutant Discharge Elimination System (NPDES). Initial concern over potential pathogen impairment of the river impaired was partially based on the presence of these discharges. Treatment plant upgrades since that time have greatly reduced pathogen loading from these sources (Johnson, 1985).

The following sections examine the distribution and relative importance of these sources in the Napa River watershed.

5.1 Permitted Wastewater Discharges

Six municipal wastewater treatment facilities are permitted to discharge treated municipal wastewater to the Napa River watershed, all to the main stem (Table 6) . National Pollutant Discharge Elimination System (NPDES) permits for these facilities limit discharge to wet season conditions when dilution of effluent by river flow is at least 10:1, and require full disinfection of effluent though chlorination/dechlorination. All facilities are subject to stringent effluent limits for enterococci or total coliform (Table 6). Monthly self-monitoring reports for 2003 and 2004 indicate that all facilities currently meet effluent limits, with no reported total coliform values higher than 10 CFU/100mL. The discharges therefore do not contribute measurably to pathogen loading as long as they are managed properly.

Table 6
Municipal wastewater Treatment Facilities Discharging to the Napa River

Facility	Location	Effluent Limit—Median, CFU/100 mL	NPDES Permit #
Napa Sanitation District	Ratto's Landing South of Napa	35 enterococcus	CA0037575
Town of Yountville	Access Road East of Yountville	2.2 total coliform	CA0038121
City of St. Helena	Thoman Lane South of St. Helena	23 total coliform	CA0038016
City of Calistoga	Dunaweal Lane South of Calistoga	23 total coliform	CA0037966
City of American Canyon	Mezzetta Drive, American Canyon	2.2 total coliform	CA0038768
Napa River Reclamation District #2109	Milton Road, South of Napa	240 total coliform	CA0038644

5.2 Analysis of Water Quality Data and Watershed Characteristics

The following section explores relationships between the bacteria data collected in the 2002–2003 Water Board/SFEI study and land uses in the watershed. While the bacterial data are not sufficient in either spatial or temporal resolution to allow quantitative assessment of pathogen loads, the observations presented here support a relative assessment of the importance of different nonpoint source categories.

Different delivery mechanisms drive pathogen loading during the wet and dry seasons. During the wet season, loading is primarily via precipitation-driven surface runoff, and secondarily though groundwater flow into stream channels. Surface runoff is largely absent in the dry season and pathogen delivery is predominantly though groundwater inflow (including in many cases septic system leachate or sanitary sewer line leakage), direct deposition (e.g., animals in the creek), and low-volume runoff from human activities (e.g., lawn and landscape watering, car washing, washing of animal holding areas, etc.). Therefore, dry and wet season pathogen loading are discussed separately below.

5.2.1 General Trends

Figures 4a and 4b show *E. coli* sampling locations with their catchment areas delineated, locations of major towns, and general land cover categories in the watershed. Land cover information was obtained from 1996 Association of Bay Area Governments (ABAG) data. The broad land-cover categories shown are open space (consisting of natural forest, grassland, and open range), agriculture (vineyards, orchards, row crops, pasture, and animal facilities), and urban (residential, commercial, and industrial).

Several general observations can be made from the Water Board/SFEI *E. coli* data (Table 5). Bacteria levels were below numeric targets in both dry and wet seasons at sites located in open space-dominated watersheds: Ritchey Creek, Mill Creek, Dutch Henry Creek, and Napa River at Tubbs Lane. Since these sites are relatively unaffected by human activities, wildlife is most likely the predominant pathogen source there. The low bacteria levels indicate that wildlife do not constitute a widespread pathogen problem in the watershed.

Winter *E. coli* values were notably higher than summer levels at several sites: Napa River at Calistoga, Sulphur Creek, Salvador Channel, and, less clearly, Tulokay Creek. All of these sites receive runoff from heavily urbanized areas, suggesting that urban runoff is a primary wet season pathogen source there. Septic tank failure may also contribute to wet season loading at some of these sites.

At the Murphy Creek site, dry season bacteria counts were substantially higher than in the wet season. This effect is seen to a lesser degree at Browns Valley Creek. Both of these sites are in urbanized, primarily residential areas—the Browns Valley area is served by sanitary sewer lines, while the area surrounding the Murphy Creek sampling site relies on individual septic systems. It is hypothesized that pathogen loading at these sites is largely due to septic tank or sanitary sewer failure, and that wet season runoff dilutes loading from these sources, resulting in reduced wet season bacterial densities. These sites are discussed further in Section 5.2.3, below.

Bacteria levels in the main stem of the Napa River upstream of the City of Napa were generally low during both wet and dry seasons. The two farthest downstream sampling sites on the Napa

River main stem (Trancas Street and Third Street, both in the City of Napa) showed high *E. coli* levels during the October 2002 sampling event. In the case of the Third Street site, this may have been due to the large, localized populations of wild and semi-domesticated waterfowl that reside in this part of the river.

5.2.2 Statistical Analysis of Water Board/SFEI Data

Water Board and SFEI staff conducted statistical analysis to examine relationships between wet and dry season bacterial levels and general land cover categories throughout the watershed. Variables examined in this analysis are presented in Table 7. January 2003 Water Board/SFEI *E. coli* data (Table 5) were used to represent wet season pathogen loading, and July 2003 *E. coli* data represented dry season loading. October 2002 data were omitted from this analysis because of the low number of sites sampled at that time.

Land cover variables were calculated using ArcInfo GIS software. Catchment areas (contributing watershed areas) were defined for each water quality sampling point shown in Figures 4a and 4b and the land cover variables described in Table 7 were calculated for each of these catchment areas.

Table 7
Water Quality and Land Cover Variables Used in Statistical Analysis

Variable	Description
E. coli Wet	January 2003 Water Board/SFEI *E. coli* values
E. coli Dry	July 2003 Water Board/SFEI *E. coli* values
Popden	Population density of catchment area
Pct_Open	Percent open space in catchment area
Pct_Ag	Percent agricultural land in catchment area
Pct_Urb	Percent urban land in catchment area
Popden_50	Population density within 50 meters of stream
Pct_Open_50	Percent open space within 50 meters of steam
Pct_Ag_50	Percent agriculture within 50 meters of stream
Pct_Urb_50	Percent agriculture within 50 meters of stream

Associations between the bacterial variables and land cover variables were estimated using Kendall's Tau-b statistic (Table 8). This statistic is a non-parametric measure of the degree of correlation—or association—between variables, and is well suited for non-normal, statistically "messy" data sets such as the one considered here (SAS Institute, 1995). The higher the absolute value of Kendall's Tau-b, the stronger the correlation. Positive values indicate a positive relationship between variables (variables increase or decrease together), while negative values indicate an inverse relationship (an increase in one variable is associated with a decrease in the other). The probability column in Table 8 indicates the probability that the calculated Kendall's Tau-b would be exceeded randomly by a set of unrelated variables. In other words, the probability value is an indicator of the statistical significance of the correlation between the variables in question. Probabilities less than 0.05 are regarded by convention to indicate a statistically significant correlation, while probabilities less than 0.01 indicate a highly significant correlation. While a statistically significant correlation does not in and of itself show causality, it can be a useful element of a weight of evidence approach to source assessment.

Figure 4a
Catchment areas and General Land Cover for Water Board/SFEI Sites—North

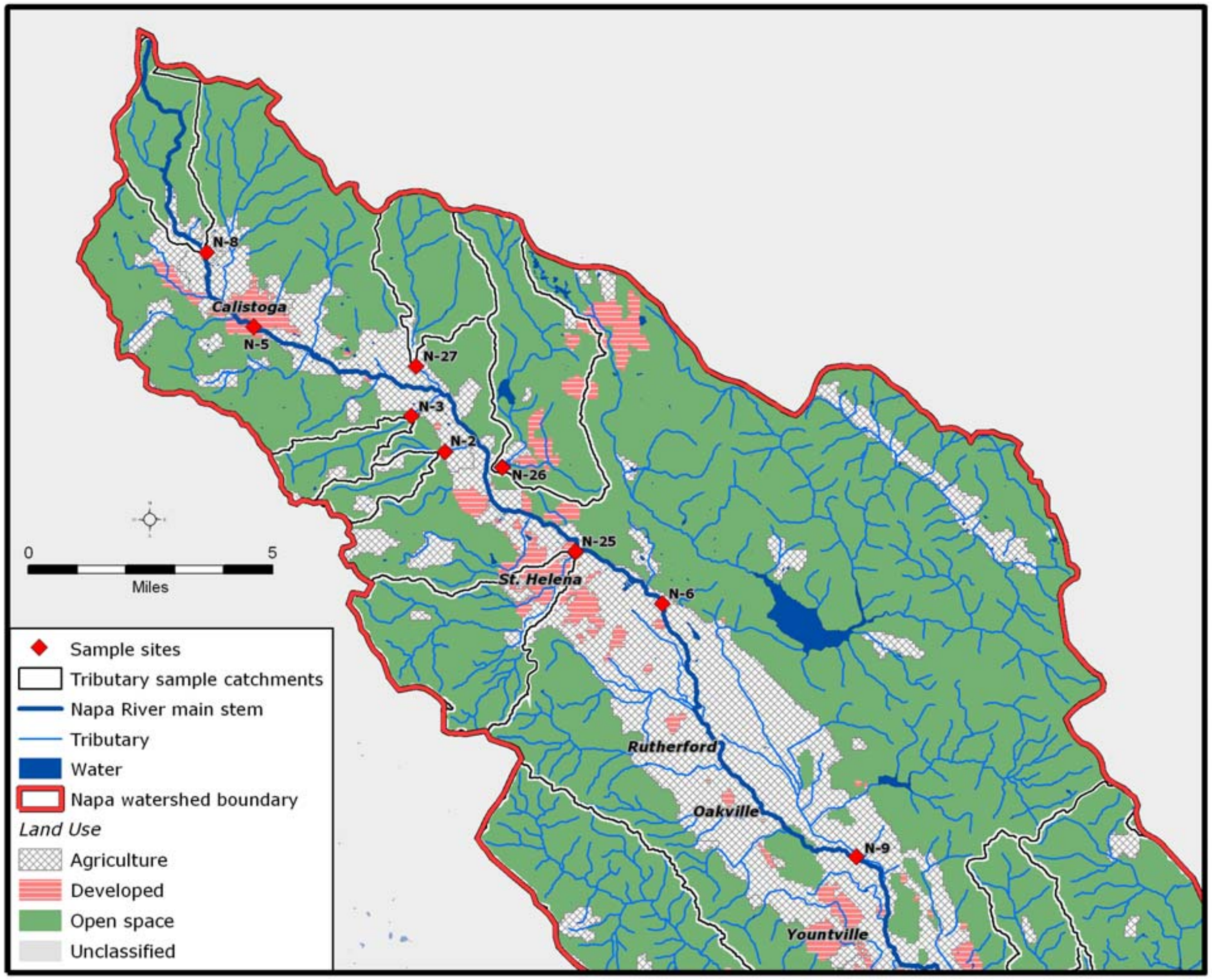
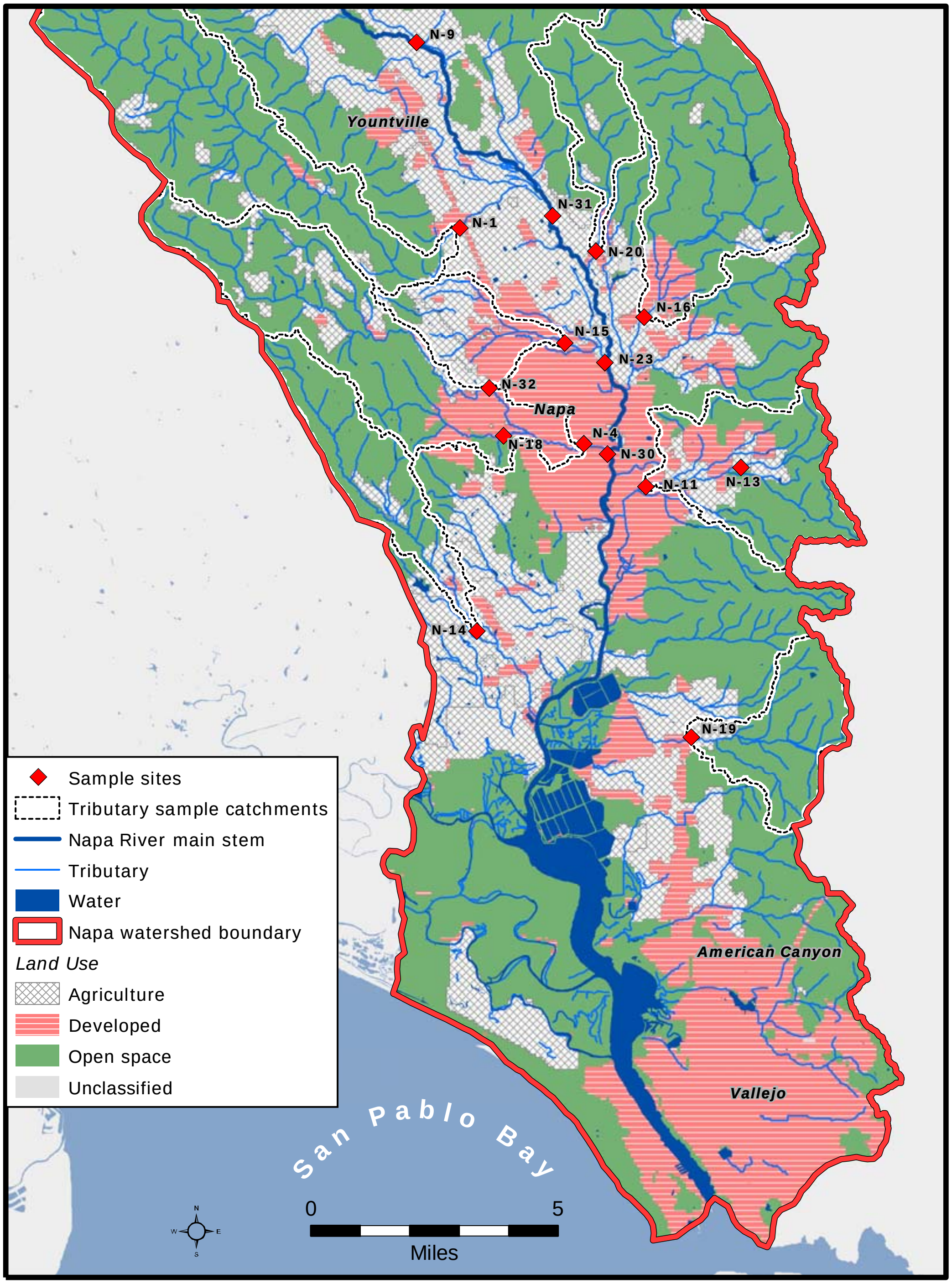


Figure 4b
Catchment areas and General Land Cover for Water Board/SFEI Sites—South



Wet season bacterial counts were highly correlated with population in the catchment area, and with population density within 50 meters of the stream (Table 8). Percent urban land in catchment area, and within 50 meters of the stream were also correlated with wet season bacteria. These correlations suggest that a large proportion of wet season pathogen loading is from urban runoff, but does not rule out septic tanks or sewer-line failure as an additional source.

Table 8
Correlations Between *E. Coli* Levels and
Land Cover Variables in the Napa River Watershed

Land Cover Variable	E. Coli Wet (22 sites)		E. Coli Dry (20 sites)	
	Kendall's Tau-b	Probability [a]	Kendall's Tau-b	Probability
Popden[b]	0.4585	0.0030**	-0.0533	0.7389
PCT_Open	-0.2227	0.1498	-0.2995	0.0604
PCT_Agric	0.0000	1.0000	0.3189	0.0456*
PCT_Urban	0.3747	0.0152*	0.0000	1.0000
Popden_50	0.4760	0.0021**	-0.0339	0.8320
PCT_Open_50	-0.2092	0.1754	-0.3189	0.0456*
PCT_Agric_50	-0.0174	0.9101	0.2029	0.2033
PCT_Urban_50	0.3799	0.0140*	.0.0823	0.6065

[a]Probability values followed by * or ** indicate significant or highly significant correlations, respectively.
[b]Refer to Table 8 for descriptions of land cover variables.

Correlations between dry season *E. coli* values and land cover variables have less clear implications. A significant, negative correlation between bacteria counts and percent open land within the fifty-meter buffer was observed. This is consistent with the widely recognized effectiveness of open space buffers for pollution reduction.

It is difficult to account for the significant, positive correlation observed between dry season bacterial counts and percent agriculture in the catchment area. Vineyards, which are not expected to contribute significantly to pathogen loading, represent the large majority of agricultural land use in the Napa watershed. It is possible that animal facilities, which account for only a small percentage of this broad land cover category, may account for this correlation. Another possible cause may be that, compared to open space, agricultural land cover is frequently associated with scattered, low-density residential and commercial development, which may constitute pathogen sources. The very high, negative correlation observed between open space and agriculture in the Napa watershed may also contribute to this correlation. That is, agricultural land may correlate with dry season bacterial counts simply because agriculture and open land together dominate many of the subwatersheds sampled, and a subwatershed with low open space will naturally be high in agriculture.

Our statistical analysis is limited by such factors as the relatively small number of sample sites, the small number of samples per site, the low precision of bacterial sampling results, and the general nature of the ABAG mapping categories. The analysis is therefore best suited to detecting broad, general relationships. It should be understood that failure to detect a statistically significant correlation between bacteria densities and any given land use variable does not preclude that land use as a pathogen source. For example, failure to detect a relationship between developed land and dry season bacteria levels does not mean that this land use category does not constitute a significant dry season source. It *may* mean that *most* residentially developed land in the watershed does not contribute to dry season loading, but it does not eliminate (or even render less likely) the possibility that *some* residentially developed land constitutes a significant dry season source on a local level. The supplemental monitoring described below addresses localized sources.

5.2.3 Supplemental Monitoring

The Water Board conducted a supplemental sampling program in May 2004 in order to investigate pathogen sources near hotspots identified in the Water Board/SFEI study. Since no significant rainfall had occurred for more than a month prior to this sampling, the data reflected early dry-season conditions. Sampling focused on Browns Valley Creek (N-18), Murphy Creek (N-13), Napa Creek (N-4), and Salvador Channel (N-15). Samples were collected at additional stations located incrementally upstream—and where possible and appropriate, downstream—of the sites sampled in the earlier study. An additional sampling site in Sheehy Creek was included because of suspected water quality problems at this site. Samples were also collected at two sites on the main stem Napa River to confirm data previously obtained from these sites. Locations of sites monitored in the supplemental sampling effort are shown in Figure 5.

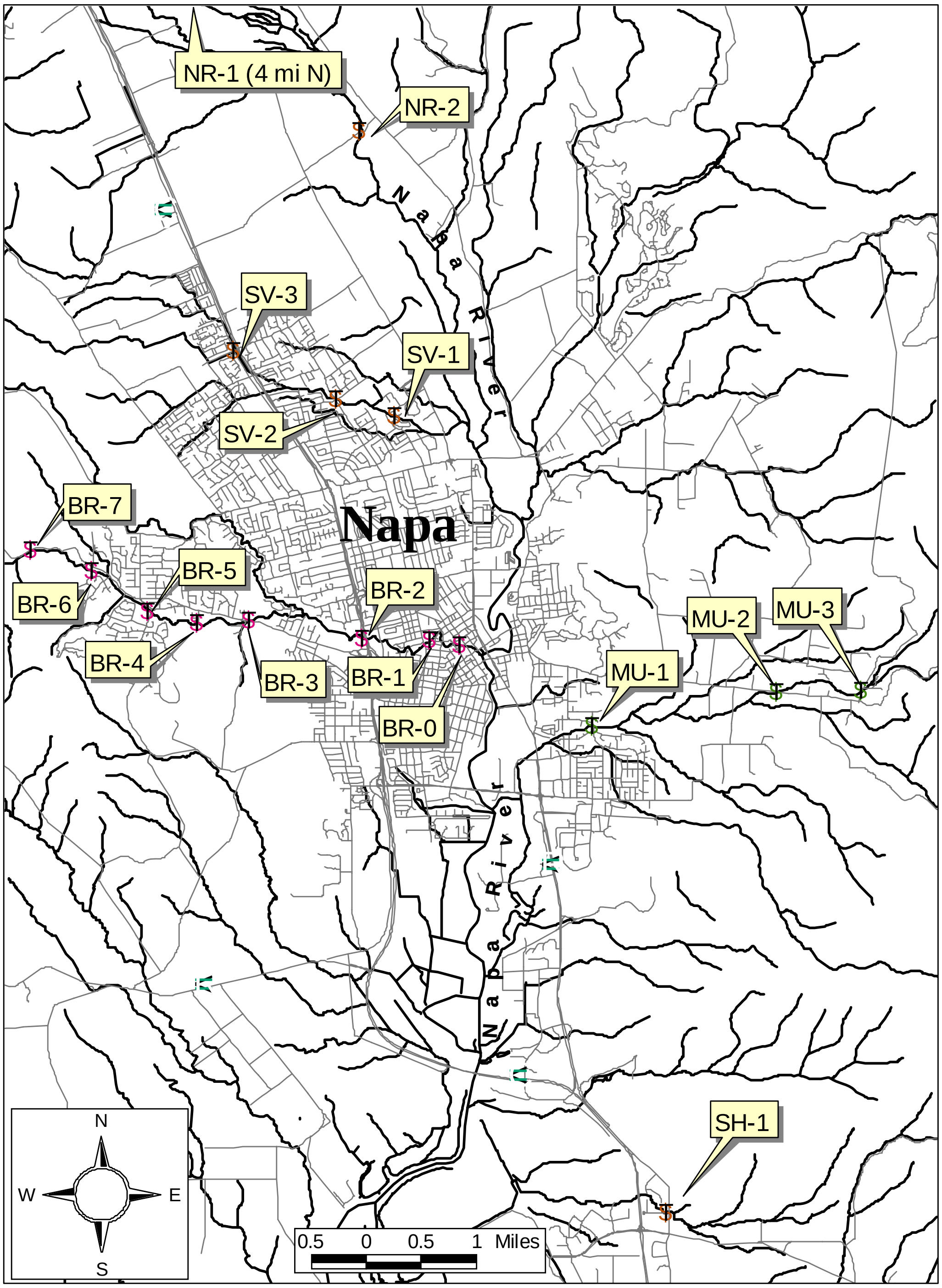
Samples were collected weekly over a five-week period. In order to conserve limited laboratory resources, an adaptive, tiered monitoring scheme was employed. All sites were sampled for the first two weeks and the results used to establish a subset of sites for three additional weeks of sampling. Sampling was discontinued at sites that were consistently very low or high for the first two weeks, or were very similar to either upstream or downstream sites.

Supplemental sampling revealed very low *E. coli* levels at stations BR-7 and BR-6 in the upper reaches of Browns Valley Creek. An abrupt, statistically significant[8] increase in bacteria levels was observed at BR-5, indicating a source between BR-6 and BR-5. Indicator bacteria levels at sites BR-4 through BR-0, while variable, were not statistically significantly different from the levels seen at BR-5. The data therefore do not indicate additional sources below BR-5, but neither do they rule out the possibility of additional sources. Dense residential development exists from BR-5 downstream, while development density declines significantly above BR-6. Information provided by the Napa Sanitation District indicates that most residential parcels adjacent to the creek from site BR-6 downstream are served by city sewer lines, but a few parcels apparently remain on septic tanks. Much of the soil adjacent to the creek in this location is severely limited for septic system applications due to low permeability and wetness. Cattle grazing occurs along Browns Valley Creek between sites BR-4 and BR-5, but the data fail to indicate a significant bacterial source at this location. It appears then, that, sewer line failure or

[8] In contrast to the 2002-2003 study, the supplemental monitoring conducted in 2004 and 2005 consisted of at least two (and usually five) samples from each site, allowing statistical comparisons among sites. For each subwatershed, one-way analysis of variance was conducted on log-transformed E. coli densities, with between-site comparisons using Student's T-test, α=0.05. Since the intent of statistical analysis in this instance was to locate E. coli sources within sub-watersheds, rather than to compare sub-watersheds, comparisons were made only within sampling periods (i.e., May 2004 or August 2005) and within sub-watersheds (e.g. sites on Browns Valley Creek were compared to other sites on Browns Valley Creek, but not with sites on Murphy Creek).

septic tank failure is the primary source of pathogens in Browns Valley Creek, with possible additional loading from cattle grazing.

Figure 5
Supplemental Water Board/SFEI Monitoring Sites.



Bacteria levels in Murphy Creek (N-13/MU-2) were moderately elevated in May 2004, but were not as high as observed in the 2002 and 2003 dry seasons (Table 5). A possible reason for this is that the 2004 samples were collected earlier in the season than those in 2002 and 2003. The data may reflect a relatively constant loading from, for instance, septic tank flows together with a diminishing dilution from groundwater inflow as the groundwater table recedes though the dry season. The low wet-season bacteria densities seen in Murphy Creek (Table 5) are consistent with dilution effects.

Little variation was seen among the three Murphy Creek sites. Land use at the two upper sites (MU-2 and MU-3) is primarily low-density residential development with some small animal facilities and mixed agriculture. Residences in this area depend on septic systems for sanitary waste disposal. Soils at and upstream of MU-3 are severely limited for septic system application due to excessive slope and shallow depth to bedrock. Septic system limitations are somewhat less severe in the vicinity of MU-2, and are largely related to low soil permeability. The lower site (MU-1) is dominated by higher density residential development and is served by sewer lines. Low density residential development extends upstream of the uppermost site, with limited cattle grazing further upstream. Additional upstream sampling in order to help distinguish between potential sources of pathogens would have been desirable, but upstream access could not be obtained when the sampling was conducted.

Bacteria counts in Sheehy Creek (SH-1) were the highest observed in this study, confirming the suspicions that had prompted sampling at this site. Extensive cattle grazing occurs immediately upstream of the sampling site. Fencing is used to exclude cattle from the stream in this area, but it is unclear if the fencing is completely effective. Reclaimed domestic wastewater from the Napa Sanitation District facility is applied to the land upstream of the sampling site. Since reclaimed water receives full disinfection as required by the facility’s NPDES permit, cattle are the likely pathogen source at this location.

Salvador Channel was sampled in May 2004 not because of high bacteria levels in previous sampling, but because a public park with significant potential for contact recreation use is planned for this creek. The planned park is located adjacent to sites SV-1 and SV-2. Elevated bacteria levels were not observed at either of these sampling locations. However, counts at the upstream site at Solano Avenue (SV-3) were significantly elevated above water quality objectives. Dense residential and commercial development exists above this site. Most of this area is served by sanitary sewer lines, suggesting that sewer line failure may be a source. The low bacteria counts observed at the two downstream sites are likely due to either bacterial die-off or dilution. Since there is dense residential development between the upper and lower sites, but no indication of additional pathogen loading, the low bacteria levels observed at the downstream site suggest a relatively localized source above the upstream site.

Table 9 May 2004 and August 2005 Supplemental *E. Coli* Sampling Results			
Site Location	**Site Number[a]**	***E. Coli* CFU/100mL, geometric mean (# of weeks sampled)**	
		May 2004	**August 2005**
Browns Valley @ Partrick Rd.	BR-7	10 (2)	--
Browns Valley @ Borrette Ln.	BR-6	39 (5)	66 (2)
Browns Valley @ Buhman Ave.	BR-5	490* (5)	--
Browns Valley @ McCormick Ln.	BR-4	523 (5)	876* (2)
Browns Valley @ Browns Valley Rd.	BR-3 (N-18)	1,008 (5)	329 (2)
Browns Valley @ Highway 29	BR-2	497 (2)	--
Napa Creek @ Jefferson St.	BR-1 (N-4)	345 (2)	--
Napa Creek @ Pearl St.	BR-0	324 (2)	--
Murphy Creek @ Shady Brook Ln.	MU-3	122 (5)	1,414 (2)
Murphy Creek @ Coombsville Rd.	MU-2 (N-13)	151 (5)	921 (2)
Tulokay Creek @ Shurtleff Ave.	MU-1	170 (2)	
Sheehy Creek @ Kelly Road	SH-1	3,286 (2)	--
Salvador Channel @ Solano Ave.	SV-3	713 (5)	1140 (2)
Salvador Channel @ Trower Ave.	SV-2	73* (2)	--
Salvador Channel @ Summerbrook Cir.	SV-1 (N-15)	51 (2)	
Napa River @ Yountville Preserve	NR-1 (N-9)	81 (2)	--
Napa River @ Oak Knoll Rd.	NR-2 (N-31)	120 (2)	--

[a]Site numbers from original Water Board/SFEI study are in parentheses.
* Asterisks indicate a statistically significant difference from the site immediately upstream.

May 2004 *E. coli* levels in the main stem of the Napa River (NR-1, NR-2) were somewhat higher than those seen in 2002 and 2003, but were below the numeric target of 126 CFU/100 mL (geometric mean). This may be due to seasonal variability, or to random variation. Upstream or tributary nonpoint sources, or wildlife in the vicinity of the sampling site may be the source of these mildly elevated bacteria counts.

The Water Board sampled a limited number of hotspot sites again in August 2005. Samples were collected on two successive weeks at the sites listed in Table 9. Results were consistent with the earlier data: an abrupt increase in *E. coli* densities on Browns Valley Creek below BR-6, elevated levels throughout Murphy Creek, and high values on Salvador Channel at SV-3. The consistency of data collected from 2002 though 2005 confirms sustained water quality impairment in these three subwatersheds.

5.3 Source Assessment Summary

Due to data and resources limitations, this report does not quantitatively estimate loads for the different pathogen sources in the Napa watershed. However, the data discussed above allow for general conclusions on the importance and magnitude of the different types of pathogen sources described at the beginning of this section. The following sources likely contribute significant, controllable pathogen loads in the watershed, and these sources will be addressed in the implementation plan presented later in this report:

- **On-site sewage disposal systems (OSDSs, septic systems)** This source category appears to be a significant, but relatively localized source of pathogen loading during the dry season. While residential development is widespread throughout the watershed, high indicator bacteria levels were associated with residential development at only a few hot spots. Hot spots have been identified in the Browns Valley Creek, Murphy Creek, and Salvador Channel areas, but additional monitoring may reveal additional locations. Since a single failing septic system can deliver extremely large numbers of bacteria, it is possible that a very small number of systems are responsible for much of the observed impairment. Septic system failure may also be a significant pathogen source during the wet season, but this effect tends to be obscured by wet season stormwater loading.

- **Sanitary sewer systems** Sanitary sewer systems are a potentially significant, but localized source. Elevated indicator bacteria levels were found in areas dominated by septic systems, areas served exclusively by sanitary sewer systems, and in mixed areas. Further monitoring during the adaptive implementation phase of this TMDL will be required to assess the relative importance of septic system failure versus sewer line failure and identify additional areas where septic/sewer loading is a concern.

- **Municipal runoff** Data indicate that urban stormwater is a significant, widespread wet season pathogen source. Most of the urban areas in the watershed are associated with elevated wet season indicator bacteria densities.

- **Grazing lands** High levels of pathogen loading from grazing lands was observed at one location (Sheehy Creek), and moderately elevated pathogen levels may be associated with grazing at additional locations (Carneros Creek, possibly Murphy and Browns Valley Creeks). Further monitoring may reveal more locations where grazing is a significant pathogen source.

- **Confined animal facilities** Third party monitoring data (Section 3.4) indicate that animal facilities are a significant pathogen source in at least some parts of the watershed. Animal facilities have also been established as widespread pathogen sources elsewhere in the region (Water Board, 2005). Further monitoring will be required to establish the locations and magnitude of pathogen loading from this source category.

- **Municipal wastewater treatment facility discharge.** Recent self-monitoring reports from the six plants that discharge to the Napa River indicate that discharges are well below numeric targets, and that the discharges do not significantly contribute to pathogen loading under normal conditions. However, these facilities constitute a major potential pathogen source if not properly managed, and will therefore be addressed in the implementation plan.

The following source is of generally minor significance, and is not readily controllable, so will not be addressed in the implementation plan:

- **Wildlife.** The low indicator bacteria levels observed at all of the sampling sites that are not heavily affected by human activity indicates that wildlife are not, in general, a significant pathogen source in this watershed. Local problems may be present in certain areas where wildlife densities are particularly high.

6. TOTAL MAXIMUM DAILY LOAD AND LOAD ALLOCATIONS

6.1 General Approach

U.S. EPA guidelines (U.S. EPA, 1991) for developing TMDLs define the maximum allowable pollutant load as the total load of a particular pollutant that can be present in a waterbody while still attaining and maintaining designated beneficial uses. TMDLs for a waterbody are the sum of individual wasteload allocations for point sources and load allocations for nonpoint sources. The sum of these components must not result in the exceedance of water quality standards for that waterbody. In addition, the TMDL must include a margin of safety (MOS), either implicit or explicit, that accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody.

For most pollutants, TMDLs are expressed on a mass loading basis (e.g., pounds per day, organisms per day). The Code of Federal Regulations (40 CFR § 130.2(1)) states that TMDLs do not need to be expressed as loads (mass per unit time), but may be expressed as "other appropriate measure." For pathogen indicators, it is the number of organisms in a given volume of water (i.e., their density), and not their mass or total number, that is significant with respect to public health and protection of beneficial uses. The density of fecal indicator organisms in a discharge and in the receiving waters is the technically relevant criterion for assessing the impact of discharges, the quality of the affected receiving waters, and the public-health risk. Therefore, this TMDL plan establishes density-based TMDLs and pollutant load allocations, expressed in terms of indicator bacteria densities.

Establishment of a density-based, rather than a load-based TMDL carries the advantage of eliminating the need to conduct a complex and potentially error-prone analysis to link loads and expected densities. A load-based TMDL would require calculation of acceptable loads based on acceptable bacterial densities and expected flows, and then back-calculation of expected densities under various load reduction scenarios. Since flows in the Napa River, and especially in its tributaries, are highly variable and difficult to measure, such an analysis would inevitably involve a great deal of uncertainty, with no increased water quality benefit.

6.2 Proposed Total Maximum Daily Loads

Proposed TMDLs for the Napa River watershed are listed in Table 10. These TMDLs will be applicable year-round. As shown, the TMDLs are based on the density-based REC-1 water quality objectives and U.S. EPA-recommended water quality criteria for contact recreation (Tables 2 and 3). This TMDL represents the total number of fecal indicator bacteria that can be discharged from all sources while not exceeding numeric targets established for this TMDL.

Table 10 Total Maximum Daily Loads of Pathogen Indicators for the Napa River	
Indicator	**TMDL (CFU/100 mL)**
E. coli	Geometric mean < 126 [a] 90^{th} percentile < 409 [b]
Fecal coliform[c]	Geometric mean < 200 [a] 90^{th} percentile < 400 [b]
Total coliform[c]	Median < 240 [a] No sample to exceed 10,000

[a]Based on a minimum of five consecutive samples collected at approximately equal intervals over a 30-day period.
[b]No more than 10 percent of total samples during any 30-day period may exceed this number.
[c]The Total Maximum Daily Loads for total coliform and fecal coliform shall sunset and shall no longer be effective upon the replacement of the total and fecal coliform water quality objectives in the Basin Plan with *E.coli*-based water quality objectives for contact recreation.

6.3 Proposed Load and Wasteload Allocations

Density-based load allocations are proposed for this TMDL. Unlike mass-based load allocations, the density-based load allocations do not add up to equal the TMDL, since the densities of individual pollution sources are not additive. Rather, in order to achieve the density-based TMDL, it is simply necessary to assure that each source meets the density-based overall load allocation (Santa Ana Water Board, 1998; Central Coast Water Board, 2002).

Table 11 presents the density-based pathogen load and wasteload allocations proposed for the Napa River watershed. These load allocations will apply year-round to the different source categories of pollution in the watershed. The attainment of these allocations will ensure protection of the water quality and beneficial uses of the Napa River and its tributaries.

Table 11
Density-Based Pollutant Load Allocations and Wasteload Allocations[a] for Pathogen Dischargers in the Napa River Watershed

Categorical Pollutant Source	*E. coli*		Fecal coliform[b]		Total coliform[b]	
	Geometric mean[c]	90th percent-ile[c]	Geometric mean[c]	90th percent-ile	Median[c]	Single sample maximum
On-site sewage disposal systems	0	0	0	0	0	0
Sanitary sewer systems	0	0	0	0	0	0
Municipal runoff	< 113	< 368	< 180	< 360	< 216	9,000
Grazing lands	< 113	< 368	< 180	< 360	< 216	9,000
Confined animal facilities	< 113	< 368	< 180	< 360	< 216	9,000
Wildlife[d]	< 113	< 368	< 180	< 360	< 216	9,000

[a] These allocations are applicable year-round. Wasteload allocations apply to any sources (existing or future) subject to regulation by a NPDES permit. Allocations reflect a 10% margin of safety.
[b] The allocations for total coliform and fecal coliform shall sunset and shall no longer be effective upon the replacement of the total and fecal coliform water quality objectives in the Basin Plan with *E.coli*-based water quality objectives for contact recreation.
[c] Based on a minimum of five consecutive samples collected at approximately equal intervals over a 30-day period.
[d] Wildlife are not believed to be a significant source of pathogens and their contribution is considered natural background; therefore, no management measures are required.

Proposed wasteload allocations for each of the six wastewater treatment facilities that discharge to the Napa River are not specified by source category, but rather by individual discharger, as presented in Table 12.

Table 12 Density-Based Wasteload Allocations[a] for Municipal Wastewater Treatment Facilities							
Facility	*E. coli* Density (CFU/100 mL)						NPDES Permit #
	E. coli		Fecal coliform[b]		Total coliform[b]		
	Geometric mean[c]	90th %ile[c]	Geometric mean[c]	90th %ile	Median[c]	Single sample max	
Napa Sanitation District	< 126	< 400	< 200	< 400	< 240	10,000	CA0037575
Town of Yountville	< 126	< 400	< 200	< 400	< 240	10,000	CA0038121
City of St. Helena	< 126	< 400	< 200	< 400	< 240	10,000	CA0038016
City of Calistoga	< 1263	< 400	< 200	< 400	< 240	10,000	CA0037966
City of American Canyon	< 126	< 400	< 200	< 400	< 240	10,000	CA0038768
Napa River Reclamation District #2109	< 126	< 400	< 200	< 400	< 240	10,000	CA0038644

[a]These allocations are applicable year-round. Wasteload allocations apply to any sources (existing or future) subject to regulation by a NPDES permit.
[b]The allocations for total coliform and fecal coliform shall sunset and shall no longer be effective upon the replacement of the total and fecal coliform water quality objectives in the Basin Plan with *E.coli*-based water quality objectives for contact recreation.
[c]Based on a minimum of five consecutive samples collected at approximately equal intervals over a 30-day period.

In the case of allocations specified by source category, it is the responsibility of individual facility or property owners within a given source category to meet these allocations. In other words, individual facilities and property owners shall not discharge or release a load of pollution that will increase the density of fecal coliforms in the downstream portion of the nearest waterbody above the proposed load allocations assigned to that source type. This allocation scheme assumes that the concentration of fecal coliforms upstream from the discharge point is not in excess of the assigned load allocations. For example, the geometric mean of fecal coliform concentrations in stormwater runoff samples collected at a residential area's storm drain that discharges into a tributary shall not exceed the allocated loads listed for the urban runoff source category.

OSDSs and sewer line failure, the primary potential sources of untreated human waste to the Napa River and its tributaries, are assigned load allocations of zero for the following reasons:

- As sources of human waste (as opposed to animal waste) they pose the greatest threat to the public health

- The zero load allocation is consistent with the existing Basin Plan prohibition of release of untreated sewage
- When operated properly and lawfully, OSDSs and sanitary sewer systems should not cause any human waste discharges
- Human waste discharges from these sources are fully controllable and preventable

For these reasons, zero load allocations for these source categories are both feasible and warranted.

6.4 Margin of Safety

TMDLs are required to include a margin of safety (MOS) to account for uncertainty in the relationship between pollutant loads and water quality in the receiving water body. The overall level of uncertainty in this TMDL is relatively low, and conservative assumptions in pathogen loading and transport are used. Therefore, a ten percent explicit margin of safety is employed for all load allocations and the wasteload allocation for municipal runoff. This explicit MOS reflects the inherent uncertainty in estimating pathogen loading from nonpoint sources and diffuse sources such as municipal runoff, and in assessing the effectiveness of management measures in reducing pathogen loading. This approach is consistent with the methodology provided in U.S. EPA's Protocol for Developing Pathogen TMDLs (U.S. EPA, 2001).

This TMDL employs an implicit MOS for the wasteload allocations for wastewater treatment plant discharges. These point sources are regulated by NPDES permits with defined effluent limits, therefore there is little uncertainty in pathogen loading. In addition, wastewater discharges from these facilities are prohibited except during the wet season when the discharge receives greater than 10 to 1 dilution in the receiving water.

6.5 Seasonal Variation

While pathogen loads are typically greatest during the winter wet season due to high volumes of surface runoff, indicator bacteria densities can be high at any time of year. Dry season densities were higher than wet season densities at a number of sites monitored in the Water Board/SFEI study.

Recreational use of the Napa River and its tributaries is most prevalent during the summertime, but can occur at any time of year. Therefore, no seasonal variations to the above-listed TMDLs and load allocations are proposed.

7. LINKAGE ANALYSIS

An essential component of developing a TMDL is to establish a relationship (linkage) between pollutant loadings from various sources and the numeric targets chosen to measure the attainment of beneficial uses. For this TMDL, the proposed load allocations protect the beneficial uses (the linkage is established) because:

- Fecal waste from warm-blooded animals can contain pathogens
- *E. coli* bacteria are present in fecal waste from warm-blooded animals and are routinely used as a monitoring surrogate for pathogens
- The proposed density-based load allocations are the same as, or more stringent than proposed numeric water quality targets
- The proposed numeric targets are the same as current U.S. EPA recommended bacterial water quality criteria for recreational waters
- The U.S. EPA recommend are conservatively based on epidemiological studies (U.S. EPA, 2002) and are protective of beneficial uses

Therefore, achievement of the proposed pollutant load allocations (listed in Section 6) will ensure the protection of the water quality and beneficial uses of the Napa River and its tributaries.

There is no need to perform transport and fate analysis of pathogen loadings because numeric targets apply at all points in the watershed. That is, any potential pathogen source must meet numeric targets at the point at which the source enters the Napa River or any of its tributaries. Since pathogen regrowth is very unlikely in this watershed, and net pathogen die-off is virtually certain, pathogen densities at any point downstream of the initial point of discharge will be lower than at the point of discharge.

8. PUBLIC PARTICIPATION

Public participation is a requirement of the TMDL process and vital to its success. Release of this TMDL project report is an opportunity for the public to provide input to the Water Board. The TMDL will be formally established when it is adopted as an amendment to the Basin Plan.

8.1 Formal Process for Public Participation

A draft basin plan amendment and this supporting staff report will be presented to the Water Board for review and adoption in the April 2006. Two public hearings, a testimony hearing and an adoption hearing, will be held before the Water Board, which will consider adoption of the TMDL into the Basin Plan. This process will allow the public to formally comment on the TMDL.

8.2 Informal Process for Public Participation

Our pathogen TMDL stakeholder process builds upon the existing sediment TMDL stakeholder framework. We have participated in combined sediment-nutrient-pathogen TMDL meetings since early 2003, and presented a status report to the Napa County Board of Supervisors in January 2004. In November 2005, we held a CEQA scoping meeting and public meeting to solicit response to the preliminary project report. We maintain continuing involvement with the Napa River Watershed Taskforce, the Napa County Resource Conservation District, the Napa Farm Bureau, and with local, county, state, and federal agencies involved in the Watershed. We are available to attend and/or conduct additional meetings as needed or requested.

9. IMPLEMENTATION PLAN

9.1 Overview

TMDLs are strategies to restore clean water. Implementations plans specify actions needed to solve the problem, and are required under California Law. The following implementation plan describes existing regulatory controls and cites relevant sections of the California Water Code (CWC) establishing the Water Board's authority to enforce the provisions set forth in the Implementation Plan. Section 13242 of the CWC requires that an implementation plan be incorporated into the Basin Plan upon Water Board adoption of the final TMDL Basin Plan amendment.

The implementation plan presented in this report and the associated Basin Plan Amendment provides a description of proposed actions necessary to achieve water quality objectives. The plan describes necessary actions, presents a time schedule for these actions, and describes the compliance monitoring and surveillance to be undertaken to ensure successful implementation.

The overall intent of this implementation plan is to restore and protect beneficial uses of the Napa River and its tributaries by reducing pathogen loadings. Potential pathogen sources in the watershed include: septic systems, sanitary sewer line failure, municipal runoff, livestock, and wildlife. The Water Board recognizes the technical, institutional, and monetary challenges that each source category may face in designing and implementing measures to reduce their respective loading. As such, we are trying to be as flexible as possible in the implementation approach for reducing pathogen loading. We anticipate that enforcement mechanisms will only be needed where individuals have chosen not to assess and reduce their potential to impact water quality.

This implementation plan describes the Water Board's regulatory authority (Section 9.2) as well as other plans and policies in the Napa River watershed that affect pathogen source management activities (Sections 9.3 and 9.4). A description of the proposed implementation actions is provided in Section 9.5. Evaluation of progress toward attaining implementation goals is described in Section 9.6, and a long-term water quality monitoring program is discussed in Section 10.

9.2 Legal Authorities and Requirements

The Water Board has the responsibility and authority for regional water quality control and planning per the state's Porter-Cologne Water Quality Control Act. The Water Board regulates point source pollution by implementing a variety of programs, including the NPDES Program for point sources discharging into waters of the United States. The State also controls nonpoint source pollution as specified in the state's *Plan for California's Nonpoint Source Pollution Control Program* (State Board, 2000; hereafter referred to as the State NPS Management Plan). The State's Porter Cologne Water Quality Control Act gives the Water Board authority to issue Waste Discharge Requirements (WDRs) for point and nonpoint sources of contamination.

9.3 California Nonpoint Source Program

California's Nonpoint Source (NPS) Pollution Control Program has been in effect since 1988 (WMI Chapter, 2001). The NPS Program is a regulatory strategy aimed at addressing nonpoint source pollution throughout the State of California. The NPS program is being revised to enhance efforts to protect water quality, and to conform to the Clean Water Act Section 319 (CWA 319) and the Coastal Zone Act Reauthorization Amendments Section 6217 (CZARA). The lead state agencies for the NPS Program are the State Water Board, the nine Regional Water Boards and the California Coastal Commission. The NPS Program's long-term goal is to "improve water quality by implementing the management measures identified in the California Management Measures for Polluted Runoff Report (CAMMPR) by 2013."

The State also has a Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program that requires current and proposed nonpoint source discharges to be regulated under waste discharge requirements (WDRs), waiver of waste discharge requirement, Basin Plan prohibition, or some combination of these tools (State Board, 2004). For each source category that is currently discharging but not yet regulated, a regulatory tool has been identified.

9.4 Plans & Policies in the Napa River Watershed

Below is a description of the current regulations, policies, and plans for each of the categorical pathogen sources in the Napa River watershed. Source categories of concern include:

- Faulty onsite sewage disposal systems (OSDSs)
- Sanitary sewer system failure
- Grazing lands
- Confined animal facilities
- Municipal runoff

On-site sewage disposal systems
The San Francisco Bay Basin Plan specifically addresses water quality issues related to on-site wastewater treatment and dispersal systems (on-site systems). In 1978, Water Board adopted a Policy on Discrete Facilities enumerating the following principles, which apply to all wastewater discharges:

- The system must be designed and constructed so as to be capable of preventing pollution or contamination of the waters of the State or creating a nuisance for the life of the development project
- The system must be operated, maintained, and monitored so as to continually prevent pollution or contamination of the waters of the state and the creation of a nuisance
- The responsibility for both of the above must be clearly and legally assumed by a public entity with the financial and legal capability to assure that the system provides protection to the quality of the waters of the State for the life of the development project

The policy also makes the following requests of city and county governments:

- That the use of new discrete sewerage systems be prohibited where existing community sewerage systems are reasonably available
- That the use of individual septic systems for any subdivision of land be prohibited unless the governing body having jurisdiction determines that the use of the septic systems is in the best public interest and that the existing quality of the waters of the State is maintained consistent with the State Water Board's Resolution 68-16
- That the cumulative impacts of individual disposal system discharges be considered as part of the approval process for development

The Water Board has delegated authority for permitting and regulation of individual on-site wastewater treatment systems (septic systems) in Napa County to the county government. Delegation was enacted in 1964 by means of the Board's Resolution No. 596, which waives the requirement for filing reports of waste discharge with the Board for systems that are appropriately permitted by the County. Septic systems in Napa County are regulated by the Napa County Department of Environmental Management in accordance with the Napa County Code. The Code includes specifications for on-site system siting, design, installation, inspection and repair, and provisions for permitting and enforcement of violations.

In 2000, the California Water Code was amended to require the State Water Board to develop statewide regulations or standards for permitting and operation of septic systems by January 1, 2004 (CWC Sections 13290 to 13291.7). The regulations are required to address, in part, new systems, systems subject to major repairs, systems adjacent to 303(d)-listed impaired waters, and minimum requirements for monitoring to determine system performance.

In 2002, the CWC was amended to specify that all existing Waivers of Waste Discharge Requirements for septic systems would expire on June 30, 2004 in anticipation of new State Water Board regulations (CWC Section 13269(b)(2)). This amendment also requires any new Regional Water Board septic system regulations to be consistent with the new State Water Board regulations. State Water Board regulations are currently being developed, with adoption projected for late 2006. Following adoption of the regulations, on-site system programs at both the Regional Water Board and County level will need to be updated to incorporate and implement the new requirements.

Sanitary Sewer Systems
An October 2003 Water Board resolution established a collaborative program between the Water Board and Bay Area Clean Water Agencies (BACWA) to reduce sanitary sewer overflows (SSOs). The collaborative program includes four key tasks:

- Establish SSO reporting guidelines
- Develop an electronic reporting system
- Establish guidelines for sewer system management plans (SSMP)
- Conduct a series of regional workshops to provide training on the first three tasks

Reporting guidelines, the electronic reporting system, and regional workshops were completed in 2004. The Water Board in cooperation with BACWA completed the Sewer System Management

Plan (SSMP) Development Guide in July 2005. Some of the SSMP requirements direct wastewater agencies to:

- Develop an overflow emergency response plan to contain overflows and prevent wastewater from reaching surface waters
- Develop a Fats, Oils, and Grease (FOG) Control Program if needed
- Allocate adequate resources for the operation, maintenance, and repair of its collection system
- Prioritize preventive maintenance activities, such as scheduled cleaning of sewers, root control, and investigation of customer complains
- Identity structural deficiencies and prioritize repair
- Monitor the effectiveness of each SSMP element

The Water Board notified wastewater collection agencies of the requirements for preparing SSMPs in July 2005.

On May 2, 2006, the State Board adopted general Waste Discharge Requirements for sanitary sewer systems (Board Resolution 2006-0003). All public entities that own or operate sanitary sewer systems greater than one mile in length and/or convey untreated or partially treated wastewater to a publicly owned treatment facility in the State of California are required to apply for coverage under these WDRs by November 2, 2006. The WDRs contain provisions for SSO reduction measures, including development and implementation of SSMPs.

Grazing
The State Water Board and the California Coastal Commission have identified management measures to address nonpoint source pollution from grazing activities. In response to nonpoint source pollution concerns, the Range Management Advisory Committee composed of livestock industry representatives and public members was formed. The Committee developed a California Rangeland Water Quality Management Plan which concludes that ranches should complete rangeland Water Quality Management Plans for their respective ranches. Three approaches for voluntary compliance with the plan include: letter of intent with local Resource Conservation District office, development of a nonpoint source management plan; or adoption of a recognized nonpoint source management plan.

Confined Animal facilities
The Water Board has the authority to regulate confined animal facilities through use of WDRs, waiver of WDRs, or discharge prohibitions. Animal facilities are also subject to the Water Board's comprehensive runoff control program, consistent with federal regulations (40 CFR 122-24).

Municipal runoff
The Water Board has a comprehensive runoff control program that is designed to be consistent with Federal regulations (40 CFR 122-24) and is implemented by issuing NPDES permits to owners and operators of large storm drain systems and systems discharging significant amounts of pollutants. Each stormwater permit requires that the entities responsible for the system develop and implement comprehensive control programs. The cities of Napa, St. Helena,

Calistoga, and American Canyon, the Town of Yountville, and Napa County are covered by the general stormwater permit issued by the State Board and enforced by the Regional Water Board.

Current municipal runoff program requirements include the following elements:

- Develop, implement, and enforce a stormwater management plan (SWMP) to reduce the discharge of the pollutants to the maximum extent practicable
- Address specific program areas, including public education and outreach on stormwater impacts, public involvement, illicit discharge detection and elimination, construction site stormwater runoff control, post construction stormwater management in new development and redevelopment, and pollution prevention/good housekeeping for municipal operations
- Evaluation and assessment of measures
- Monitoring and reporting

9.5 Proposed Pathogen Reduction Implementation Actions

This section describes potential management measures for each source category in the Napa River watershed. In most cases, implementation efforts should focus on these source categories in those portions of the watershed associated with bacterial water quality impairment as identified through the data presented earlier in this report or through future monitoring activities discussed in Section 9.6.

To determine the appropriate level and type of source control and regulatory actions necessary to achieve water quality objectives, the Water Board will consider the following factors:

- Feasibility of achieving the required level of performance (assigned pollutant load allocations) for each source
- Magnitude of the water quality impairment caused by each source
- History of source control efforts and regulatory requirements

Feasibility is a function of the technical capability and cost of management measure implementation. Water quality impairment is a function of the type of source (i.e. human versus animal waste) and its potential for causing an exceedance of water quality objectives.

Discharging entities will not be held responsible for uncontrollable coliform discharges originating from wildlife. If wildlife contributions are determined to be the cause of exceedances, the TMDL targets and allocation scheme will be revisited as part of the adaptive implementation program.

Many implementation activities are already underway in the watershed. The Water Board strongly supports these activities and recommends that these efforts be continued. Implementation of pathogen control measures that also reduce sediment and nutrient loads are encouraged, as this may preclude the need for implementation of additional management measures for those sources.

All sources are required to identify potential pathogen sources on their facilities and develop a plan for reducing pathogen runoff. Sources must then implement site-specific management measures to reduce the pathogen run-off and document the measures taken.

Each source category will provide documentation on progress made toward implementation of control measures. In some cases it may be desirable to identify an appropriate third party with expertise in implementation that could help evaluate reports for each source category. Where a third party is not identified, the Water Board will independently assess compliance. In all cases, the discharger is ultimately responsible for implementing identified control measures.

Throughout the TMDL process, the Water Board and stakeholders in the watershed will need to monitor compliance with management measure implementation and assess whether water quality is improving. The Implementation Plan includes steps for evaluation and follow-up for assessing compliance with the TMDL. Ultimately, the long-term success of the TMDL implementation plan will be measured by attaining the designated TMDL load allocations.

If reasonable progress toward implementing the management practices is not demonstrated, the Water Board will consider additional regulatory control or taking enforcement actions on those source categories and/or individual dischargers that are not participating in good faith. Examples of additional regulation include requiring permits for individual grazing lands or confined animal facilities or requiring operating permits for all OSDSs.

If it is demonstrated that reasonable and feasible management measures have been implemented for a sufficient period of time and TMDL targets are still not being met, the TMDL will be reevaluated and revised accordingly.

Table 13 presents proposed implementation actions to be undertaken by the Water Board. These actions are applicable to all source categories. Tables 14-18 describe proposed actions for responsible parties for reduction of pathogen loading from each major source category.

Table 13 **Proposed Water Board Implementation Actions to Reduce Pathogen Loading**
1. In coordination with responsible parties and interested third parties in the watershed, conduct monitoring program to measure progress toward, attainment of water quality objectives, meeting benchmarks, and compliance with TMDL implementation plan.
2. Assist in identifying funding mechanisms for implementation and monitoring.
3. Report to stakeholders on progress in meeting implementation of management measures and attainment of water quality objectives, including a discussion of options for regulatory action and follow-up, as needed.
4. Implement, as necessary, WDRs or waiver of WDRs related to pathogen reduction.

Table 14
Proposed Implementation Actions to Reduce Pathogen Loading from OSDSs

Implementing Party	Action
Napa County Department of Environmental Management	1. In cooperation with the Water Board and sanitary sewer collection system owners, identify areas of greatest water quality concern from septic system failure based on proximity to impaired reaches, soil type, topography, and other factors.
	2. Submit a plan and implementation schedule to evaluate OSDS performance for the watershed and to bring identified OSDSs up to appropriate repair standards. Priority should be given to systems identified as posing water quality risks.
	3. Report progress on implementation of pathogen reduction measures.

Table 15
Proposed Implementation Actions to Reduce Pathogen Loading from Sanitary Sewer Systems

Implementing Party	Action
Napa Sanitation District; City of Calistoga; City of St. Helena; Yountville Joint Treatment Plant; City of American Canyon; Napa River Reclamation District #2109	1. In cooperation with the Water Board and Napa County DEM, provide existing sanitary sewer maps to Water Board staff in order to identify potential areas of greatest water quality concern from collection system failure based on proximity to impaired reaches, soil type, topography, and other factors.
	2. Comply with provisions of general WDRs for sanitary sewer systems.
	3. Report progress on implementation of pathogen reduction measures. Priority should be given to areas identified as posing water quality risks.

Table 16 Proposed Implementation Actions to Reduce Pathogen Loading from Municipal Runoff	
Implementing Party	**Action**
Napa County; City of Napa; Town of Yountville; City of St. Helena; City of Calistoga City of American Canyon	1. Implement Phase II stormwater management plan.
	2. Update/amend stormwater management plan to include specific measures to reduce pathogen loading.
	3. Report progress on implementation of pathogen reduction measures.

Table 17 Proposed Implementation Actions to Reduce Pathogen Loading from Grazing Lands	
Implementing Party	**Action**
Owners of Grazing Operations	1. Participate in ongoing RCD/NRCS conservation programs.
	2. Implement management measures that reduce pathogen runoff.
	3. Where water quality impacts are identified, implement site-specific source control measures and conservation practices.
	4. Report on progress of pathogen loading reduction measures.

Table 18 Proposed Implementation Actions to Reduce Pathogen Loading from Confined Animal Facilities	
Implementing Party	**Action**
Confined Animal Facility Owners	1. Participate in ongoing RCD/NRCS conservation programs.
	2. Implement management measures that reduce pathogen runoff.
	3. Where water quality impacts are identified, implement site-specific source control measures and conservation practices.
	4. Report on progress of pathogen loading reduction measures.

9.6 Watershed Groups and Stakeholder Partnerships

Water Board staff encourages, but does not require, watershed groups and stakeholder partnerships to coordinate, with the ultimate goal of achieving water quality targets. In many cases, watershed groups may assist and participate in many actions to facilitate successful implementation of this TMDL, including developing appropriate management practices, conducting group or watershed-based monitoring, sharing technical knowledge, and obtaining funding. Watershed groups can assist individual dischargers in achieving compliance. However, as required by the state's Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program, individual dischargers continue to bear the ultimate responsibility for complying with water quality requirements and orders.

9.7 Evaluating Progress Towards Attaining Implementation Goals

In 2011 and approximately every five years after the adoption of the TMDL, the Water Board will evaluate site-specific, sub-watershed specific, and watershed-wide compliance with the trackable implementation measures described in Tables 14 through 18 and in the Basin Plan. In evaluating compliance with the trackable implementation measures, the Water Board will consider the level of participation of each source category as well as individual dischargers (as documented by Water Board staff or designated third parties). The results of the evaluation will be reported to stakeholders in the Watershed.

If a discharger demonstrates that all implementation measures have been undertaken or that it is infeasible to meet their allocation due to wildlife contributions, the Water Board will consider revising allocations as appropriate. If source control actions are fully implemented throughout the Watershed and the TMDL targets are not met, the Water Board may consider re-evaluating or revising the TMDL and allocations. If, on the other hand, the required actions are not implemented, or are partially implemented, the Water Board may consider regulatory or enforcement action against parties or individual dischargers not in compliance.

10. MONITORING AND EVALUATION PROGRAM

10.1 Overview

It is important to monitor water quality progress, track TMDL implementation, and modify TMDLs and implementation plans as necessary, in order to:

- Assess trends in water quality to ensure that improvement is being made
- Address any uncertainty in various aspects of TMDL development
- Oversee TMDL implementation to ensure that implementation measures are being carried out
- Ensure that the TMDL remains effective, given changes that may occur in the watershed after TMDL development

The primary measure of success for this TMDL is attainment or continuous progress toward attainment of the TMDL targets and load allocations. However, in evaluating successful implementation of this TMDL, attainment of trackable implementation actions (i.e., MPs) will also be heavily relied upon. Therefore, two types of monitoring are proposed for this TMDL: 1) water quality monitoring, discussed below; and 2) monitoring of implementation of actions, discussed in Section 9.6.

10.2 Water Quality Monitoring

In order to assess the progress made in water quality and obtain additional information for further refinement of the TMDL, Water Board staff and stakeholders in the Watershed will collaborate to monitor selected water quality testing stations within the Watershed and the Bay. The main objectives of the water quality monitoring program are to:

- Assess attainment of TMDL targets
- Evaluate spatial and temporal water quality trends in the River and its tributaries
- Further identify significant pathogens source areas
- Collect sufficient data to prioritize implementation efforts and assess the effectiveness of implementation actions.

In the summer of 2006, Water Board staff will conduct additional, spatially intensive *E. coli* sampling near identified hotspots in Browns Valley Creek, Murphy Creek, and Salvador Channel. Sampling results will be examined in conjunction with maps of septic system locations, sanitary sewer lines, soils, and topography to further define the relative contributions of septic

Water Board staff will also conduct watershed-wide sampling each wet season and dry season through at least 2010. Table 19 presents locations for this annual baseline water quality monitoring. Each site will be sampled for *E. coli* ten times each year. Five samples will be collected weekly for one thirty-day period in each wet season (November through March) and for one thirty-day period in each dry season (May through September). All water quality monitoring (including Quality Assurance and Quality Control procedures) will be performed pursuant to the State Water Board's Quality Assurance Management Plan for the Surface Water

Ambient Monitoring Program. Additional monitoring will be conducted as needed if funds are available.

Table 19 Baseline Monitoring Sites
Napa River at Third Street, Napa
Napa River at Zinfandel Lane
Napa River at Calistoga Community Center
Browns Valley Creek at Browns Valley Road
Browns Valley Creek at Borrette Lane
Murphy Creek at Coombsville Road
Murphy Creek at upstream location to be determined[a]
Salvador Channel at Solano Avenue
Salvador Channel at Dry Creek Road
Four additional tributaries to be determined[a], rotated each year
[a]Sites will be determined by Water Board staff in coordination with stakeholders.

10.3 Adaptive Implementation

Approximately every five years, the Water Board will review the Napa River Pathogen TMDL and evaluate new and relevant information from monitoring, special studies, and scientific literature. The reviews will be coordinated through the Water Board's continuing planning program and will provide opportunities for stakeholder participation. Any necessary modifications to the targets, allocations, or implementation plan will be incorporated into the Basin Plan. In evaluating necessary modifications, the Water Board will favor actions that reduce sediment and nutrient loads, pollutants for which the Napa River watershed is also impaired. At a minimum, the following questions will be used to conduct the reviews. Additional questions will be developed in collaboration with stakeholders during each review.

- Are the River and tributaries progressing toward TMDL targets as expected? If progress is unclear, how should monitoring efforts be modified to detect trends? If there has not been adequate progress, how might the implementation actions or allocations be modified?
- What are the pollutant loads for the various source categories (including naturally occurring background pathogen contributions and the contribution from open space lands), how have these loads changed over time, how do they vary seasonally, and how might source control measures be modified to improve load reduction?
- Is there new, reliable, and widely accepted scientific information that suggests modifications to targets, allocations, or implementation actions? If so, how should the TMDL be modified?

If it is demonstrated that all reasonable and feasible source control measures have been implemented for a sufficient period of time and TMDL targets are still not being met, the Water Board will reevaluate water quality standards, TMDL targets and allocations as appropriate.

10.4 Relationship to Other TMDLs in the Napa River Watershed

In addition to pathogens, the Napa River is listed as impaired by nutrients and sediments. The sediment TMDL is scheduled for Water Board adoption later in 2006. We anticipate adoption of the nutrient TMDL in 2007.

Many of the implementation actions prescribed in this TMDL will also satisfy implementation requirements for the other pollutants. For example, by meeting conditions of the Water Board's grazing waiver program, cattle producers will meet the requirements for all three TMDLs. This is also the case for the confined animal waiver.

We anticipate that pathogen TMDL requirements for septic systems and sewer lines will generally fulfill the requirements of the nutrient TMDL. (These sources are not relevant to the sediment TMDL.) However, it should be noted that not all actions to abate pathogen pollution from septic systems also reduce nutrient pollution. For instance, incorporating a disinfection unit into a septic system will control pathogens, but has no effect on nutrient loading to nearby waters. Furthermore, nutrients (especially nitrate) can be more mobile in soil than pathogens. (Pathogens, being particles, are more readily retained in the soil than nitrate, a chemical solute.) Therefore, setbacks appropriate for pathogens may not be sufficient for nutrients.

A number of pollutant source categories that are not important for pathogens can be significant nutrient or sediment sources. Wastewater treatment plants are not significant pathogen sources, but can be important sources of nutrients. Sediment source categories that were not addressed in the pathogen TMDL include vineyards (preliminary data indicate that vineyards are not a significant nutrient source in the Napa watershed), unpaved roads, and actively eroding gullies and shallow landslides eroded by concentrated runoff.

It is difficult to compare levels of impairment attributable to the three pollutants because the mechanisms and the consequences of impairment differ for each. Pathogens impair contact recreational use because they pose health risks to users. Excess nutrients impair aquatic habitat by stimulating excess algae growth, which can in turn deplete dissolved oxygen and smother bottom habitat. In extreme cases excess nutrients can also result in acute toxicity. Excess sediment degrades stream habitat in a number of ways, including clogging of spawning gravels, intensifying streambed scour during peak flows, and filling of deep pools.

11. REGULATORY ANALYSES

11.1 Overview

This section includes the analyses required pursuant to the Administrative Procedures Act to adopt or modify a regulation. Many Basin Plan provisions are considered regulations, and many of the changes contained in the proposed Basin Plan amendment (BPA) add regulatory provisions to the Basin Plan. To adopt these changes, the Water Board must complete an environmental checklist pursuant to the California Environmental Quality Act (CEQA), consider reasonable alternatives to the proposal, and consider economic factors relating to compliance with all new regulatory requirements.

11.2 Environmental Checklist

CEQA requires agencies to review the potential for their actions to result in adverse environmental impacts. CEQA further requires agencies to adopt feasible measures to mitigate potentially significant impacts. Chapter 11 contains the environmental checklist for the proposed Basin Plan amendment. An explanation follows the environmental checklist and provides details concerning the environmental impact assessment. The analysis concludes that adopting the proposed Basin Plan amendment will not have any significant adverse environmental effects.

11.3 Alternatives

To illustrate how some of the choices made in developing the proposed Basin Plan amendment affect its foreseeable outcomes, this analysis considers a range of alternatives to the Basin Plan amendment. It discusses how each alternative would affect foreseeable outcomes and the extent to which the alternative would achieve the goals of the proposed Basin Plan amendment. As discussed in Section 12, the Basin Plan amendment does not pose any significant adverse environmental impacts; therefore, the alternatives would not avoid or lessen any significant adverse impacts. The following alternative scenarios involve different targets, allocations, and implementation strategies: (1) proposed Basin Plan amendment, (2) no Basin Plan amendment, (3) higher TMDL targets and allocations, (4) lower TMDL targets and allocations, (5) seasonal TMDL, and (6) longer implementation.

Proposed Basin Plan Amendment
The proposed project is the Basin Plan amendment adopting the pathogen TMDL for the Napa River watershed. The Basin Plan amendment is based on the technical analyses described in Sections 2 through 9 of this report. The Basin Plan amendment includes target E. coli concentrations (126 CFU/100 mL geometric mean; 320 CFU/100 mL 90th percentile) for the Napa River and its tributaries, and assigns load allocations to the various pathogen source categories to achieve the targets.

No Basin Plan Amendment
Under this alternative, the Water Board would not amend the Basin Plan to adopt the proposed pathogen TMDL. Neither the proposed targets nor the proposed allocations would be adopted,

and no new implementation activities would be initiated. In the event that no actions were taken to address the Napa River watershed's pathogen impairment, pathogen concentrations would likely either stay the same or increase over time, due to the aging of waste management systems.

If the Water Board were to decline to adopt a pathogens TMDL, the Clean Water Act requires the U.S. Environmental Protection Agency (U.S. EPA) to complete a TMDL for the Napa River watershed. How U.S. EPA's TMDL would differ from the TMDL described in the proposed Basin Plan amendment is unknown. U.S. EPA would likely rely, at least in part, on analyses completed to date; however, U.S. EPA would be free to develop its own TMDL in any manner it deemed appropriate, within legal constraints. U.S. EPA would identify targets and allocate pathogen loads. U.S. EPA would not impose an implementation plan directly. However, the Water Board would be expected to incorporate U.S. EPA's TMDL and appropriate implementation actions into the Basin Plan through the continuing planning process.

This alternative would involve the Water Board declining to exercise the authority and responsibility delegated to it by U.S. EPA to implement Section 303(d) of the Clean Water Act. The Water Board would not maintain responsibility for developing and implementing the Napa River Pathogens TMDL. In addition, the U.S. Federal Government may not be as effective as the Water Board at developing a TMDL and encouraging stakeholder participation for this area given the regional expertise of the Water Board and local stakeholders.

Higher TMDL Targets/Allocations
Under this alternative, the TMDL targets would be set at a higher level than those proposed in the Basin Plan amendment, therefore raising the proposed pathogen load allocations.

This alternative would not protect the water contact recreation beneficial use of the Napa River watershed to the same extent as the proposed targets.

Lower TMDL Targets/Allocations
Under this alternative, the TMDL targets would be set at a lower level than those proposed in the Basin Plan amendment. While the proposed targets are protective of human health, this alternative could ensure additional protection for recreational users of the Napa River watershed. The pathogen load allocations, however, would need to be reduced to achieve these lower TMDL targets. This could necessitate additional TMDL implementation actions.

Meeting the lower allocations could require substantial additional effort to reduce pathogen loads. Because the costs of achieving these greater pathogen reductions may be disproportionately large when compared to the costs of the proposed reductions, the added costs may be unreasonable relative to the environmental benefits.

Seasonal TMDL
Under this alternative, the TMDLs for the Napa River and its tributaries would be applicable only during certain periods of the year (i.e., the dry season) and not throughout the year, as proposed by the Basin Plan amendment.

This alternative would be easier to achieve. It would not, however, fully protect the beneficial uses of the Napa River watershed at all times. Given that recreational uses occur year round, this would increase risk to users in some seasons.

Longer Implementation
Under this alternative, the allocations would be phased in over a longer period of time than proposed by the Basin Plan amendment. Therefore, attainment of the designated water quality objectives would be postponed, putting public health in jeopardy.

This alternative would not meet the Basin Plan amendment's objectives because it would delay, without any reasonable justification, attainment of the water quality objectives and protection of beneficial uses of the Napa River watershed. Further, most of the proposed implementation actions are and have been required under various established regulatory programs. Therefore, their implementation should be already underway, and by the end of the identified implementation period should be fully completed.

Preferred Alternative
Because the proposed Basin Plan amendment will not pose any significant adverse environmental impacts, the alternatives would not avoid or lessen any significant impacts. Some alternatives could be considered environmentally superior because they could conceptually involve lower allocations and greater implementation efforts. In this way, they could result in lower pathogen concentrations in the Napa River watershed. These alternatives are the lower TMDL targets and lower allocations scenarios. Both could be less feasible to implement than the proposed Basin Plan amendment. The proposed Basin Plan amendment is the preferred alternative.

11.4 Economic Considerations

Overview
The California Environmental Quality Act requires that whenever one of California's nine regional water boards, such as the San Francisco Bay Regional Water Quality Control Board (Water Board), adopts a rule that requires the installation of pollution control equipment or establishes a performance standard or treatment requirement, it must conduct an environmental analysis for reasonably foreseeable methods of compliance (Public Resource Code 21159 [a][3][c]). This analysis must take into account a reasonable range of factors, including economics. Furthermore, if the rule includes an agricultural control plan, then the total cost of the program must be estimated and potential sources of funding must be identified (Water Code 13141).

The proposed Napa River Pathogens Basin Plan amendment includes performance standards (i.e., targets and allocations), and therefore requires the consideration of economic factors. The Total Maximum Daily Load (TMDL) implementation plan also proposes activities for agriculture, and therefore, the total cost of the implementation effort is estimated and potential funding sources are identified.

The objective of this analysis is to estimate the costs of implementing the TMDL for pathogen reduction on land areas that drain into the Napa River watershed. It has been determined that pathogens originating from on-site sewage disposal systems (OSDS), sewer systems, grazing lands, confined animal facilities, and municipal runoff can be reduced to achieve the goals of the TMDL. In the proposed BPA the Water Board has proposed general implementation measures for each pathogen source. The implementation measures are primarily composed of monitoring, implementation of management practices (MPs), and reporting.

The TMDL implementation costs are estimated for each source category and for each of the proposed implementation actions contained in the BPA. Summary Tables 20 and 21 provide the cost estimates. We provided an upper and lower range of cost estimates since there is uncertainty about the exact costs. In most cases, the particular elements of the implementation action are required to be developed at some point in the future, and therefore, the specifics are unknown. For cases in which it is possible to make educated guesses about the likely elements of an implementation action, cost estimates are included. For other cases, estimating the elements of a program would be decidedly speculative, and therefore, no cost estimates are developed. Cost estimates were projected for a 10-year planning horizon. Costs of implementing existing requirements are also not included in this report.

Cost Estimates

Municipal Runoff

Napa County's municipal runoff program is administered by the Napa County Flood Control and Water Conservation District (NCFCWCD), under a joint powers agreement among the Cities of Napa, St. Helena, and Calistoga, the Town of Yountville, and Napa County. The program is regulated under federal NPDES storm water permit requirements. NCFCWCD's permit requires development and implementation of a storm water management plan that includes specifics on what MPs will be used to address certain program areas. The program areas include public education and outreach; illicit discharge detection and elimination; construction and post-construction; and good housekeeping for municipal operations. NCFCWCD's storm water management plan is entitled *Action Plan 2003-2007* (NCFCWCD, 2003) and is already being implemented.

To meet the requirements of the TMDL, the County will be required to develop additional management measures for pathogen reduction; identify measurable goals and time schedules of implementation; and assign responsibility for each task. The specifics of the storm water program efforts to reduce pathogens are not yet known and will be described in NCFCWCD's *Action Plan 2008-2012* (to be released in 2008). NCFCWCD is required to submit the stormwater management plan to the Water Board for approval at that time. The Water Board will review this document for its adequacy in meeting the storm water requirements. An estimate of the storm water program efforts and their costs is provided below.

Inspections/Monitoring: No monitoring of storm water outfall water quality is proposed for this TMDL. The existing storm water management plan provides for illicit discharge detection activities. Therefore, no new inspection/monitoring costs are anticipated.

Stormwater Plan Implementation: Development and implementation of a storm water program for this watershed is required independently of the Basin Plan amendment. Since this is an existing requirement under Phase II of the storm water program, no additional cost is estimated for implementation of the existing storm water management program. Some additional implementation measures or management programs may be needed for pathogen reductions. The specific measures are not known at this time, but may include signage, education, and pet waste reduction measures. It has been estimated for a similar stormwater program in Marin County that additional pathogen-specific measures would result in a 2 to 15 percent increase to the annual program budget (Lewis, pers. comm., 2004). Applying these percentages to the $100,000/year Napa stormwater program budget, we estimate a minimum increase in storm water program costs of $2,000 per year, and a maximum of $15,000 per year.

Reporting: Reporting on the municipal storm water program is required independent of the TMDL under Phase II of the municipal storm water program. Therefore, no costs have been estimated for reporting.

Onsite Sewage Disposal Systems

The Basin Plan amendment requires the County to develop a plan and implementation schedule to evaluate Onsite Sewage Disposal Systems (OSDS) performance in the Napa River watershed and to bring identified OSDS up to the County's repair standards. It anticipates that repairs will be made to failing systems. The specifics of the management program that will document and assess performance of OSDS have not yet been determined. Within the Napa River watershed, approximately 9,000 parcels have septic systems. Of those, approximately 860 are located on parcels that are within 15 meters of a surface drainage watercourse (Wang et al., 2004). (Parcels are included in this count if any portion of the parcel is located within 15 meters of a watercourse. In many—if not most—cases the actual septic system is located further away than 15 meters, and the count is therefore conservative.) Among these, approximately 70 septic system parcels are located within 100 feet of the "high priority" (as described in Section 10 of the staff report and in the Basin Plan amendment) waterbodies, Murphy Creek and Browns Valley Creek (Pahl, pers. comm. 2005). Inspection and repair is currently proposed only for septic systems adjacent to Murphy and Browns Valley Creeks, and possibly a very limited number of systems adjacent to Salvador Creek. Inspection and repair may be required for additional subwatersheds based on water quality monitoring conducted during the adaptive implementation phase of this TMDL. However, since monitoring to date suggests that less than half of the stream reaches in the watershed are impaired, we assume that no more than 400 of the 860 septic systems mentioned above will require inspection and/or repair. The cost of system repairs will vary according to the type, age, and location of the system. The national average for failing systems ranges from 10–20% (U.S. EPA, 2002). There is no information on failure rates in Napa County.

Evaluation/Monitoring: The specifics of the program that will document and assess performance of OSDS have not yet been determined. For calculating low-range cost estimates, we assumed inspections only of the70 parcels adjacent to Murphy and Browns Valley Creeks every ten years. For calculating high-range cost estimates, we assumed inspection every five years of 400 septic systems. Inspections would likely include a visual survey of the tank, water level, and leach field. A hydraulic load and dye test would likely be necessary. This type of inspection could be performed by a qualified contractor and would cost approximately $500 per inspection (Smith, pers. comm. 2004).

Additional program costs incurred by the County to implement an expanded evaluation, monitoring, and reporting program are estimated to range from $10,000 to $50,000 per year.

Repair Program Implementation: OSDS repair costs vary greatly depending upon the problem. As a low-range cost estimate, we assumed a minor system repair costing approximately $2,000, including the cost of interim waste pumping and hauling. As a high-range per-unit cost estimate, a complete system replacement of a failed leach field could require installation of a mound system for a cost of approximately $40,000 (including labor and engineering) (Ng, pers. comm.2006). For the low-range estimate, a failure rate of 10% of the70 high priority septic systems in the Murphy and Browns Valley subwatersheds, and a repair cost of $2,000 per system is assumed. For a high-range estimate we assume a failure rate of 20% of 400 septic systems, with a repair cost of $40,000 per system.

Reporting: The Basin Plan amendment also requires the County to report progress on implementation of the OSDS management program. Oversight of the inspection results and follow-up would vary according to the number of systems inspected, frequency of inspection, type of system, and economies of scale. A similar reporting/follow-up program in Marin County involving biannual inspection of 1,300-3,500 septic systems has been estimated to cost $24,000/year (Economic Planning Systems, 2003). This value is used as a conservative high-range estimate for the Napa County program. The low-range estimate is one quarter of the high-range estimate, or $6,000/year.

Grazing Lands Runoff

The proposed Basin Plan amendment anticipates that the Water Board will develop waiver of Waste Discharge Requirements (WDRs) conditions (similar to the existing waiver conditions for Dairies) for grazing land operators. It also requires grazing operators to submit a Report of Waste Discharge that identifies site-specific grazing management measures and provides a schedule to implement measures to reduce animal runoff. At this point, the site-specific actions or general waiver conditions are unknown.

There are currently approximately 23,000 acres of grazing land in the Napa River watershed (Jones and Stokes, 2005). Based on conversations with National Resource Conservation Service (NRCS), U.C. Cooperative Extension, and Napa Farm Bureau staff, we assume that there are approximately 20 grazing operations in the watershed.

Inspection/Monitoring: We assumed that all grazing operations would require an initial visit from technical assistance staff, with annual visits thereafter. Initial visits were assumed to be full-day (roughly $1000), with half-day ($500) annual visits.

Management Measures Implementation: Based on conversations with NRCS staff and individual ranchers, we estimate that approximately 75% of grazing lands in the Napa River watershed currently have adequate MPs in place. We therefore assume that additional management measures will be required in a maximum of 25% of the grazing land within the watershed. This assumption is consistent with water quality data, which indicate moderate, relatively localized impairment.

The specific pathogen reduction implementation measures will vary with the geography, pattern of animal use, and management practices. Without knowing specific grazing practices or the geography of individual ranches, we assume that typical MP measures may include livestock rotation through pastures, fencing animals out of the waterways, and installing off-stream water troughs. Since fencing is likely to be the most costly MP, this was used as a conservative cost estimate. However, the Water Board acknowledges that there are other acceptable methods of managing livestock access to streams.

Fence installation (39 inches high with barbed wire and galvanized posts) is estimated to cost approximately $4.80 per linear foot to install. Water troughs (224 gallon capacity, 2x2x8 feet) are estimated to cost $163/trough. As a high-range cost estimate, we assumed that 25% of the blue-line streams (as determined using GIS) within grazed lands would be fenced. Using GIS, we calculated 500,000 linear feet of blue-line streams. With $4.80/foot to install and 500,000 x 25% (x2) linear feet of stream to be fenced, and assuming that 25% of blue-line streams would require fencing, the high-range cost for fencing $1,200,000. The high-range cost for water troughs (one water trough per 20 acres for 25% of total grazing acreage) is approximately $46,863. Low range cost estimates for these costs are assumed to be one fifth of the high range estimates. For both high- and low-range estimates, annual maintenance costs equal to one-tenth of initial capital costs are assumed.

It is possible that fencing the creeks may reduce the amount of forage available to livestock, resulting in a decline in livestock productivity and/or causing a reduction in herd size. The extent and cost of these losses are considered too speculative to estimate, and are not considered in this analysis.

Reporting: It is not known how the grazing land operators will be required to report on their compliance with the BPA requirements. Since these facilities will be operating under a waiver of Waste Discharge Requirements (WDR), we assumed that Water Board staff would inspect each of the 15 facilities. Both high- and low-range estimates assume that each facility will be inspected once every five years at $500 per inspection.

Confined Animal Facilities

Reconnaissance by Water Board staff indicates that between 20 and 100 confined animal facilities in the Napa River watershed have the potential to affect water quality. The facilities are mostly small, and range from poultry operations to kennels to horse stables. The proposed Basin Plan amendment anticipates that the Water Board will develop waiver of Waste Discharge Requirements (WDRs) conditions (similar to the existing waiver conditions for dairies) for equestrian and other non-dairy confined animal facilities. It also requires facility operators to submit a Report of Waste Discharge that identifies site-specific management measures and provides a schedule to implement measures to reduce animal runoff. At this point, the site-specific actions or general waiver conditions are unknown.

No applicable information could be found for the costs of inspections, MPs, and reporting for the mixture of small confined animal facilities typical of this watershed. However, it has been estimated that pathogen TMDL implementation actions would cost equestrian facilities in the

Tomales Bay watershed an average of $20,000 per facility in one-time capital improvements and $6,600/year per facility in manure management expenses (Water Board, 2005). The average size of Napa confined animal facilities in considerably smaller than the facilities affected by the Tomales Bay TMDL. In recognition of this size disparity, we assumed average one time MP capital costs of $5,000 per facility, and average annual manure management costs of $2,000 per facility for facilities in the Napa River watershed. We further assumed an average annual inspection cost of $500 per facility and a total annual tracking cost of $5,000. Low-range estimates assume 20 facilities, and high-range estimates assume 100 facilities.

Sanitary Sewer Systems
All sanitary sewer activities specified in the Basin Plan amendment are currently required under the existing Sanitary Sewer Management Plan program. No new costs are anticipated as a result of implementing this TMDL.

Domestic Wastewater Treatment Plants
All wastewater treatment plant activities specified in the Basin Plan amendment are currently required under the facilities' NPDES permits. No new costs are anticipated as a result of implementing this TMDL.

Potential Sources of Funding
Several state and federal grant programs are aimed at non-point source pollution control and implementing TMDL actions. Potential funding sources for pathogen reduction measures include Watershed Protection Programs (funded by CALFED, Prop. 13, Prop. 40, and Prop. 50) and Nonpoint Source Pollution Control Programs (funded by EPA via the 319 grant program, Prop. 13, Prop. 40, and Prop. 50). The State Water Resources Control Board administers a consolidated grant program to award and manage these funding sources. In addition, low-interest State Revolving Fund loans may be available. Small Community Wastewater Grants may be another source of funding for septic projects. Funds for improvements to agricultural lands are available through the Natural Resources Conservation Service.

Benefits of the Basin Plan Amendment
The benefit of implementing this TMDL would be overall water quality improvement of the Napa River and its tributaries and achievement of the water quality objectives for contact recreational uses. Successful implementation of this TMDL would reduce pathogenic bacteria to levels deemed safe for water contact recreation. Implementation of this TMDL provides important human health benefits for which it would be speculative to assign a monetary benefit.

The Napa River and its tributaries, with their many public parks, are important recreational resources. Successful implementation of the TMDL would provide improve water quality for many recreational uses including kayaking, swimming, wading, and other water activities. Improved water quality also contributes to tourism, which in turn benefits local businesses.

Table 20 Summary of Estimated Costs for Pathogen TMDL Implementation (Year 0 through 10)						
Source Category	**One Time Cost (Site Development/Infrastructure)**		**Annual Costs**		**Ten-Year Program Cost**	
	Low	**High**	**Low**	**High**	**Low**	**High**
Municipal Runoff	$0	$0	$2,000	$15,000	$20,000	$150,000
Onsite Sewage Disposal Systems	$14,000	$3,200,000	$19,500	$114,000	209,000	$4,340,000
Grazing Lands	$269,373	$1,266,863	$36,937	$136,686	$603,809	$2,499,040
Confined Animal Facilities	$100,000	$500,000	$55,000	$255,000	$650,000	$3,050,000
Sanitary Sewer Systems	$0	$0	$0	$0	$0	$0
Wastewater Treatment Plants	$0	$0	$0	$0	$0	$0
GRAND TOTAL	$383,373	$4,966,863	$113,437	$520,686	$1,482,809	$10,039,040

Table 21
Implementation Actions and Estimated Costs

Implementation Action	Responsible Party		One-Time Cost		Annual Cost		10-Year Program Cost	
	Name	No.	Low	High	Low	High	Low	High
Municipal Runoff								
1. Inspection/ Monitoring	Napa County Flood Control and Water Conservation District (NCFCWCD)	1	$0	$0	$0	$0	$0	$0
2. Stormwater Plan Implementation	NCFCWCD	1	$0	$0	$2,000	$15,000	$20,000	$150,000
3. Reporting	NCFCWCD	1	$0	$0	$0	$0	$0	$0
	Total		$0	$0	$2,000	$15,000	$20,000	$150,000
Onsite Sewage Disposal Systems (OSDS)								
1. Evaluation/ Monitoring	Napa County	1	$0	$0	$13,500	$90,000	$135,000	$900,000
2. Repair Program Implementation	Homeowner	70-400	$14,000	$3,200,000	$0	$0	$14,000	$3,200,000
3. Reporting	Napa County	1	$0	$0	$6,000	$24,000	$60,000	$240,000
	Total		$14,000	$3,200,000	$19,500	$114,000	$209,000	$4,340,000
Grazing Lands								
1. Inspection/ Monitoring	Ranchers	20	$20,000	$20,000	$10,000	$10,000	$110,000	$110,000
2. Implement Management Measures	Ranchers	20	$249,373	$1,246,863	$24,937	$124,686	$473,809	$2,369,040
3. Reporting	Ranchers	20	$0	$0	$2,0000	$2,000	$20,000	$20,000
	Total		$269,373	$1,266,863	$36,937	$136,686	$603,809	$2,499,040
Confined Animal Facilities								
1. Inspection/ Monitoring	Confined Animal Facilities	20-100	$0	$0	$10,000	$50,000	$100,000	$500,000
2 Implement Management Measures	Confined Animal Facilities	20-100	$100,000	$500,000	$40,000	$200,000	$500,000	$2,500,000
3. Reporting	To be determined		$0	$0	$5,000	$5,000	$50,000	$50,000
	Total		$100,000	$500,000	$55,000	$255,000	$650,000	$3,050,000
Sanitary Sewer Systems								
1. Comply with approved Sanitary Sewer Management Plan	System Owners	6	$0	$0	$0	$0	$0	$0
	Total		$0	$0	$0	$0	$0	$0
Domestic Wastewater Discharges								
1. Comply with applicable NPDES permits	Facility Owners	6	$0	$0	$0	$0	$0	$0
	Total		$0	$0	$0	$0	$0	$0

12. ENVIRONMENTAL CHECKLIST

1.	**Project Title:**	Pathogens in the Napa River Watershed Total Maximum Daily Load (TMDL) Basin Plan Amendment
2.	**Lead Agency Name and Address:**	California Regional Water Quality Control Board, San Francisco Bay Region 1515 Clay Street, Suite 1400 Oakland, California 94612
3.	**Contact Person and Phone Number:**	Peter Krottje (510) 622-2382
4.	**Project Location:**	Napa River Watershed, San Francisco Bay Region
5.	**Project Sponsor's Name and Address:**	California Regional Water Quality Control Board, San Francisco Bay Region 1515 Clay Street, Suite 1400 Oakland, California 94612
6.	**General Plan Designation:**	Not Applicable
7.	**Zoning:**	Not Applicable

8. **Description of Project:**

   The project is a proposed Basin Plan amendment to adopt a TMDL for pathogens in the Napa River watershed. The project would involve numerous actions to reduce pathogen concentrations in the Napa River and its tributaries. Additional details are provided in the explanation attached.

9. **Surrounding Land Uses and Setting:**

   The proposed Basin Plan amendment would affect all segments of the Napa River watershed. Implementation would involve specific actions throughout the watershed. Napa River watershed land uses include a mix of urban, low-density residential, agricultural, and open space.

10. **Other public agencies whose approval is required** (e.g., permits, financing approval, or participation agreement.)

    The California State Water Resources Control Board, the California Office of Administrative Law, and the U.S. Environmental Protection Agency must approve the proposed Basin Plan amendment.

ENVIRONMENTAL IMPACTS:

Issues:	*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?	☐	☐	☒	☐
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 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 Department of Conservation as an optional model to use in assessing impacts on agriculture and farmland. **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?	☐	☐	☐	☒
c) 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—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?	☐	☐	☐	☒

Issues:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
III. AIR QUALITY—(cont.):				
b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation?	☐	☐	☒	☐
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?	☐	☐	☒	☐
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 U.S. 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?	☐	☐	☒	☐

Issues:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
IV. BIOLOGICAL RESOURCES—(cont.):				
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?	☐	☐	☐	☒
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?	☐	☐	☐	☒
V. 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 a unique archaeological resource pursuant to §15064.5?	☐	☐	☒	☐
c) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?	☐	☐	☒	☐
d) Disturb any human remains, including those interred outside of formal cemeteries?	☐	☐	☒	☐
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?	☐	☐	☒	☐

Issues:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
VI. GEOLOGY AND SOILS—(cont.):				
c) Be located on 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 wastewater disposal systems where sewers are not available for the disposal of wastewater?	☐	☐	☐	☒
VII. 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?	☐	☐	☐	☒

Issues:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
VII. HAZARDS AND HAZARDOUS MATERIALS -- (cont.):				
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?	☐	☐	☐	☒
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?	☐	☐	☐	☒
VIII. HYDROLOGY AND WATER QUALITY—Would the project:				
a) Violate any water quality standards or waste discharge requirements?	☐	☐	☐	☒
b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater 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 of 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 stormwater drainage systems or provide substantial additional sources of polluted runoff?	☐	☐	☐	☒

Issues:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
VIII. HYDROLOGY AND WATER QUALITY—(cont.):				
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?	☐	☐	☐	☒
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 of seiche, tsunami, or mudflow?	☐	☐	☐	☒
IX. 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?	☐	☐	☐	☒
X. 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?	☐	☐	☐	☒

Issues:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
XI. 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?	☐	☐	☒	☐
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?	☐	☐	☐	☒
XII. 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?	☐	☐	☐	☒
c) Displace substantial numbers of people necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒

Issues:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
XIII. 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?	☐	☐	☐	☒
XIV. 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?	☐	☐	☐	☒
XV. 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?	☐	☐	☐	☒
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?	☐	☐	☐	☒

Issues:	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
XV. TRANSPORTATION /TRAFFIC–(cont.):				
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)?	☐	☐	☐	☒
XVI. UTILITIES AND SERVICE SYSTEMS—Would the project:				
a) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?	☐	☐	☐	☒
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?	☐	☐	☐	☒
g) Comply with federal, state, and local statutes and regulations related to solid waste?	☐	☐	☐	☒

Issues:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
XVII. 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 cumulative considerable? ("Cumulative 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)?	☐	☐	☒	☐
c) Does the project have environmental effects, which will cause substantial adverse effects on human beings, either directly or indirectly?	☐	☐	☐	☒

12.1 Explanation

Project Description

The proposed project is a Basin Plan amendment to adopt a Total Maximum Daily Load (TMDL) for pathogens in the Napa River watershed (see proposed Basin Plan amendment). The goal of the Basin Plan amendment is to improve environmental conditions. The Basin Plan amendment would include target density-based pathogen concentrations for the Napa River and its tributaries and assign wasteload allocations to achieve the targets. The TMDL implementation plan would involve numerous actions to achieve the targets and allocations. The Basin Plan amendment would affect all segments of the Napa River watershed, and implementation actions may occur throughout the watershed.

The proposed targets and allocations are measures of performance. The implementation plan outlines the Water Board's approach to meeting these measures of performance. To reduce pathogen concentrations in the Napa River watershed, the plan describes actions the Water Board would take, actions expected of dischargers in the watershed, and actions the Water Board might take to compel, as necessary, entities to comply with all requirements. The Water Board would not directly undertake any actions that could physically change the environment, but adopting the proposed Basin Plan amendment could indirectly result in other parties (e.g., land owners, government entities, and special districts) undertaking projects to satisfy requirements derived from the Basin Plan amendment. These projects could physically change the environment. The adverse environmental impacts of such physical changes are evaluated below to the extent that they are reasonably foreseeable. Changes that are speculative in nature do not require environmental review.

Until the parties that must comply with requirements derived from the Basin Plan amendment propose specific projects, many physical changes cannot be anticipated. These specific projects could be subject to environmental review under the California Environmental Quality Act (CEQA), and CEQA compliance would be the responsibility of the lead agency for each project. The environmental reviews would identify any potentially significant adverse environmental impacts of the specific proposals, along with appropriate mitigation measures. Until such projects are proposed, however, identifying specific impacts and mitigation measures would require inappropriate speculation. Moreover, any mitigation deemed necessary by the lead agencies for those projects would not be within the jurisdiction of the Water Board to require.

Direct and Indirect Physical Changes

Table 22 summarizes the actions that could conceivably be undertaken if the proposed Basin Plan amendment were adopted, and explains the rationale for including them or not including them in this environmental review. The physical changes that require evaluation are those associated with (1) minor construction, (2) earthmoving and grading operations, and (3) waste handling and disposal. Although these activities are reasonably foreseeable, the implementation plan does not specify the nature of these actions. Therefore, this analysis considers these actions in general programmatic terms. To illustrate the possible nature of these activities, some examples are described below.

Table 22 Implementation Actions Subject to Environmental Review	
Possible Actions	**Environmental Change Subject to Review**
Pollution prevention/storm water management plan	Waste handling and disposal
Storm water treatment	Minor construction/waste handling and disposal
Storm sewer maintenance	Waste handling and disposal[a]
Inspections of existing septic systems, animal operations, and small wastewater treatment facilities	None—No physical environmental change
Repair/Replace septic systems	Earthmoving operations/waste handling and disposal[b]
Best Management Practices; fence construction, development of off-stream water sources	Minor Construction
Repair/Replace existing animal waste ponds	Earthmoving operations/waste handling and disposal[b]
Data collection and analysis	None—No physical environmental change

[a]The Basin Plan amendment may not increase maintenance, but maintenance activities may be targeted to maximize removal and disposal of collected waste.
[b]Earthmoving could include grading, sediment removal, capping, or other actions taken to prepare a site for wastewater treatment.

- *Minor Construction.* Basin Plan amendment-related construction activities would generally be small in scale. Most would relate to replacing or repairing existing wastewater treatment and disposal systems such as septic systems, animal waste management ponds and/or manure stockpiles. In a few cases, new systems could be constructed, such as community leach fields. Animal facility operators could also choose to adopt management practices (MPs) that include retention or detention basins, separators, infiltration basins, or vegetated swales. Construction could also be undertaken to divert storm water flows. It is speculative to determine where these new systems will be located and whether any new system would require an independent review under CEQA. Individual landowners may also undertake minimal construction activities to reduce animal waste runoff including fence construction and off-creek water troughs. These would likely be limited to barbed wire fencing along portions of waterways.

- *Earthmoving Operations.* The Basin Plan amendment could result in the use of heavy equipment to move soils from one place to another. For example, construction or repair of wastewater treatment facilities could include grading, soil removal and disposal, soil containment, capping, slope stabilization, or landscaping. Recontouring and restoring animal facilities to redirect runoff flows could involve temporarily diverting creeks or other less disruptive soil movement. Routine channel maintenance could entail periodic sediment removal.

- *Waste Handling and Disposal.* Human and animal waste requires disposal. Pollution prevention and outreach activities could encourage more collection of human and animal waste, which could increase the amount of waste requiring proper disposal. For example, programs could support the inspection of waste containment ponds or septic tanks, thereby increasing the need for maintenance and collection of such waste. In some cases, disposal could be arranged on site (e.g., by constructing a leach field or waste pond on site). In others, the waste could be transported to another site for disposal or further treatment. While implementation projects would reasonably collect more waste for proper disposal, the possible amount of this waste stream is unknown. The Basin Plan amendment would not affect the amount of waste generated, but additional waste could be collected.

These examples are not intended to be exhaustive or exclusive. As specific implementation proposals are developed and proposed, lead agencies will need to undertake environmental review and could identify specific environmental impacts and appropriate mitigation measures.

Changes Likely With or Without the Basin Plan Amendment

The implementation plan relies on some actions that will occur with or without the proposed Basin Plan amendment. Because these actions do not result from the Basin Plan amendment, environmental review is not included in this analysis. Some implementation actions for the Napa River watershed are likely to occur with or without the proposed Basin Plan amendment because a sediment and nutrient TMDLs are being developed for this watershed. Many of the actions intended to reduce sediment and nutrient loading to the watershed will also reduce pathogen loading. However, because the TMDLs are not yet completed, specific implementation details are unknown. Additional environmental review will occur as the sediment and nutrient TMDLs are completed.

Other actions likely to occur with or without the Basin Plan amendment include implementing Phase II of the storm water management plan pollution prevention program and implementation of existing programs such as technical assistance programs from the University of California Cooperative Extension, Napa Resource Conservation District, and the Natural Resource Conservation Service. All these activities are already underway.

Changes Too Speculative to Evaluate

Several conceivable actions that could be taken as a result of the Basin Plan amendment require speculation and cannot be evaluated in this environmental review. Although the proposed Basin Plan amendment includes plans to implement management practices (MPs) for animal facilities, more site-specific information is needed before actual controls can be implemented. Therefore, specific actions are too speculative to consider. Similarly, it would be speculative to determine whether implementation of MPs will cause any changes in the feasibility of maintaining the land in agricultural uses. Therefore, potential changes in land use are speculative and will not be evaluated. Lastly, as discussed above, even in cases in which some physical changes are foreseeable (e.g., additional wastewater facilities, such as a restroom, community leach field, or boater pump-out), the exact nature of these changes is often speculative pending specific project proposals to be put forth by those subject to requirements derived from the Basin Plan amendment.

Environmental Analysis

The proposed Basin Plan amendment does not define the specific actions entities could take to comply with requirements derived from the Basin Plan amendment. As discussed above, physical changes resulting from the Basin Plan amendment are foreseeable, but the attributes of specific implementation actions (e.g., location, extent, etc.) are unknown, pending specific proposals to comply with Basin Plan amendment requirements. CEQA requires lead agencies to review the potential for their actions to result in adverse environmental impacts. CEQA further requires lead agencies to adopt feasible measures to mitigate potentially significant impacts. Therefore, the analysis below assumes that lead agencies would adopt mitigation measures necessary to address potentially significant impacts as long as appropriate measures are readily available. As explained below, mitigation measures are readily available to address all the foreseeable impacts of the Basin Plan amendment, including possible local agency actions to the extent that they can be anticipated. Therefore, the potential impacts of the proposed Basin Plan amendment would be less-than-significant.

An explanation for each box checked on the environmental checklist is provided below:

I. Aesthetics

a–b) Any physical changes to the aesthetic environment as a result of the Basin Plan amendment would be small in scale. Possible MPs that could be implemented on individual properties, such as fence construction or off-stream water troughs, are common practices that would have less-than-significant impact on the aesthetic environment. If specific construction projects were proposed to comply with requirements derived from the proposed Basin Plan amendment, local agencies would require environmental review and any necessary mitigation. Therefore, the proposed project would result in less-than-significant impact to scenic vistas and resources.

c–d) The Basin Plan amendment would not degrade the existing visual character or quality of any site or its surroundings. Potential minor construction would be consistent with the open space and low density residential land uses in the area. It would not create any new source of light or glare.

II. Agriculture Resources

a–c) The Basin Plan amendment would not involve the conversion of farmland to non-agricultural use. It would not affect agricultural zoning or any Williamson Act contract.

III. Air Quality

a) Because the Basin Plan amendment would not cause any change in population or employment, it would not generate ongoing traffic-related emissions. It would also not involve the construction of any permanent emissions sources. For these reasons, no permanent change in air emissions would occur, and the Basin Plan amendment would not conflict with applicable air quality plans.

b) The Basin Plan amendment would not involve the construction of any permanent emissions sources or generate ongoing traffic-related emissions. Construction that would occur as a result of Basin Plan amendment implementation, including earthmoving operations, would be short-term. Fine particulate matter (PM_{10}) is the pollutant of greatest concern with respect to construction. PM_{10} emissions can result from a variety of construction activities, including excavation, grading, demolition, vehicle travel on paved and unpaved surfaces, and vehicle and equipment exhaust. If specific construction projects were proposed to comply with requirements derived from the proposed Basin Plan amendment, local agencies would require any necessary mitigation through their environmental reviews. The Bay Area Air Quality Management District has identified readily available measures to control construction-related air quality emissions (BAAQMD 1999). These measures include watering active construction areas; covering trucks hauling soil; paving, applying water, or applying soil stabilizers on unpaved areas; sweeping paved areas; and sweeping public streets. Lead agencies would ensure that appropriate emissions control measures are implemented. Therefore, the Basin Plan amendment would not violate any air quality standard or contribute substantially to any air quality violation, and its temporary construction-related air quality impacts would be less-than-significant.

c) Because the Basin Plan amendment would not generate ongoing traffic-related emissions or involve the construction of any permanent emissions sources, it would not contribute considerably to cumulative emissions.

d–e) Because the Basin Plan amendment would not involve the construction of any permanent emissions sources, it would not expose sensitive receptors to ongoing pollutant emissions posing health risks or creating objectionable odors.

IV. Biological Resources

a–d) The Basin Plan amendment is designed to benefit water quality. If, pursuant to the proposed Basin Plan amendment, specific projects were proposed that were to involve construction and earthmoving activities that could modify habitats, adversely affect special-status species, disturb riparian habitat or sensitive natural communities, or affect federally protected wetlands or interfere substantially with movement of resident or migratory fish or wildlife species, these projects would be minor and temporary in nature. In such cases, local agencies would also conduct environmental review and identify necessary mitigation measures. Through the CEQA and permitting processes, lead agencies would ensure that readily available mitigation measures are implemented, such as avoiding or, if feasible, relocating or replacing sensitive habitat. Fences that may be constructed are designed to restrict livestock without impeding wildlife movement. Therefore, the Basin Plan amendment would not substantially affect habitats, special-status species, sensitive communities, wetlands, wildlife movement, migratory corridors, or nurseries and its review would ensure that readily available measures are implemented, such as avoiding construction during the breeding season, avoiding sensitive habitat areas, and minimizing disturbances. Therefore, the Basin Plan amendment would not substantially affect habitats, special-status species, sensitive communities, wetlands, migratory corridors, or nurseries, and its impacts would be less-than-significant.

e–f) If, pursuant to Basin Plan amendment requirements, specific projects were proposed that were to involve construction or earthmoving activities, then local agencies would develop such proposals in accordance with their own local policies and ordinances, including any applicable habitat conservation plans, natural community conservation plans, or other plans intended to protect biological resources. Therefore, the Basin Plan amendment would not conflict with local policies, ordinances, or adopted plans.

V. Cultural Resources

a–d) Local agencies could propose specific projects involving earthmoving or construction to comply with requirements derived from the proposed Basin Plan amendment. Construction would generally be small in scale, and earthmoving would likely occur in areas already disturbed by recent human activity. If necessary to protect historical, archaeological, or paleontological resources, local agencies would require mitigation through their environmental reviews. Lead agencies would ensure that readily available measures are implemented, such as requiring a trained professional to observe major earthmoving work and stop the work if evidence of cultural resources is discovered. Therefore, the Basin Plan amendment would not substantially affect any cultural resource, and its impacts would be less-than-significant.

VI. Geology and Soils

a) The Basin Plan amendment would not involve the construction of habitable structures; therefore, it would not involve any human safety risks related to fault rupture, seismic ground-shaking, ground failure, or landslides.

b) Local agencies could propose specific projects involving earthmoving or construction activities to comply with requirements derived from the proposed Basin Plan amendment. To meet the proposed Basin Plan amendment targets, construction would be designed to reduce overall soil erosion and pathogen loads associated with erosion. However, temporary earthmoving operations could result in short-term erosion. Local agencies would require necessary mitigation measures through their environmental review and grading permit processes. Lead agencies would ensure that readily available measures are implemented, such as dust suppression (e.g., spraying water), use of erosion control MPs, and proper construction site management. In addition, construction projects over one acre in size would require a general construction National Pollutant Discharge Elimination System permit and implementation of a storm water pollution prevention plan. Therefore, the Basin Plan amendment would not result in substantial soil erosion, and its impacts would be less-than-significant.

c–d) The Basin Plan amendment would not involve the construction of habitable structures, and any construction would be relatively small in scale. Local agencies proposing construction to comply with requirements derived from the Basin Plan amendment would undertake engineering and environmental studies to ensure that they do not locate structures on unsuitable soil, including expansive soil. Construction would be designed to minimize any potential for landslides, lateral spreading, subsidence, liquefaction, or collapse. Therefore, the Basin Plan amendment would not create safety or property risks due to unstable or expansive soil.

e) The purpose of the Basin Plan amendment is to ensure that existing wastewater systems are properly designed and functioning. Activities include increased inspections of such facilities and repair/replacement of existing facilities. Such activities would not place new septic tanks or other wastewater disposal systems in unsuitable soils. Therefore, the Basin Plan amendment would not affect the capability to adequately support wastewater disposal systems.

VII. Hazards and Hazardous Materials

a–h) This Basin Plan amendment would not affect the transportation or potential release of hazardous materials, nor create a significant public or environmental hazard beyond any hazards currently in existence. Basin Plan amendment-related activities would not interfere with any emergency response plans or emergency evacuation plans and would not affect the potential for wildland fires.

VIII. Hydrology and Water Quality

a) The project would amend the Basin Plan, which articulates applicable water quality standards; therefore, it would not violate standards or waste discharge requirements.

b) The Basin Plan amendment would not decrease groundwater supplies or interfere with groundwater recharge. Construction of facilities such as retention or detention basins, infiltration basins, or vegetated swales could increase groundwater recharge.

c) Local agencies could propose specific projects involving earthmoving or construction activities to comply with requirements derived from the proposed Basin Plan amendment. Such projects could affect existing drainage patterns. However, to meet the proposed Basin Plan amendment targets, they would be designed to reduce overall soil erosion and pathogen loads associated with erosion. Nevertheless, temporary earthmoving operations could result in short-term erosion. If necessary to address specific impacts, local agencies would require mitigation measures through their environmental reviews. Lead agencies would ensure that readily available measures are implemented, such as dust suppression (e.g., spraying water), use of erosion control MPs, and proper construction site management. In addition, construction projects over one acre in size would require a general construction National Pollutant Discharge Elimination System permit and implementation of a storm water pollution prevention plan. Therefore, the Basin Plan amendment would not result in substantial erosion, and its impacts would be less-than-significant.

d) The Basin Plan amendment could involve some earthmoving operations that could affect existing drainage patterns, but Basin Plan amendment-related activities would not substantially increase the amount of impervious surfaces in any watershed. Therefore, the Basin Plan amendment would not increase the rate or amount of runoff, or result in flooding.

e–f) Basin Plan amendment-related activities would not substantially increase the amount of impervious surfaces in any watershed. Therefore, the Basin Plan amendment would not increase the rate or amount of runoff, or exceed the capacity of storm water drainage systems. Because the proposed Basin Plan amendment is intended to reduce pathogen-laden runoff, it would not be a source of new polluted runoff, or degrade water quality.

g–i) Basin Plan amendment-related construction would be small in scale and would not include housing or structures that would pose or be subject to flood hazards.

j) Basin Plan amendment-related construction would not be subject to substantial risks due to inundation by seiche, tsunami, or mudflow.

IX. Land Use and Planning

a) Basin Plan amendment-related construction would be limited to existing open space and grazing areas and would be too small in scale to divide any established community.

b–c) The Basin Plan amendment would not conflict with any land use plan, policy, or regulation, and would not conflict with any habitat conservation plan or natural community conservation plan.

X. Mineral Resources

a–b) Basin Plan amendment-related earthmoving (i.e., excavation) and construction would be relatively small in scale and would not result in the loss of availability of any known mineral resources.

XI. Noise

a) Earthmoving and construction could temporarily generate noise. Projects that local agencies propose to comply with requirements derived from the Basin Plan amendment would be consistent with the local agencies’ own standards.

b) To comply with requirements derived from the Basin Plan amendment, local agencies could propose specific projects involving earthmoving or construction, which could result in temporary groundborne vibration or noise. If necessary, local agencies could require mitigation measures through their environmental reviews. Lead agencies would ensure that readily available measures are implemented, such as restricting the hours of operations and ensuring that earthmoving equipment is equipped with mufflers to reduce noise. Therefore, the Basin Plan amendment would not result in substantial noise, and its impacts would be less-than-significant.

c) The Basin Plan amendment would not cause any permanent increase in ambient noise levels. Any noise would be short-term.

d) To comply with requirements derived from the Basin Plan amendment, local agencies could propose specific projects involving earthmoving or construction, which could result in temporary increases in ambient noise levels in excess of noise levels without the Basin Plan amendment. Noise-generating operations would comply with local noise minimization requirements, including local noise ordinances. If necessary, local agencies could require that noise reduction mitigation measures are implemented, such as restricting the hours of noise-generating operations. Therefore, the Basin Plan amendment would not result in substantial noise, and its impacts would be less-than-significant.

e–f) The Basin Plan amendment would not cause any permanent increase in ambient noise levels, including aircraft noise. Therefore, it would not expose people living within an area subject to an airport land use plan or in the vicinity of a private airstrip to excessive noise.

XII. Population and Housing

a–c) The Basin Plan amendment would not affect the population of the-Napa River Watershed. It would not induce growth through such means as constructing new housing or businesses, or by extending roads or infrastructure. The Basin Plan amendment would also not displace any existing housing or any people that would need replacement housing.

XIII. Public Services

a) The Basin Plan amendment would not affect populations or involve construction of substantial new government facilities. The Basin Plan amendment would not affect service ratios, response times, or other performance objectives for any public services, including fire protection, police protection, schools, or parks.

XIV. Recreation

a–b) Because the Basin Plan amendment would not affect population levels, it would not affect the use of existing parks or recreational facilities. No recreational facilities would need to be constructed or expanded.

XV. Transportation /Traffic

a–b) Because the Basin Plan amendment would not increase population or provide employment, it would not generate any ongoing motor vehicle trips. Earthmoving and construction would be temporary, and related traffic would be of short-term duration. Therefore, the Basin Plan amendment would not substantially increase traffic in relation to existing conditions. Levels of service would be unchanged.

c) The Basin Plan amendment would not affect air traffic.

d) Because the Basin Plan amendment would not affect any roads or the uses of any roads, it would not result in hazardous design features or incompatible uses.

e) The small-scale construction that could occur as a result of the Basin Plan amendment would not likely restrict emergency access. Local agencies would confirm that specific proposals would not restrict emergency access through their environmental reviews.

f) Because the Basin Plan amendment would not increase population or provide employment, it would not affect parking demand or supply.

g) Because the Basin Plan amendment would not generate ongoing motor vehicle trips, it would not conflict with adopted policies, plans, or programs supporting alternative transportation.

XVI. Utilities and Service Systems

a) The project would amend the Basin Plan, which is the basis for wastewater treatment requirements in the Bay Area; therefore, the Basin Plan amendment would be consistent with such requirements.

b) Because the Basin Plan amendment would not affect water demands or supplies, it would not require the construction of new or expanded water facilities. To comply with requirements derived from the proposed Basin Plan amendment, local agencies could propose to repair older facilities or construct some new wastewater treatment facilities. However, such construction would not pose any adverse impacts not otherwise discussed in this analysis. Local agencies could require necessary mitigation measures through their environmental reviews, and as described throughout this analysis, all potential impacts can be mitigated to less-than-significant levels. Because lead agencies would ensure that readily available measures are implemented, the impacts of constructing storm water facilities would be less-than-significant.

c) To comply with requirements derived from the proposed Basin Plan amendment, local agencies could propose to construct some new or expanded urban runoff management facilities. However, such construction would not pose any adverse impacts not otherwise discussed in this analysis. Local agencies could require necessary mitigation measures through their environmental reviews, and as described throughout this analysis, all potential impacts can be mitigated to less-than-significant levels. Because lead agencies would ensure that readily available measures are implemented, the impacts of constructing storm water facilities would be less-than-significant.

d) Because the Basin Plan amendment would not increase population or provide employment, it would not require an ongoing water supply. It would also not require ongoing wastewater treatment services.

e) Basin Plan amendment implementation would comply with federal, state, and local wastewater treatment requirements. Pollution prevention and outreach activities could divert pathogen-containing waste from improper leaching into the environment toward proper disposal facilities. Therefore, it is possible that repair to existing wastewater facilities may be required or facility capacity may need to be expanded. However, such construction would not pose any adverse impacts not otherwise discussed in this analysis. Local agencies could require necessary mitigation measures through their environmental reviews, and as described throughout this analysis, all potential impacts can be mitigated to less-than-significant levels. Because lead agencies would ensure that readily available measures are implemented, the impacts of repairing or expanding wastewater facilities would be less-than-significant.

f–g) The Basin Plan amendment would not substantially affect municipal solid waste generation or landfill capacities.

XVII. Mandatory Findings of Significance

a) When taken as a whole, the Basin Plan amendment would not degrade the quality of the environment. The proposed Basin Plan amendment is intended to benefit human health by decreasing pathogen concentrations in the Napa River Watershed.

b) As discussed above, the Basin Plan amendment could pose some less-than-significant adverse environmental impacts related to earthmoving and construction operations. These impacts would be individually limited, and most would be short-term. As specific implementation proposals are developed and proposed, lead agencies would undertake environmental review and identify specific environmental impacts and appropriate mitigation measures. For cases in which potential impacts could be significant, local lead agencies would adopt readily available mitigation measures to ensure that possible impacts would be less-than-significant. Therefore, the incremental effects of the Basin Plan amendment are inconsequential. For this reason, the Basin Plan amendment's cumulative effects would be less-than-significant, and adopting the Basin Plan amendment would require no mandatory findings of significance.

c) The Basin Plan amendment would not cause any substantial adverse effects to human beings, either directly or indirectly. The Basin Plan amendment is intended to benefit human beings (particularly swimmers and other recreational users) by decreasing pathogen concentrations.

13. GLOSSARY

Bacteria: Single-celled microorganisms that lack a cell nucleus and contain no chlorophyll. Bacteria of the coliform and enterococcus groups are considered the primary indicators of fecal contamination and are often used to assess water quality.

Beneficial uses: Designated uses of water, including, but not limited to, domestic, municipal, agricultural, and industrial water supply; power generation; recreation; aesthetic enjoyment; navigation; preservation and enhancement of fish, wildlife, and other aquatic resources and preserves. (California Water Code [CWC] section 13050[f])

Best management practices (BMPs): Methods, measures, or practices formally adopted by an agency to meet its nonpoint source control needs. BMPs include, but are not limited to, structural and nonstructural controls and operation and maintenance procedures. BMPs can be applied before, during, and after pollution-producing activities to reduce or eliminate the introduction of pollutants into receiving waters. See management practices (MPs).

Catchment area: The area draining into a lake, reservoir, or stream; contributing watershed.

Coliform bacteria: See total coliform bacteria.

Colony-forming unit (CFU): A single bacterial cell capable of reproducing and giving a positive test response in the laboratory. As used in this document, CFU is functionally synonymous with "bacteria count."

Discharge: Flow of surface water in a stream or canal or the outflow of groundwater from a flowing artesian well, ditch, or spring. Can also apply to the discharge of liquid effluent from a facility or to chemical emissions into the air through designated venting mechanisms.

Effluent: Municipal sewage or industrial liquid waste (untreated, partially treated, or completely treated) that flows out of a treatment plant, septic system, pipe, and the like.

Enterococci: A subgroup of the fecal streptococci that includes S. faecalis and S. faecium. The enterococci are differentiated from other streptococci by their ability to grow in 6.5 percent sodium chloride, at pH 9.6, and at 10°C and 45°C. Enterococci are a valuable bacterial indicator for determining the extent of fecal contamination of recreational surface waters.

***Escherichia coli*:** A subgroup of the fecal coliform bacteria. *E. coli* is part of the normal intestinal flora in humans and animals and is, therefore, a direct indicator of fecal contamination in a waterbody. The O157:H7 strain, sometimes transmitted in contaminated waterbodies, can cause serious infection, resulting in gastroenteritis. See also fecal coliform bacteria.

Fecal coliform bacteria: A subset of total coliform bacteria that are present in the intestines or feces of warm-blooded animals. They are often used as indicators of the sanitary quality of water. See also total coliform bacteria.

Gastroenteritis: An inflammation of the stomach and the intestines.

Geometric mean: Mathematically defined as the Nth root of N factors; equivalent to the antilogarithm of the mean of the logarithm of a group of numbers. Geometric mean is more appropriate than arithmetic mean for bacterial water quality data because these data tend to be logarithmically distributed, with heavily right-skewed distributions.

Indicator: Measurable quantity that can be used to evaluate the relationship between pollutant sources and their impact on water quality.

Indicator bacteria: Bacteria used to indicate the potential presence of other (usually pathogenic) organisms. Indicator bacteria are generally more easily sampled and measured than the actual pathogenic organisms.

Load allocation (LA): The portion of a receiving waterbody's loading capacity that is attributed either to one of its existing or future nonpoint sources of pollution or to natural background sources.

Loading capacity (LC): The greatest amount of loading that a waterbody can receive without violating water quality standards. The LC equals the TMDL.

Management practices (MPs): Methods, measures, or practices designed to control nonpoint source pollution. MPs are distinguished from BMPs in that BMPs have been formally adopted by a regulatory agency to meet pollution control needs, while MPs may not have been formally adopted. MPs include, but are not limited to, structural and nonstructural controls and operation and maintenance procedures. MPs can be applied before, during, and after pollution-producing activities to reduce or eliminate the introduction of pollutants into receiving waters.

Margin of safety (MOS): A required component of the TMDL that accounts for the uncertainty about the relationship between the pollutant loads and the quality of the receiving waterbody (CWA section 303[d][1][C]).

Most probable number (MPN): An assay procedure that yields a statistically estimated bacteria count for a sample. MPN is often used as the reporting unit for these assays, in which case it is functionally synonymous with "bacteria count."

National Pollutant Discharge Elimination System (NPDES): The national program for issuing, modifying, revoking and reissuing, terminating, monitoring, and enforcing permits, and imposing and enforcing pretreatment requirements, under sections 307, 402, 318, and 405 of the Clean Water Act.

Nonpoint source: Pollution sources that are diffused and do not have a single point of origin or are not introduced into a receiving stream from a specific outlet. The pollutants are generally carried off the land by stormwater runoff. Commonly used categories for nonpoint sources are agriculture, forestry, urban, mining, construction, land disposal, and saltwater intrusion.

On-site sewage disposal system (OSDS): A septic system in which wastewater is treated at the site on which the wastewater is generated. This is in contrast to a centralized wastewater treatment facility that receives wastewater piped in from remote sources.

Pathogen: A microorganism capable of causing disease.

Point source: 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, landfill leachate collection system, vessel, or other floating craft from which pollutants are or may be discharged. This term does not include return flows from irrigation agriculture or agricultural stormwater runoff (40 CFR 122.2).

Protozoa: Single-celled organisms that reproduce by fission and occur primarily in the aquatic environment. Waterborne pathogenic protozoans of primary concern include Giardia lamblia and Cryptosporidium, both of which affect the gastrointestinal tract.

Septic system: An on-site system designed to treat domestic sewage. A typical septic system consists of a tank that receives waste from a residence or business and a system of tile lines or a pit for disposal of the liquid effluent. Sludge that remains after decomposition of the solids by bacteria in the tank must be pumped out periodically.

Stakeholder: Those parties likely to be affected by, or that can affect, the TMDL.

Total coliform bacteria: A group of bacteria found in the feces of warm-blooded animals. The total coliform group also includes many common soil bacteria, which do not indicate fecal contamination. See also fecal coliform bacteria.

Total Maximum Daily Load (TMDL): The sum of the individual wasteload allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources and natural background, and a margin of safety (MOS). TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measures that relate to a state’s water quality standards.

Virus: Submicroscopic pathogen consisting of a nucleic acid core surrounded by a protein coat. Requires a host in which to replicate (reproduce).

Waste load Allocation (WLA): The portion of a receiving waterbody’s loading capacity that is allocated to one of its existing or future point sources of pollution. WLAs constitute a type of water quality-based effluent limitation (40 CFR 130.2[h]).

Wastewater treatment: Chemical, biological, and mechanical procedures applied to an industrial or municipal discharge or to any other sources of contaminated water to remove, reduce, or neutralize contaminants.

Water Quality Criteria: Elements of water quality standards expressed as constituent concentrations, levels, or a narrative statement, representing a quality of water that supports a particular use. When criteria are met, water quality will generally protect the designated use. In California, water quality criteria are referred to as water quality objectives (WQO).

Water Quality Objective (WQO): See water quality criteria.

Water Quality Standard (WQS): Provisions of state and federal law that consist of: 1) a designated use or uses for the waters of the United States; 2) water quality criteria for such waters to protect such uses; and 3) statements to prohibit degradation (antidegradation policy). Water quality standards are to protect public health or welfare, enhance the quality of the water, and serve the purpose of the Clean Water Act (40 CFR 131.3).

Watershed: A drainage area or basin in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.

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13. APPENDICES

Appendix A. Fecal coliform data collected by Napa County Department of Environmental Management.

Date	Sample Location						
	Oak Knoll Rd.	Trancas Bridge	River Point	China point	Imola Bridge So.	Napa Yacht Club	Kennedy Park
	Fecal coliforms, CFU/100 mL						
21-Dec-02	450	278	512	689	530	—	620
30-Dec-02	240	122	145	201	300	—	310
6-Jan-03	20	31	97	100	110	—	52
13-Jan-03	520	350	663	416	185	—	410
21-Jan-03	410	300	122	410	410	—	148
28-Jan-03	41	10	100	310	95	—	84
10-Feb-03	63	100	30	74	30	30	100
24-Feb-03	52	52	85	187	52	100	410
10-Mar-03	30	41	10	100	200	10	5
24-Mar-03	100	10	100	259	200	31	100
7-Apr-03	20	5	5	100	100	100	41
21-Apr-03	74	100	310	74	52	200	200
5-May-03	146	197	203	146	288	309	262
19-May-03	31	30	31	240	187	10	161
2-Jun-03	52	95	41	197	109	31	285
23-Jun-03	20	41	86	216	85	97	146
7-Jul-03	—	—	31	62	122	158	84
21-Jul-03	74	30	10	305	109	74	335
4-Aug-03	20	52	52	253	301	253	581
18-Aug-03	10	40	52	95	198	92	269
15-Sep-03	30	—	156	97	143	187	156
29-Sep-03	10	—	107	291	424	164	128
27-Oct-03	5	52	206	247	134	122	74
10-Nov-03	2,400	520	4,611	472	213	657	197
24-Nov-03	10	41	31	5	20	5	5
8-Dec-03	472	839	886	467	464	419	238
22-Dec-03	187	158	213	450	419	573	275
5-Jan-04	86	122	85	160	109	350	135
20-Jan-04	110	109	146	74	85	63	85
2-Feb-04	—	2,909	2,359	2,987	98	836	122
17-Feb-04	311	350	305	—	663	350	594
1-Mar-04	63	52	63	2,247	158	84	110
15-Mar-04	52	63	52	86	20	20	74
29-Mar-04	41	31	20	20	30	20	5
12-Apr-04	10	30	41	—	20	5	52
10-May-04	20	41	41	63	86	20	52
24-May-04	41	171	52	74	86	5	98
21-Jun-04	31	63	—	—	142	63	140
19-Jul-04	63	41	—	—	—	177	213
2-Aug-04	83	106	—	1,203	—	687	1,203
16-Aug-04	—	384	368	169	119	350	118
8-Sep-04	226	677	1,354	437	141	122	134

Appendix B. *E.coli* data collected in the 2002-2004 Water Board/SFEI study.

Site #	LOCATION	OCTOBER 2002 SAMPLING EVENT 10/2/02	10/8/02	10/17/02	10/23/02	10/29/02
2	Mill Creek@121	110	—	—	—	—
3	Ritchey Creek	98	—	—	—	—
4	Napa Crk@ Jefferson	610	930	150	>24,000	240
5	Napa River@Calistoga	63	—	—	—	—
6	Napa River@Zinfandel	10	—	—	—	—
9	Napa R.@Yountville Preserve	10	—	—	—	—
13	Murphy Creek	440	390	620	500	430
15	Salvador@Ball park	63	—	—	—	—
16	Miliken@Hedgside Rd.	74	—	—	—	—
18	Browns Valley Creek	980	17,000	800	150	6,100
19	Fagan Creek@Kelly Road	160	—	—	—	—
23	Napa River@Trancas	1,100	—	—	—	—
25	Sulfur Creek	10	—	—	—	—
26	Bell Canyon Creek	210	< 1	41	120	340
30	Napa River@ 3rd St.	2,600	3,400	310	470	500
31	Napa River@Oak Knoll	10	—	—	—	—

Site #	LOCATION	JANUARY 2003 SAMPLING EVENT 1/6/03	1/13/03	1/22/03	1/29/03	2/6/03
1	Dry Creek@RR Bridge	31	—	—	—	—
2	Mill Creek@121	52	—	—	—	—
3	Ritchey Creek	130	—	—	—	—
4	Napa Crk@ Jefferson	380	240	1,400	440	360
5	Napa River@Calistoga	530	—	—	—	—
6	Napa River@Zinfandel	84	—	—	—	—
8	Napa River@Tubbs	74	—	—	—	—
9	Napa R.@Yountville Preserve	97	—	—	—	—
11	Tulokay Creek	330	—	—	—	—
13	Murphy Creek	380	31	86	74	41
14	Carneros @Wither	180	—	—	—	—
15	Salvador@Ball park	430	—	—	—	—
16	Miliken@Hedgside Rd.	52	—	—	—	—
18	Browns Valley Creek	4,400	170	930	440	990
19	Fagan Creek@Kelly Road	300	—	—	—	—
20	Soda Creek@Silverado	10	—	—	—	—
23	Napa River@Trancas	110	—	—	—	—
25	Sulfur Creek	560	—	—	—	—
26	Bell Canyon Creek	230	20	41	31	20
27	Dutch Henry Creek	10	—	—	—	—
30	Napa River@ 3rd St.	31	150	120	140	160
31	Napa River@Oak Knoll	97	—	—	—	—

Appendix B., continued.

Site #	LOCATION	JULY 2003 SAMPLING EVENT				
		7/7/03	7/16/03	7/23/03	7/30/03	8/6/03
1	Dry Creek@RR Bridge	110	—	—	—	—
2	Mill Creek@121	20	—	—	—	—
3	Ritchey Creek	63	—	—	—	—
4	Napa Crk@ Jefferson	110	—	—	—	—
5	Napa River@Calistoga	110	<10	41	41	10
6	Napa River@Zinfandel	20	20	20	10	10
8	Napa River@Tubbs	20	—	—	—	—
9	Yountville Eco-Reserve	41	20	10	<10	<10
11	Tulokay Creek	41	—	—	—	—
13	Murphy Creek	660	—	—	—	—
14	Carneros @Wither	460	—	—	—	—
15	Salvador@Ball park	20	—	—	—	—
16	Miliken@Hedgside Rd.	150	—	—	—	—
18	Browns Valley Creek	1,400	170	2,100	1,500	3,200
19	Fagan Creek@Kelly Road	74	—	—	—	—
23	Napa River@Trancas	41	—	—	—	—
25	Sulfur Creek	10	—	—	—	—
26	Dell Canyon Creek	30	—	—	—	—
30	Napa River@ 3rd St.	63	72	74	120	270
31	Napa River@Oak Knoll	31	—	—	—	—
32	Redwood Crk.@Redwood Rd.	120	—	—	—	—

Site #	LOCATION	MAY 2004 SUPPLEMENTAL SAMPLING				
		5/5/04	5/12/04	5/19/04	5/26/04	6/2/04
BR-0	Napa Creek @ Pearl St.	250	420	—	—	—
BR-1	Napa Creek @ Jefferson St.	350	340	—	—	—
BR-2	Browns Valley @ Highway 29	330	750	—	—	—
BR-3	Browns Valley @ Browns Valley Rd.	2,900	540	3,100	290	240
BR-4	Browns Valley @ McCormick Ln.	380	330	680	720	640
BR-5	Browns Valley @ Buhman Ave.	2,600	810	330	340	120
BR-6	Browns Valley @ Borrette Ln.	150	160	<10	20	20
BR-7	Browns Valley @ Partrick Rd.	<10	<10	—	—	—
MU-1	Tulokay Creek @ Shurtleff Ave.	160	180	—	—	—
MU-2	Murphy Creek @ Coombsville Rd.	97	51	330	280	160
MU-3	Murphy Creek @ Shady Brook Ln.	400	280	74	63	51
NR-1	Napa River @ Yountville Preserve	160	41	—	—	—
NR-2	Napa River @ Oak Knoll Rd.	170	85	—	—	—
SH-1	Sheehy Creek @ Kelly Road	2,700	4,000	—	—	—
SV-1	Salvador Channel @ Summerbrook Cir.	86	30	—	—	—
SV-2	Salvador Channel @ Trower Ave.	41	130	—	—	—
SV-3	Salvador Channel @ Solano Ave.	160	1,100	340	790	3,900

Site #	LOCATION	AUGUST 2005 SUPPLEMENTAL SAMPLING 8/19/05	8/25/05
BR-3	Browns Valley @ Browns Valley Rd.	310	350
BR-4	Browns Valley @ McCormick Ln.	320	2400
BR-6	Browns Valley @ Borrette Ln.	93	47
MU-2	Murphy Creek @ Coombsville Rd.	530	1600
MU-3	Murphy Creek @ Shady Brook Ln.	1000	2000
SV-3	Salvador Channel @ Solano Ave.	1300	1000